Montenegrin Journal of Economics

Volume 20, Number 2
April 2024
Quarterly publication

Print edition ISSN 1800-5845
Web edition ISSN 1800-6698
COBISS.CG-ID 9275920

Publishers

ELIT – *Economic Laboratory for Transition Research*
Dz. Washingtona 4/5, Podgorica, Montenegro

Partnering with:

University of Szczecin,
Poland

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INDEXING

ESCI - Emerging sources citation index Thomson Reuters (2015)
SCOPUS (2017)
Cabell's (2012)
ECONIS Datenbank (2012)
DOAJ - Directory of Open Access Journals (2012)
Genamics Journal Seek (2012)
NewJour (2012)
ProQuest - ABI/Inform, Research Library, Social Sciences (2012)
RePEc (2012)
Scirus (2012)
Ulrich's Periodicals Directory (2012)
World-Wide Web Virtual Library (2012)
EBSCO Publishing, Inc. (2011)
Index Copernicus International S.A. database (2011)
Journal of Economics Literature (2006)

The journal is published four times a year

Printing: 150 copy

Journal customer service:

Tel: + 382 68 688 888; + 382 68 583 622;
E-mail: vesodraskovic@gmail.com
Web address: **http://www.mnje.com**

Account: **510-21341-37** (*Crnogorska komercijalna banka*, Podgorica, Montenegro)

Printed by : „3M Makarije“ - Podgorica

Decision of the Ministry of Culture and the Media No 05-962/2 of May 23, 2005
„Montenegrin Journal of Economics“ was registered to the records media under the number 560

CIP – Каталогизација у публикацији
Централна народна библиотека Црне Горе
33 (051)

MONTENEGRIN Journal of Economics /
glavni i odgovorni urednik, Editor in Chief - Veselin Drašković. – God. 1. br. 1 (2005).
- Nikšić (Novaka Ramova 12) : "ELIT – ekonomska laboratorija za istraživanje tranzicije",
2005 (Podgorica: 3M Makarije) . – 30 cm

Četiri puta godišnje.
ISSN 1800-5845 = Montenegrin Journal of Economics
COBISS.CG-ID 9275920

ISSN 1800-5845
9 771800 584007

ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

Vol. 20, No. 2 (April, 2024)

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Tam, P.T., Thuy, L.T. (2024), "Financial Capacity Affecting the Credit Lending Activities at the Commercial Banks Post-Covid-19 in Vietnam", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 7-17.

Financial Capacity Affecting the Credit Lending Activities at the Commercial Banks Post-Covid-19 in Vietnam

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ARTICLE INFO

Received November 14, 2022
Revised from December 15, 2022
Accepted January 15, 2023
Available online April 15, 2024

JEL classification: B26, C40, G21, M50

DOI: 10.14254/1800-5845/2024.20-2.1

Keywords:

Credit,
policy,
lending,
commercial,
bank,
post- Covid-19

ABSTRACT

For nearly 2 years, Vietnam's economy has been negatively impacted by the Covid-19 pandemic. In that context, individual customers play an essential role in developing commercial banks and the country's economic and social activities. With the competition of banks, customers can choose products and services. The customer will select the bank with the most practical effect and the best credit policy. If customers are unsatisfied with the bank's products or services, they are ready to immediately choose other banks' products and services. Therefore, taking care of old customers and attracting new customers is always an issue that many banks be solved. Therefore, the paper's primary goal is to explore critical factors affecting individual customers' credit lending at commercial banks post-Covid-19 in Vietnam. The data get from 700 individual customers lending credit with commercial banks and used structural equation modeling (SEM) and SPSS 20.0, Amos software. The paper finds five factors affecting individual customers' credit lending with a significance level of 0.01, and five hypotheses are accepted. The article's value determines the financial capacity's most substantial impact on individual customers' credit lending activities. Finally, the author had necessary recommendations for improved credit lending activities to develop effective consumer loan lending services. This service is formulated to meet the consumption needs of individuals, bring positive impacts to the whole society, and make an essential contribution to the economic growth of each country post-Covid-19 epidemic.

INTRODUCTION

Credit activities ensure capital needs in production, business activities, and consumption needs of individuals in the economy. Many significant activities, projects, and works, with the scale of hundreds of billions of VND, but not all investors have enough capital to carry out their tasks. With increasing consumer demand, economic activities had to continuously rotate to match with customers. And the introduction of credit contributes to the distribution of credit capital to business owners, regulating the entire economy and facilitating the continuous production process. At the same time, these are also sources of forming

fixed and working capital of enterprises for people in the country or abroad. Credit is also considered a tool to support people in the context of complicated epidemics and increased unemployment. Since then, it has dramatically affected daily life. Many people have been unable to take care of each meal in the family. In addition, credit has supported consumers to promptly solve economic problems, helping them to buy cars, build houses, do small businesses, etc.

Credit lending activities contribute to strengthening the economic accounting regime of enterprises: Economic accounting is the calculation of expenses and business results of an enterprise with the role of credit; it has affected the appropriate measures to adjust business activities. Because of the development of technology, almost 90% of the capital of enterprises will be deposited into bank credit management. In addition, when there is a need to use capital to invest in business projects, businesses can borrow directly from banks, also known as bank credits or credit institutions, to serve their business activities its business. When using bank loans, companies must respect credit activities, that is, make sure to repay loans according to the agreed time limit with the bank, avoiding the case of being late bad debt situation affects the business's reputation and reliability to its partners. Because of this, businesses need to know how to consider using capital to suit the company's operating situation. Therefore, the paper's primary value is to study factors affecting individual customers' credit lending to commercial banks and propose policy recommendations to improve the credit lending activities in Vietnam post-Covid-19.

1. LITERATURE EMPIRICAL REVIEW

1.1 Credit lending activities (CLA)

Credit lending activity is a collection of opinions, reflecting the most common attribute and expressing the nature of this relationship. Credit lending activities of credit institutions and foreign bank branches to customers is a form of credit extension in which credit institutions. The credit institution assigns or commits to hand the customer a sum of money for use for a specified purpose within a certain period following the agreement on the principle of repayment of both principal and interest (Aysan & Disli, 2019; Berger & Bouwman, 2009). Many studies mentioned the concept of a loan contract, which is a written agreement between an organization and a credit institution, with a customer being an organization or individual, whereby the credit institution agrees to advance an amount of money for the customer to use within a certain period, provided that both principal and interest are returned, based on trust. The written agreement between a credit institution (lender), on the other hand, and an organization and individual (borrower), on the other, to establish certain rights and obligations of the parties in the process borrow money, using and pay the loan (Dahir et al., 2019; Kahn & Winton, 2004; Laidroo, 2010). Thus, committing to give the borrower a sum of money to use for the purpose, the borrower must comply with the principle of repaying the loan principal and interest when it is due. Accordingly, the lending process starts from the application and approval stage until the debt is fully recovered, aiming to bring loan efficiency (Silva et al., 2018; Heid & Kruger, 2011).

1.2 Financial capacity (FC)

Financial capacity means the ability to ensure financial resources for the operation of the bank to achieve the goals set by the enterprise. Or, correctly understood, financial capacity is raising capital to meet the bank's activities and ensure the bank's financial safety. When assessing the financial capacity of a bank, it is necessary to focus on 3 main criteria, including Assets, capital, and business results. Assess the property's condition: A comparison of total assets at the end of the period and at the beginning (Louhichi & Boujelbene, 2017; Haq & Heaney, 2012). Combined with considering the proportion of each investment in total assets and the trend of fluctuations to see if the balance is high or low and whether it is suitable for the type of asset business or not. From there, we can consider the level of assurance for the production and business process of the bank (Khanifah et al., 2020; Onyiriuba, 2016; Chen et al., 2013). Assess your capital situation: Including analysis of volatility and capital structure to see whether the business is financially independent or dependent, as well as to know the current difficulties of the bank.

Evaluate business results: This includes analyzing business results for 3 years and looking at fluctuations to see if the business is profitable, thereby determining whether its financial capacity is excellent or weak (Roulet, 2018; Kosak et al., 2015; Beutler et al., 2020). Thus, the author gave hypothesis H1 below:

Hypothesis H1: Financial capacity affects the credit lending activities at commercial banks.

1.3 Management capacity (MC)

Management capacity is the combined characteristics of 3 factors knowledge, skills, and attitude of each individual. Competence is also expressed through the ability to apply and control to achieve efficiency through goals at work. A person with good competence has the right amount of knowledge, skills, and attitudes for the job and knows how to use them competently to meet the needs of the position being undertaken (Nepp et al., 2012; Gomez et al., 2020; Ben Naceur et al., 2018). Management capacity is the knowledge, skills, behaviors, and attitudes an administrator needs to be effective in various organizational and administrative activities. Improving governance, administration, and transparency in the operation of credit institutions is one of the contents and requirements set out in the strategy for developing the banking industry. Thus, the author gave hypothesis H2 below.

Hypothesis H2: Management capacity affects the credit lending activities at commercial banks.

1.4 Credit process (CP)

Credit is considered an indispensable business activity for the development of a country. Credit activities will help the State, people, and businesses solve many problems related to consumption, business, etc., especially during the complicated development of the epidemic. The credit process is a summary table describing the bank's job, from receiving a loan application from a customer to deciding to lend, disburse, collect debts and liquidate credit contracts (Adesina, 2019; Bassett et al., 2020). The bank credit process is understood as a summary of the bank's job description from receiving a customer's loan application until the decision to lend, disburse, collect and liquidate the credit contract. And the bank credit process is understood as a summary of the bank's job description from receiving a customer's loan application until deciding to lend, disburse, collect the debt and liquidate the contract credit (Abdul-Rahman et al., 2018; Broner et al., 2014). And compliance with the credit process at banks is critical. Each form of credit will carry different operating procedures. Thus, the author gave hypothesis H3 the following:

Hypothesis H3: The credit process affects the credit lending activities at commercial banks.

1.5 Banking technology (BT)

The Industrial Revolution 4.0 has been happening at a fast pace and unpredictable developments, affecting the socio-economic development of the global economy, including Vietnam. By identifying the impacts of the Industrial Revolution 4.0 on the financial - banking sector. Modern banking technology helps banks boost business operations, reduce transaction costs, and increase security, transparent and safer transactions with new technologies such as Blockchain and biometrics in the banking system payment, using fingerprints, and replacing payment cards (Bustamante et al., 2019; Carlson et al., 2013; Cornett et al., 2011). At the same time, building a cashless society is an excellent opportunity for banks to promote their products and services. The demand for online payment increases as e-commerce activities develop and the internet of things technology becomes more popular, which is also an excellent opportunity for banks to expand their business in the 4.0 industrial revolution. Digital banking is trending strongly in Vietnam and many countries worldwide (Havranek et al., 2016; Qayyum & Noreen, 2019; Berger et al., 2017). The development and application of digital banking bring many benefits to all 3 groups: customers - banks - the economy. Thus, the author proposes the final hypothesis H4 as follows:

Hypothesis H4: Banking technology affects credit lending activities at commercial banks.

1.6 Quality of human resources (QHR)

A substantial bank or not depends greatly on human resources. The better the quality of human resources, the more banks develop and have a firm foothold in the market. The quality of human resources is all the characteristics that reflect the nature and specificity related to human production and development activities. The higher the quality of human resources, the higher the labor productivity. The quality of human resources is an essential factor in the digital transformation process and business development and is the guiding foundation for all commercial banks' activities (Ozili & Outa, 2017; Usman, 2015). High-quality human resources are the subject of system operation, digital technology infrastructure control, and plan implementation according to digitized processes. The creativity of human resources in participating in the bank's activities is an essential basis for new ideas and initiatives to help improve business processes, thereby improving business processes, system performance, cost savings, and risk reduction for commercial banks in the process of digitization. Thus, the author gave hypotheses H5 following:

Hypothesis H5: Human resource quality affects commercial banks' credit lending activities.

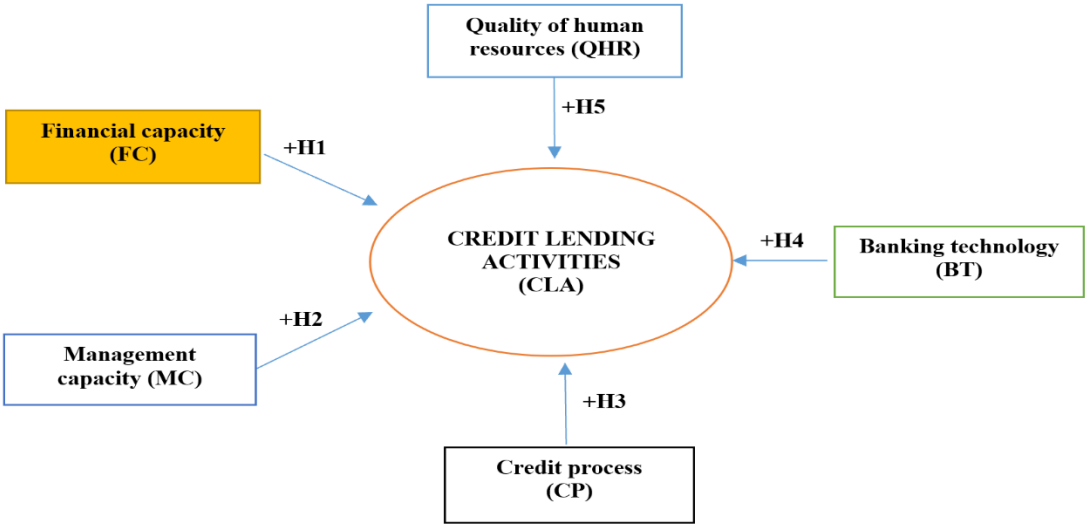

Figure 1. A research model for critical factors affecting individual customers' credit lending activities at commercial banks

Source: The author proposed

2. METHODOLOGY AND DATA

Measures and appropriate questionnaires to collect necessary information and complete survey questionnaires for quantitative research. Qualitative research is a form of exploratory research in which data is contained in qualitative form. First, the study is based on theories, previous research models, and draft scales for the factors of individual customers' credit lending activities at commercial banks. Next, conduct a face-to-face interview (hand-to-hand) based on the discussion outline to collect opinions from 50 customers who regularly bank to redefine these draft scales, thereby correcting the scale.

Step 1: The author identifies the research problem related to individual customers' credit lending activities at commercial banks. This research process aims to systematize and combine the results of previous studies, clarifying the fundamental theoretical issues about the factors affecting individual customers' credit lending activities at commercial banks (Hair et al., 2021).

Step 2: The author aims to identify factors affecting individual customers' credit lending activities at commercial banks. The author designed all questions in part of the questionnaire arranged on a scale of 1 to 5 (5-point Likert scale), showing the increasing level of agreement of the respondents to the issue of

the author's business interview. The specific meanings are as follows: (1) disagree entirely. (2) Disagree. (3) Normal. (4) Agree. (5) agree entirely (Hair et al., 2021).

Step 3: The author applied qualitative research. The author discussed the proposed research model with 7 managers related to big banks and consulted experts working for those commercial banks in Vietnam. The author develops a discussion outline and conducts in-depth interviews with 30 experts in banking management. The author analyzes and discusses survey results, compared with previous studies on individual customers' credit lending activities at commercial banks, discovers the factors, and tests the hypothesis from the results (Hair et al., 2021).

Step 4: The author applied quantitative research: The author surveyed 700 customers related to individual customers' credit lending activities at commercial banks from March to May 2022 in Vietnam. The sampling method is convenient and mailed to each individual, but 659 samples were processed. Measure the level of impact of factors by SEM model. Collected data with a sample size of at least five models on an observed variable. In this study, the total number of observed variables is 23, so based on the technique, the minimum number of enterprises needed to achieve this study is 23 x 5 = 115 (Hair et al., 2021). Check the model's goodness of fit, and GFI, AGFI, CFI, and NFI with a value > 0.9 is considered a good fit. After that, the data was collected to evaluate the scale's reliability, such as Cronbach's Alpha and exploratory factor analysis (EFA), to shorten the observed variable in the factor.

Step 5: The author discusses results and policy recommendations from examining the fit of factors with market data. The author proposed policy recommendations to develop individual customers' credit lending activities at commercial banks in Vietnam post-Covid-19. Finally, confirmatory factor analysis (CFA) and structural modeling were conducted to consider the measurement model's satisfactory ability and to see if the measurement model is acceptable. Thus, the research process is a sequence of actions in a row associated with the knowledge base and logical thinking steps. In this concept, the research process includes a series of steps to think and apply knowledge of research methods and specialized expertise, from posing a problem to finding an answer. The steps in the research process must follow a particular sequence mentioned above.

3. EMPIRICAL RESULTS

3.1 Analysis of the situation for individual customers' credit lending activities at commercial banks

Determining that removing difficulties for production and business activities of enterprises and people affected by the Covid-19 pandemic is a crucial task over the past time, the banking industry has drastically implemented solutions to satisfactorily meet the demand for credit capital for production and business, such as: restructuring the repayment term, exempting and reducing interest and fees, keeping the debt group unchanged at credit institutions); policies to reduce lending interest rates for customers, loan programs to pay wages to stop working; and pay salaries to restore production. Solutions for exemption and reduction of payment service fees.

In 2021, the State Bank made three adjustments to operating interest rates with a total reduction of 1.5-2% per year. In addition, with the incentives of the State Bank and the Government's support for businesses and people, such as: allowing tax payment deadlines to be delayed and interest rates reduced, commercial banks are required to lower interest rates for affected companies. The impact of the pandemic... helped banks' credit growth to increase slightly compared to the same period last year. Credit activities in Vietnam have developed quite strongly, with the active participation of many credit institutions, including the involvement of more and more financial institutions. Although still modest, the total outstanding consumer credit and the proportion of credit to the actual credit economy increased sharply in recent years. Consumer lending activities of financial institutions have basically met people's needs, increased access to finance, and contributed to stimulating consumption, thereby supporting economic growth.

The prospect of the banking industry in 2022 depends significantly on the ability to control the Covid-19 epidemic and the economy's recovery speed. If the recovery speed of the economy is good, the

economy's capital absorption capacity increases, the banking system's capital supply activity will be enhanced, and asset quality and income will be improved by the bank, so it will be better. In 2022, the growth figures in agriculture, industry, trade, tourism, and services... in the first months of the year show that Vietnam's economy continues to prosper, giving forecasts that GDP growth in the second quarter reached over 7% and the whole year over 7%. In that context, Vietnam Report's survey indicates that the dark shadow of the pandemic has receded, giving way to a bright picture of the banking industry in 2022.

3.2 Analysis of descriptive statistics and Cronbach's alpha for factors affecting individual customers' credit lending activities at commercial banks

Table 1. Testing descriptive statistics and Cronbach's alpha for the individual customers' credit lending activities at commercial banks

Code	*Items*	*Cronbach's alpha*	*Mean*	*Std. Deviation*
Financial capacity (FC)		**0.932**	-	-
FC1	Modify loan conditions, loan procedures	0.911	3.0152	1.00443
FC2	Prioritize loan approval for customers who are facing many difficulties in business	0.931	3.0121	1.03576
FC3	Review and adjust loan credit packages to suit customer needs	0.897	3.1214	0.96306
FC4	Customers can easily access the bank's capital, and banks always have available loans	0.903	3.0470	1.00873
Management capacity (MC)		**0.951**	-	-
MC1	Manage transactions, avoid loss of deposits and withdrawals for individual customers	0.921	3.0334	0.98874
MC2	Support disbursement of loan packages, investment packages	0.950	3.0121	1.00599
MC3	Confidentiality of business information, transaction history, financial revenue, and expenditure	0.933	3.0865	0.96289
MC4	Promote socio-economic growth through arbitrage, interest, and investment from transactions	0.935	3.0486	1.00337
Credit process (CP)		**0.846**	-	-
CP1	Banks need to issue clear credit regulations	0.793	3.3915	0.87605
CP2	Developing detailed credit regulations	0.801	3.4977	0.96342
CP3	Credit officers comply with regulations	0.838	3.2747	0.97483
CP4	Quick disbursement time	0.785	3.3657	0.89312
Banking technology (BT)		**0.944**	-	-
BT1	The technology system is highly appreciated	0.918	3.0091	0.99233
BT2	The bank's statement and reporting system is operational, and accurate information	0.936	2.9985	1.00681
BT3	Easy-to-use information access system	0.931	3.0819	0.96408
BT4	Technology system that integrates many utilities for users such as QR Pay, air ticket booking...	0.924	3.0076	1.02918
Quality of human resources (QHR)		**0.882**	-	-
QHR1	The team of highly qualified human resources at the commercial bank	0.843	2.3596	0.64738
QHR2	The professionalism of banking personnel in their positions	0.823	2.4052	0.61741
QHR3	The quantity and quality of IT staff in the banking industry	0.879	2.3961	0.65885
QHR4	Building and developing high-quality human resources to meet the requirements of the customers	0.847	2.4249	0.67638
Credit lending activities (CLA)		**0.931**	-	-
CLA1	The bank provides the highest loan amount	0.916	3.4234	0.96195

CLA2	Low deposit requirement	0.867	3.3278	0.98561
CLA3	Low-interest rate and quick loan disbursement	0.916	3.2822	0.99658

Source: Author collected and processed from SPSS 20.0

Table 1 tests the reliability of the scale, including five independent factors (1) Financial capacity (FC), (2) Management capacity (MC), (3) Credit process (CP), (4) Banking technology (BT), and (5) Quality of human resources (QHR). Besides, the dependent factor shows individual customers' credit lending activities at commercial banks. Table 1 shows that Cronbach's alpha for various factors affecting individual customers' credit lending activities at commercial banks is higher than 0.7.

Table 2. Testing critical factors affecting individual customers' credit lending activities

Relationships			*Standardized estimate*	*S.E*	*C.R*	*P*	*Result*
CLA	<---	FC	0.553	0.037	14.986	***	Accepted
CLA	<---	MC	0.087	0.028	2.669	0.008	Accepted
CLA	<---	CP	0.182	0.040	5.310	***	Accepted
CLA	<---	BT	0.170	0.032	5.529	***	Accepted
CLA	<---	QHR	0.102	0.059	3.809	***	Accepted

Source: Author collected and processed from SPSS 20.0, Amos

Table 2 shows five factors affecting individual customers' credit lending activities at commercial banks, with a significance level of 0.01. The article's novelty is finding out the financial capacity factor that substantially impacts individual customers' credit lending activities at commercial banks, with a standardized estimate of 0.553.

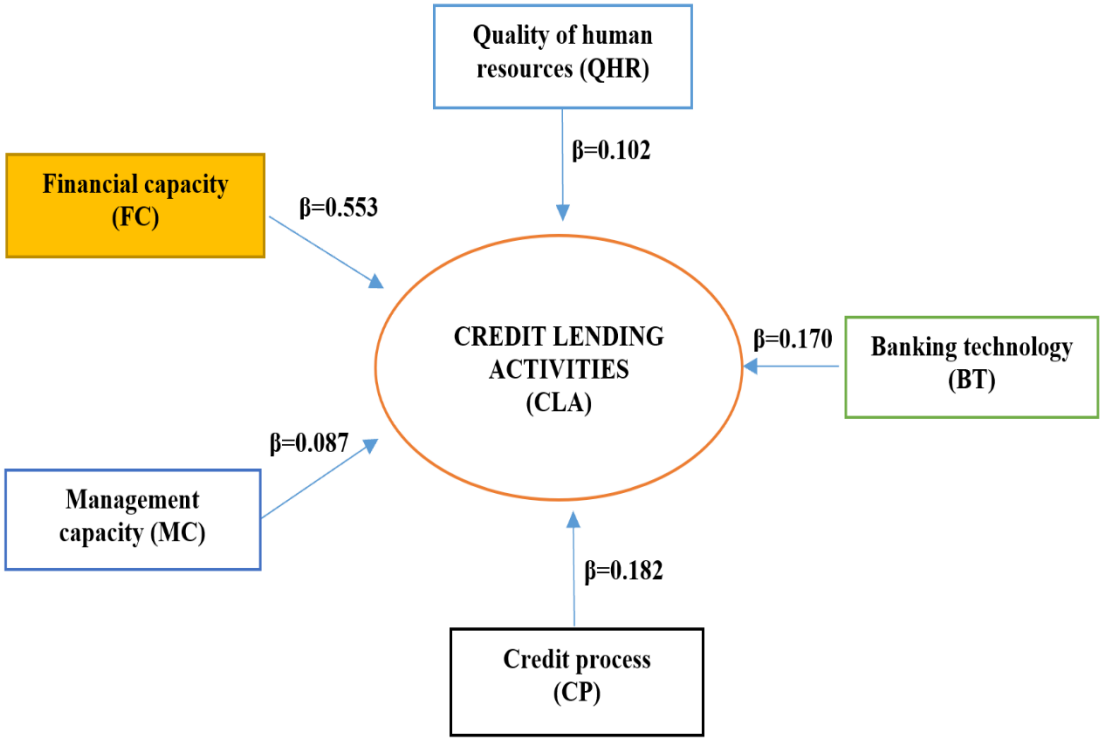

Figure 2. Testing for various factors affecting individual customers' credit lending activities

Source: Author collected and processed from SPSS 20.0, Amos

Figure 2 showed that the assessment of the key factors affecting individual customers' credit lending activities at commercial banks: CMIN/DF = 2.785 (<5.0), GFI = 0.933 (>0.800), TLI = 0.965 (>0.900), CFI = 0.972 (> 0.900) and RMSEA = 0.052 (<0.08). The article aims to determine the five factors affecting individual customers' credit lending activities at commercial banks in Vietnam, especially the financial capacity factor, which is the most important.

Table 3. Testing Bootstrap 50.000 samples for factors affecting individual customers' credit lending activities

Parameter			*SE*	*SE-SE*	*Mean*	*Bias*	*SE-Bias*
CLA	<---	FC	0.049	0.001	0.557	0.000	0.002
CLA	<---	MC	0.028	0.001	0.073	-0.002	0.001
CLA	<---	CP	0.052	0.001	0.210	-0.004	0.004
CLA	<---	BT	0.036	0.001	0.172	-0.005	0.003
CLA	<---	QHR	0.062	0.001	0.209	-0.005	0.006

Source: Author collected and processed from SPSS 20.0, Amos

Table 3 shows that testing Bootstrap with 50.000 samples for factors affecting individual customers' credit lending activities at commercial banks, with a significance level of 0.01.

3.3 Result discussion

With the unpredictable developments of the epidemic situation, banks need to consider plans to maintain business operations and respond to the difficulties they have faced and will face, and at the same time, turn risks into threats by taking advantage of the pandemic.

Firstly, improve the quality of credit appraisal: The bank needs to strengthen the training and retraining of credit officers and staff on appraisal experience. During the appraisal process, credit officers need to regularly update information, industry forecasts, market prices, and financial and technical information, and they need to survey the reality of the industry in which the customer is doing business. This helps to ensure that the assessment is always accurate and highly effective. In addition, credit officers should attach importance to direct contact and interview with customers. Credit officers must go to consumer, production, and business customers to survey reality to avoid being deceived by customers. to minimize bad debts, banks need to persistently comply with the instructions of the State Bank in rescheduling the repayment period, exempting and reducing loan interest for customers borrowing capital at the bank. This will cause banks to sacrifice their profit targets.

Secondly, reducing credit growth is an excellent opportunity for banks to adjust their loan portfolios towards a new, safer, more sustainable risk appetite. Even this is an opportunity for banks to change their asset portfolio, reduce the proportion of credit, and increase other assets. Although this is not easy because credit is always considered the most fundamental asset of the banking business, it also brings the most losses if credit risk occurs. Therefore, many banks always aim to reduce the proportion of credit, reduce interest income from the credit, and increase the balance of service activities, thereby increasing revenue from non-credit activities to improve the training and retraining of the bank's officers and employees: Regularly fostering and improving the professional qualifications of the staff. Periodically organize refresher courses to improve professional qualifications and help credit officers update and understand the newly issued regulations and regulations so that they have solid professional knowledge. Specifically, regular training on lending operations, credit risk management methods, and experience in handling situations.

Thirdly, digitalizing documents, procedures, working, and transaction methods internally and with customers through this epidemic are considered urgent. Accelerate the completion of the extensive data system and quickly put digital banking products and e-banking transactions into use, especially with the retail banks serving individual customers and small and medium enterprises to reduce direct dealings with this customer group and improve the efficiency of lending activities for personal, household and business

consumption: The Bank must continue to improve and renovate the lending process for personal, family and business consumption in the direction of simplifying procedures, reducing hassles for borrowers, but still ensuring loan safety, and at the same time improving the appraisal ability to shorten the loan settlement time; Establish a simple and straightforward enforcement mechanism to shorten the gap between policy and actual implementation; Develop effective lending policies; Open an effective lending policy, there should be clear regulations on the conditions, principles of appraisal, loan term, and interest recovery.

Fourthly, modernizing information technology: The bank needs to equip and upgrade software programs, establish an internal information system, complete and synchronously to serve business safely and effectively. It is convenient for providing timely and accurate information, helping direct and manage the bank's operations best. The Covid-19 epidemic is an opportunity for banks to test the effectiveness of their policies on risk management, including operational risk. This is an excellent opportunity for the bank to know if the current operating process and human resources system is operating effectively and if any place can be adjusted to be more optimized. Especially in terms of human resources, when currently, we are continuously assessed as a country with low labor productivity, many laborers in the apparatus are inefficient, so this will be an opportunity for banks to improve the role of inspection and examination. The bank should promote internal assessment and analysis to enhance credit quality and efficiency, reducing staff shortages and credit loans not following the bank's regulations, such as: exceeding the limit, without collateral, using capital for wrong purposes, carrying out comprehensive inspection and supervision of all aspects, prioritizing in-depth examination of topics and areas leading to negative impacts; Improve the capacity and responsibility of inspection and control officers and take responsibility for the unit's inspection results.

Finally, the commercial bank also needs to foster and train more staff, especially accounting department staff and sales staff. Since most accounting work is done on computers nowadays, accountants need to be proficient in using accounting software to help process and manage information faster, more timely, and accurately, and sales staff are capable of dealing with customers in the bank. Thereby, it also contributes to improving labor productivity and business performance. To further strengthen the leadership role of the Board of Directors in the joint stock commercial bank. Promote the activities of trade unions and movements of emulation for good labor, innovation initiatives, and cultural, artistic, and physical training movements, creating an exciting atmosphere to contribute to the implementation of business tasks.

CONCLUSIONS

Lending is one of the main activities bringing high profits for commercial banks, so the issue of improving loan quality is always the bank's top concern, and it is an important goal to achieve. The data get from 700 individual customers lending credit with commercial banks and used structural equation modeling (SEM) and SPSS 20.0, Amos software. The paper finds five factors affecting individual customers' credit lending with a significance level of 0.01, and five hypotheses are accepted. The results of the research model are determined according to the standardized Beta coefficient, including (1) Financial capacity (FC), (2) Management capacity (MC), (3) Credit process (CP), (4) Banking technology (BT), and (5) Quality of human resources (QHR) focus on performing well the following specific vital tasks. Thus, the Bank's leadership has determined that for sustainable development in the period of integration and competition, it is not possible to forever take advantage of the advantage of being a wholesale bank in the past, but must develop in parallel with retail and wholesale. With the retail development strategy, the current target customers of commercial banks are large organizations and enterprises and small customers such as individuals and households. Finally, the goal of personal credit development of commercial banks is included in the overall plan of retail banking development. From now until the end of 2022, commercial banks must continue supporting people and businesses to remove difficulties and prepare for economic recovery. The State Bank of Vietnam continues to implement many measures, solutions, and critical credit management, such as moderate credit growth associated with credit quality improvement, focusing on production and business fields and priority areas, and strictly controlling credit in potentially dangerous areas.

ACKNOWLEDGEMENTS

The author thanks all lecturers and managers of Lac Hong University (LHU). This article is supported and funded by LHU, Vietnam.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Preepremmote, P. (2024), "Impacts of Foreign Direct Investment on Economic Development: The Case of Thailand",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 19-26.

Impacts of Foreign Direct Investment on Economic Development: The Case of Thailand

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ARTICLE INFO

Received December 24, 2022
Revised from January 10, 2023
Accepted February 10, 2023
Available online April 15, 2024

JEL classification: D33, F21, F43, F63, O11

DOI: 10.14254/1800-5845/2024.20-2.2

Keywords:

Foreign Direct Investment,
Economic Development,
Economic Growth,
Poverty,
Income Inequality

ABSTRACT

The FDI towards economic development is widely debatable. With the insufficiencies of research related to Thailand, this study aims to investigate the effects of Foreign Direct Investment (FDI) on economic development, which refers to reducing and eliminating income poverty, and income inequality within a growing economy, and creating structural change during the period 1991–2020. A Seemingly Unrelated Regression (SUR) analysis was used to investigate the effects of FDI on economic development. The empirical results indicated that FDI has a significantly positive impact on economic growth because FDI can contribute to the diversification of the economy, the provision of technology and knowledge, the development of the host country's skills base, a boost of productivity, and the establishment of linkages with local firms. While FDI has a significant negative impact on poverty and income inequality. However, FDI has no significant effect on structural change. From the overall results, it can be concluded that FDI leads to economic growth but does not improve economic development in Thailand. FDI alone cannot help the economic development. There are other factors to promote economic growth: capital investment, trade openness and human capital. However, labor force and inflation enable the slow economic growth. Capital accumulation is an alternative channel to reduce income poverty, but the labor force stimulates income poverty. Labor force and trade openness help support income inequality. In addition, capital investment, labor force, and human capital urge economic structure to industry and service sectors. Finally, the results also suggest that Thailand need to persevere to FDI attracting strategy because there is a threshold that FDI helps in stimulating the economy and reduce poverty and inequality in the economy.

INTRODUCTION

Foreign Direct Investment (FDI) is an important element of Thailand's economic development, and the country is one of the major FDI destinations in Southeast Asia. The stock of FDI stood at USD 279,140 million in 2021 (Figure 1). Japan and Singapore are by far the largest investors in the country, accounting for just over half of FDI inflows. Hong Kong, the US, the Netherlands, China and Mauritius are also among the top investors.

Figure 1. Foreign Direct Investment in Thailand, 2019-2021

FDI	*2019*	*2020*	*2021*
FDI Inward Flow (million USD)	4,790	-4,849	11,423
FDI Stock (million USD)	275,372	289,391	279,140
Number of Greenfield Investments	143	72	79
Value of Greenfield Investments (million USD)	4,646	2,015	3,914

Source: UNCTAD, 2022

FDI remains a matter issue of global debate and affects the domestic economy in several ways, such as job creation, infrastructural development, local skill development, human capital enhancements, technological progress stimulation, and labor productivity increases (OECD, 2019). Thailand is one of countries trends to utilize FDI as a tool to boost the economic development. Economic development is a way to improve well-being and population's quality of life. Therefore, economic development should be measured by several indicators. Generally, economic growth is a necessary condition of economic development. However, economic growth alone is not sufficient for measuring economic development. Previous studies in Thailand, there is a few studies related to the effect of FDI on economic development. Majority of the studies in Thailand emphasized on effects of FDI on economic growth which can be seen in the studies by Chowdhury and Mavrotas (2006); Yusoff and Nuh (2015), Santipitaksakul (2010) and Asada (2022). Another aspect is effects of FDI on poverty reduction studied by Uttama (2015), Teeramungcalanon and Chiu (2020), Jalilian and Weiss (2002).

To fill the gap of recent studies, this paper aimed to elaborate on the effect of FDI on economic development, which refers to the reduction and elimination of absolute poverty and income inequality within a growing economy and structural change. The results of this study can be expected to provide a guideline for government agencies in host countries when designing policies to attract FDI to Thailand.

1. LITERATURE REVIEW

There appears to be little previous research emphasising the effects of FDI on economic development, with most studies focusing on economic growth. OECD (2002) suggested that FDI is an integral part of an open and effective international economic system and a major catalyst to development. There are five means through which FDI can affect economic growth in the anchor economy: transferring of technological advances and know-how, increasing in competition, enhancing of human capital, consolidation of the host economy toward the world economy, and encouragement of more positive development of firms. In the empirical study, Macek et al. (2015) pointed out that FDI had positive effects on economic growth, employment, and export. Even though FDI provided several advantages, the major problem is air pollution.

Borensztein et al. (1998) proposed that FDI can lead to economic growth of host economy along with interaction of human capital. FDI is more effective at promoting economic growth than domestic investment. In case of Thailand, Chowdhury and Mavrotas (2006) found strong evidence of a bidirectional causality between GDP growth and FDI inflows in Thailand, Chile, and Malaysia. Yusoff and Nuh (2015) suggested that FDI has positively contributed to the economic growth of Thailand. Furthermore, Santipitaksakul (2010) indicated inward FDI has been beneficial to the growth of the Thai economy only in the short run but has a negative impact on the Gross National Income (GNI) in the long run. In contrast, liberalizing the foreign investment regime while retaining a restrictive trade policy regime could well generate immiserizing growth (Kohpaiboon, 2003). Similar to Asada (2022) stated that trade openness and human capital development contributed positively to Thailand's GDP growth in the long run, while FDI inflows contributed negatively.

Poverty reduction is the main goal of most countries and the main economic development indicator. FDI may have also a direct or indirect impact on poverty reduction. The FDI can have direct impacts on poverty reduction via spillovers effects. The spillovers effect on private sector is stronger through "Vertical" and "Horizontal" linkages with local suppliers and local companies in the same industry in developing countries (Görg and Greenaway, 2004). Multinational Enterprises (MNEs) provide technical assistance,

training and other information to improve the quality of the supplier's products, and transfer the modern technology to the local companies in the host country. At the end of this integrated movement, Total Factor Productivity (TFP) and economic growth increase and contribute to improving on individual and national welfare. Several studies that investigated the empirical link between FDI and poverty reduction, Uttama (2015) confirmed the positive effect of FDI on poverty reduction. Teeramungcalanon and Chiu (2020) explored the effects of sectoral FDI on income inequality using panel data across the five regions of Thailand. In term of regional level, FDI in the manufacturing sector has directly contributed to reducing income inequality through employment effects and knowledge spillovers.

On the other hand, Jalilian and Weiss (2002) found no evidence that FDI either weakens growth or reduces the incomes of the poor. More positively, the econometric analysis finds that FDI inflows, particularly in the case of ASEAN, are associated with higher economic growth, and that there is a close relation between average income growth and growth of the income of the poor. However, the literature that communicates a negative or insignificant effect of FDI on poverty comes under the Dependency Theory, which accounts for the underdevelopment of the developing countries and maintains that the nature of development triggers poverty. It is essential to emphasize that the relationship between FDI and poverty is not the same for all countries and depends on a number of factors, such as technological gap, quality of institutions, and incentives to attract FDIs.

Income inequality is also important for economic development. Several economists believed that economic growth can lead to increasing income inequality. Farhan et al. (2014) investigated the impact of FDI inflows on income distribution in ASEAN-5 countries. The results, based on quantile regression analysis, revealed that FDI inflows have an inequality-reducing effects in Malaysia, the Philippines and Thailand. However, the findings for Singapore and Indonesia suggested that FDI perpetuates inequality. Similar to Ravinthirakumaran and Ravinthirakumaran (2018) estimated the effect of FDI inflows on income inequality in Asia-Pacific Economic Cooperation (APEC) economies. The results showed that, in the long run, FDI inflows decrease income inequality. The results also confirmed that GDP per capita and trade openness help reduce income inequality while human capital widens income inequality.

Structural change is another topic for debate in the economic development field. Economic development can be defined as a process in which output growth is accompanied by qualitative changes in the structures of production. FDI is more likely to promote structural change when there is a certain alignment of the type of FDI to the stage of development of the country (Pineli et al., 2019). Moreover, Emako et al. (2022) estimated the effects of FDI on structural transformation in developing countries and four newly industrialized countries. The results suggested that FDI inflows have a positive significant effect on the structural transformation. In addition, manufacturing and service-sector output and employment growth, as well as urbanization, are major pathways via which FDI fosters structural transformation in developing countries.

2. METHODOLOGY AND DATA

Empirical analysis conducted in this paper based on examining the effect of FDI on economic development in Thailand during the period of 1995-2020. Economic development refers to the reduction and elimination of absolute poverty and income inequality within a growing economy and structural change. There are four indicators for economic development: economic growth, absolute poverty, income inequality, and structural change.

$$LnRGDP_t = C_1 + C_2LnK_t + C_3LNLF_t + C_4LNFDI_t + C_5OPEN_t + C_6INF_t + C_7HC_t + e_{1t} \quad (1)$$

$$LnPOV_t = C_8 + C_9LnK_t + C_{10}LNLF_t + C_{11}LNFDI_t + C_{12}OPEN_t + C_{13}INF_t + C_{14}HC_t + e_{2t} \quad (2)$$

$$LnINEQU_t = C_{15} + C_{16}LNK_t + C_{17}LNLF_t + C_{18}LNFDI_t + C_{19}OPEN_t + C_{20}INF_t + C_{21}HC_t + e_{3t} \quad (3)$$

$$LnSTRUC_t = C_{22} + C_{23}LNK_t + C_{24}LNLF_t + C_{25}LNFDI_t + C_{26}OPEN_t + C_{27}INF_t + C_{28}HC_t + e_{4t} \quad (4)$$

where RGDPG = Economic growth measured by percentage change of Real GDP
POV = Income poverty measured by proportion of population below the national poverty line
INEQU = Income inequality measured by Gini coefficient
STRUC = Structural change measured by ratio between agricultural sector output and non-agricultural sector output
K = Capital investment measured by value of Gross fixed capital formation
LF = Labor force measured by number of people available for work and is the sum of the employed and the unemployed
FDI = Inward FDI stock measured by value of foreign investors' equity in and net loans to enterprises resident
OPEN = Trade Openness Index measured by ratio between the sum of exports and imports and GDP
INF = Inflation rate measured by percentage change of Consumer Price Index
HC = Human Capital measured by share of government expenditure on education on GDP
t = time periods
e = error term

Since the four equations used to evaluate the effects of FDI on economic development in the Thailand are related, the Seemingly Unrelated Regression (SUR) model developed by Zellner (1962) is considerably suitable for investigating the effect of FDI on Thailand's economic development. The SUR model explains the variation of not merely one dependent variable, as in univariate multiple regression, but a set of dependent variables, and the error terms are assumed to be correlated across the equations.

3. EMPIRICAL RESULT AND DISCUSSION

The descriptive statistics for the main variables prior to empirical analysis are presented in Table 2. Statistical analysis of the series reveals the differences in terms of standard deviations vary in reaching an extremely wide range, depending on the unit and the indicator used. There is also an asymmetry: Skewness, Kurtosis, and Jarque - Bera. Skewness values are mostly negative except for inflation and human capital, while Kurtosis indicator varies around 2 except human capital, and the level of the Jarque –Bera test indicates the non-normality of the distributions.

Table 2. Summary of descriptive statistics

	LnRGDP	*LnPOV*	*LnINEQU*	*LnSTRUC*	*LnL*	*LnK*	*LNFDI*	*OPEN*	*INF*	*HC*
Mean	26.39	3.15	3.70	2.05	4.28	25.12	11.05	113.77	2.73	19.00
Median	26.44	3.35	3.73	2.08	4.29	25.17	11.15	120.27	2.24	18.94
Maximum	26.86	4.11	3.87	2.28	4.32	25.46	12.52	140.44	7.99	28.39
Minimum	25.78	1.82	3.55	1.82	4.20	24.58	9.24	77.75	- 0.90	12.06
Std. Dev.	0.32	0.77	0.08	0.14	0.04	0.27	1.07	19.95	2.32	3.44
Skewness	- 0.19	- 0.44	- 0.09	- 0.37	- 0.89	- 0.85	- 0.21	- 0.55	0.27	0.42
Kurtosis	1.78	1.70	2.23	1.93	2.34	2.56	1.63	2.07	2.23	3.76
Jarque-Bera	2.11	3.08	0.79	2.18	4.67	4.00	2.58	2.71	1.14	1.41
Probability	0.35	0.21	0.67	0.34	0.10	0.14	0.28	0.26	0.56	0.50
Sum	818.20	94.37	111.03	63.67	132.54	778.87	331.41	3,526.90	84.52	493.97
Sum Sq. Dev.	3.13	17.14	0.20	0.61	0.04	2.11	33.28	11,939.72	160.91	296.28

Seemingly Unrelated Regression model is used to investigate the effect of FDI on economic development, which refers to the reduction and elimination of absolute poverty and income inequality within a growing economy and structural change. Table 3 reveals several interesting results for the effects of FDI on economic development, which shows that Inward FDI stocks have a significant positive impact on economic growth in Thailand, in similarity to Tanna and Topaiboul (2005); Chowdhury and Mavrotas (2006); Santipitaksakul (2010) and Yusoff and Nuh (2015). In addition, FDI has a significant negative impact on poverty and income inequality, refering to reducing income poverty and income inequality. The result is in line with the previous studies of Farhan et al. (2014), Uttama (2015), Ravinthirakumaran and Ravinthirakumaran (2018), and Teeramungcalanon and Chiu (2020) pointed out that FDI leads to increase income per capita, job creation, infrastructural and human capital development and increasing investment in host country. The result indicates that FDI has no significant effect on structural change. Moreover, OECD (2019) suggest that FDI may support sustainable development in Thailand. FDI can contribute to the diversification of the economy; the provision of technology and knowledge; the development of the host country's skills base; a boost of productivity, and the establishment of linkages with local firms, which help them to access new markets and integrate in global value chains. Aside from FDI that can promote economic development, other aspects are: Gross Fixed Capital Formation, Labor Force, Trade Openness, Inflation, and Human capital.

Gross Fixed Capital Formation (K) has a significant positive effect on economic growth and structural change. It means that implying the domestic investment supports Gross Fixed Capital Formation and lead to more growth in the economy and pushes Thai economy to the industrial goods and service. Jiranyakul (2014) explained that capital formation imposes a positive long run impact on economic growth in Thailand, but there is no short-run relationship between a change in capital formation and economics growth. However, capital formation is important stimulate the domestic economy.

Labor Force (L) has a significant negative effect on economic growth. Clark et al. (1999) indicated a negative relationship between per capita income and labor force participation. In contrast to Adhikari et al. (2011) proposed that labor force is an important factor in the labor market and is an important input on an economy's potential to generate goods and services. In addition, labor force has a significant positive effect on income poverty, income inequality, and structural change, which imply that higher labor force rates contribute to income poverty, income inequality, and lead to structural changes in the economy.

Trade Openness (OPEN) has a significant positive effect on economic growth and income inequality which indicates that international trade has the potential to boost economic growth and increase income inequality in Thailand. Tanna and Topaiboul (2005) agreed that trade openness has an important role in promoting economic growth. Moreover, Asada (2022) revealed that trade openness and human capital development contributed positively to Thailand's GDP growth in the long run. Dorn et al. (2022) insisted that the effect of trade openness on income inequality differs across countries. Trade Openness tends to be beneficial to relative income shares of the very poor in the case of emerging and developing economies but trade openness increased income inequality in advanced economies.

Inflation (INF) has a significant negative effect on economic growth, in similarity to Deyshappriya (2017). However, Ruzima and Veerachamy (2016) pointed out that the relationship between inflation and economic growth can be positive, negative or neutral, depending on economic conditions, data used, and time period under study.

Human Capital (HC) has a significant positive effect on economic growth and structural change, implying an investment in human capital tends to increase economic growth, and structural change since it pushes the economies of Thailand into the industrial and service sectors.

This result is similar to the studies by Sulisnaningrum (2022) and Asada (2022), which suggested to investment in research and development for Thailand to create long-run economic growth.

Table 3. Results of the estimated effect of FDI on economic development in Thailand, using Seemingly Unrelated Regression

Dependent Variable:	*LnRGDP*	*LnPOV*	*LnINEQU*	*LnSTRUC*
Independent Variables	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*
C	24.2397 (15.8123)	- 4.0261 - 0.5087	2.5957 (2.0620)	0.1560 (0.1026)
LnK	0.2697*** (10.5633)	- 0.5511*** - 4.1818	- 0.0190 (- 0.9071)	0.2381*** (9.4117)
LnL	- 1.5278*** (-4.5120)	6.2314*** 3.5649	0.5141* (1.8491)	1.8677*** (5.5653)
LnFDI	0.1524*** (7.6744)	- 0.5254*** (- 5.1271)	- 0.0659*** (- 4.0449)	- 0.0095 (- 0.4826)
OPEN	0.0028*** (4.0786)	0.0031 (0.8779)	0.0011* (1.9854)	- 0.0008 (- 1.0913)
INF	- 0.0054* (- 1.8155)	-0.0039 (- 0.2535)	- 0.0023 (- 0.9352)	0.0006 (0.1901)
HC	0.0038* (1.6665)	- 0.0095 (- 0.8048)	- 0.0009 (- 0.4982)	0.0040* (1.7844)
R-squared	0.9923	0.9725	0.9250	0.9694
Adjusted R-squared	0.9899	0.9638	0.9013	0.9597
S.E. of regression	0.0272	0.1402	0.0223	0.0269
Durbin-Watson stat	1.5477	1.7736	2.1668	1.6039

Note: Values in parentheses are t-statistics. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

CONCLUSION

The aim of this study was to investigate the effect of FDI on economic development in Thailand during the period from 1991–2020, employing the Seemingly Unrelated Regression (SUR) model to investigate the effect of FDI on Thailand's economic development. FDI plays the most important role in promoting economic growth in Thailand, which can contribute to the diversification of the economy, the provision of technology and knowledge, the development of skills labor, a boost of productivity, and the establishment of linkages with local firms, which help them to access new markets and integrate in global value chains. In addition, FDI can reduce income poverty and income inequality because FDI leads to increase income per capita, job creation, infrastructural and human capital development. From the overall results, it can be concluded that FDI leads to economic growth but does not improve economic development in Thailand. In this case, economic development is defined as a way for reducing and eliminating income poverty, and income inequality within a growing economy, and creating structural change.

Besides FDI, investment capital, trade openness and human capital can be excluded in determining growth. While labor force and inflation are factors that slow economic growth. Capital accumulation is also another way to reduce income poverty. In contrast to the labor force that contributes to income poverty. In addition, labor force and trade openness are another channel to promote income inequality. In term of structural change effect, investment capital, labor force, and human capital are a factor that promotes structural changes in Thailand's economy that push the economy towards industry and service sectors.

Based on the results, Thai government and relevant agencies should formulate policies and guidelines to attract and stimulate more FDI.

ACKNOWLEDGMENT

The author gratefully acknowledged the financial support for this study provided by Faculty of Science and Arts, Burapha University, Chanthaburi Campus. However, the views and opinions expressed in this

paper are the sole responsibility of the author and do not necessarily reflect those of the Burapha University.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Blazevic Devic, I., Pozega, Z., Cobovic, M. (2024), "Analysing the Share of Flexible Work Forms Among Persons with Different Levels of Education in the Selected EU Countries", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 27-41.

Analysing the Share of Flexible Work Forms Among Persons with Different Levels of Education in the Selected EU Countries

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ARTICLE INFO

Received April 14, 2023
Revised from May 15, 2023
Accepted June 15, 2023
Available online April 15, 2024

JEL classification: I25; J21; 052

DOI: 10.14254/1800-5845/2024.20-2.3

Keywords:

Flexible forms of work;
education;
labour market;
EU countries

ABSTRACT

In order to evaluate the employment of people with different levels of education in flexible work forms in Bulgaria, Greece, Croatia, Hungary and Romania, the authors systematically analysed the proportions of temporary employment and part-time employment among people with different levels of education. The aim of the paper is to analyse the connection between flexible forms of work and the educational level of the persons in the sample and, based on this, to form conclusions about the importance and influence of the mentioned category on the application of flexible forms of work. The concept of flexibility has been receiving more and more attention lately, especially after the crisis caused by the pandemic in 2020, which caused companies to become more flexible in the way they work. That area is not yet sufficiently researched, and this paper aims to validate the research assumption that the educational level influences the integration of flexible forms of work in the observed EU countries. The research in the paper was conducted based on the EU LFS official data set obtained on the basis of the RPP 35/2020-LFS project approved by the European Commission and Eurostat. The paper will analyse a sample of 424,807 respondents in the period from 2008 to 2018. The analysis includes employed and unemployed persons over the age of 15 and under the age of 64 who live in households in selected countries. In the research part of the paper, significance test of the difference between proportions was used, and for the purposes of statistical analysis, the statistical programs SPSS and Statistica were used. Based on an extensive analysis of data from selected EU member states, obtained results indicate an evident difference between the proportions of employment in flexible forms of work among persons with low, medium and high level of education.

INTRODUCTION

The labour market has been the subject of research and analysis by economists around the world for many years. Through available literature, one can see their efforts in promoting the factors that influence the dynamics and changes occurring in the labour market. The labour market consists not only of job

opportunities and the demand for certain jobs, employers, employed and unemployed persons as key figures in the labour market, along with employment agencies and trade unions, but also the education system of a certain country, which can be a generator of competitiveness in the labour market (Husain et al., 2022; Turnea et al., 2022). Equally, the movement of the labour force, which brings with it the transit of intellectual capital (Saman, 2022), which is the cornerstone of the development of the global economy, gives an additional impetus to the dynamics of the labour market (Hu et al., 2022). The paper analyses the correlation between the representation of flexible forms of work and the level of education of persons in a sample from selected countries of the European Union (EU). Countries were selected based on their geopolitical position and similarities in the mentality and work habits of the population, and the additional condition was EU membership. The existence of a statistically significant difference between the proportion of highly educated persons employed on a fixed-term employment contract and the proportion of persons with medium and low level of education employed on a fixed-term employment contract will be identified. Also, the existence of a statistically significant difference between the proportion of highly educated persons employed part-time and the proportion of medium-educated and low-educated persons employed part-time will be identified. The aim of the paper is to give a comprehensive theoretical presentation of the role and significance of incorporating flexible forms of work and to use data analysis to measure the connection between flexible forms of work and the level of education of the persons examined in the sample. The paper includes research and analysis of the impact of integrating flexible forms of work in Bulgaria, Greece, Croatia, Hungary and Romania in the period from 2008 to 2018[1].

1. LITERATURE REVIEW

In order to better understand the issues analysed in the paper, it is necessary to review the most important results of previously conducted studies. The following authors write about the flexibility of the labour market in a way that systematically studies the flexibility of working hours and job permanence. Babos (2014) studies the transition from fixed-term contracts to permanent contracts in Central Eastern Europe. The main contribution of the aforementioned author's research is that it examines the function of fixed-term contracts in new EU members, countries that have not yet been involved in research in the aforementioned domain. In this research, the author analyses which individual characteristics influence the transition to permanent employment and how labour market institutions can help in understanding the differences between countries. Booth et al. (2002) analyse whether temporary jobs are a successful strategy or an inappropriate policy in the labour market (that is, they define the categories as stairs and/or dead ends). The authors state that in Great Britain, about 7% of employed men and 10% of employed women have temporary jobs. Using data from the British Household Survey, they confirm the popular perception that temporary jobs are generally not desirable compared to permanent employment because, they say, temporary workers have lower levels of job satisfaction, receive less training and are paid less. Furthermore, in their paper, they state that fixed-term contracts are a means to achieve the final goal, i.e. permanent work, because women who start with a fixed-term contract and move to a permanent job completely catch up with those who start with a permanent job.

Cahuc and Postel-Vinay (2002) and Urbański (2021) write about temporary jobs, employment protection and performance on the labour market. They state that the simultaneous use of strong job protection and measures of active employment policy in the form of temporary jobs seems contradictory, because the first aims to limit workplace closures, while the second increases it. In the paper, the authors analyse the combined impact of those two instruments using an appropriate model. Mertens et al. (2007) analyse the cost of flexibility by comparing wage penalties for fixed-term contracts in Germany and Spain using quantile regression. The authors point out that individuals with a fixed-term employment contract earn less than equivalent workers with a permanent contract in both countries. But with this paper, the author claims, he wants to point out that the results of empirical research from Spain should not be generalized and projected onto other 'repressive' EU labour markets. He concludes that in Spain it is important whether a person has a fixed-term contract or not, while in Germany it is important what the characteristics of the fixed-term contract are. The focus of the work of Fernandez-Kranz et al. (2015) is on part-time and fixed-

[1] Data presented in this paper are a segment of the empirical part of the author's doctoral dissertation which analyses the prevalence of flexible forms of work among people of different levels of education in the EU

term contracts of female workers. The authors point out that, although experience in part-time jobs is less rewarded than in fixed-term contract jobs, the effects are not as detrimental to women's wages as termination of employment. This suggests that part-time work is better than no work, even in a labour market known for its deep segmentation. Burgoon and Raess (2009) write about globalization and working time, analysing working time and flexibility in Germany. The authors explain that economic openness has uneven consequences on working hours and state that such globalization will tend to significantly reduce normal working hours in favour of flexible working hours. They point out that globalization measures reduce standard working hours, but bring more temporary work, work based on different contracts and flexible work arrangements.

Many authors state that it is knowledge that is determined as a factor in public policies that connects economic development, social stability and education. Prpic (2005, p. 6) state that knowledge-based society and knowledge-based economy are used as a political pattern that assumes the entry of knowledge into all pores of the economy and society. Jarvis (2003, pp. 26-27) points out that these terms are often insufficiently specified, along with "post-industrial society", "information society", "learning society". Becic et al. (2009, p. 12) state that the knowledge-based society and the knowledge-based economy are used as an initial framework of justification and a way of sensitizing the public for the area of a certain public policy. Schultz and Becker point out that human knowledge is shaped into human capital, which becomes as valuable as physical capital. The basis for improving the quality of jobs and working conditions and a key factor in the fight against poverty and social exclusion is definitely education. The EU encourages member states in their efforts to provide citizens with the best education and training (Europe, 2020). Equally, the EU wants to achieve inclusive education at all levels and to create and refine common values in order to strengthen social cohesion. Domovic et al. (2013, p. 9) point out that European societies have become interdependent due to the growing inter-state entanglement in EU, mobility, migration, the Internet, and the process of European expansion. Due to these changes and the impact of globalization, there is a need to modify the education systems in Europe in order to increase the competitiveness of the EU and national states, encourage the mobility of European citizens and ultimately build a common European consciousness, which can preserve the linguistic and cultural diversity of the continent as an identity feature. But it must be the result and contribution, according to Domovic et al. (2011, pp. 17-21), of all European countries that, through their educational institutions, shape education programs in which they write what society thinks about itself. Sahlberg (2012, pp. 174-175) also emphasizes that the whole society must act in concert in order to achieve economic progress and progress in education. For this, the development of an educational policy is necessary, which should be based on integration, providing equal opportunities for quality education for all, and on the involvement of the private sector and industry in the creation and monitoring of results, and not on separate sub-sector policies. Based on the previous statements, it can be concluded that one of the key variables that determines the human capital of a country is the educational opportunity available to the workforce. Noe et al. (2006: 542) that the combination of a high level of education, a strong work ethic and a high level of unemployment makes the country attractive for foreign companies, due to high productivity and low turnover.

2. THEORETICAL FOUNDATIONS

2.1 Flexibility of the EU labour market

Labour market flexibility refers to the willingness and ability of the labour market to respond to changes in market conditions, including changes in labour demand and wage rates. A flexible labour market allows employers to change due to supply and demand issues, the economic cycle and other market conditions (Stricker and Baruffini, 2020; Lipták et al., 2023). But we can talk about a truly flexible labour market only in the context of the absence of strict regulations and legal regulations related to the workforce. In this case, the employer is able to set wages, fire employees and change working hours at his own discretion (Kenton, 2019; Skýpalová et al., 2022; Bauters et al., 2021). Schmid and Schommann (2003, p. 17) state that, as a consequence of all these factors, effects appeared on the labour market in the form of applications in the content of labour relations, which became more complex, and forms of work which became more diverse and irregular. Kulusic (2009: 56-57) points out that the reason for the expansion of flexible

forms of work is, on the one hand, the need for employers to relatively easily adjust the production profile and costs to market conditions if the conditions for terminating employment relationships are easier, faster and cheaper.

2.2 Temporary work

According to Anderson and Mailand (2005, p. 23) the fixed-term work institute represents one of the forms of flexible work, namely a form of external, quantitative flexibility. Blanpain (1995: 178) state that a temporary worker is considered to be a worker who is employed for a limited period, for a job that both parties expect to last only for a short time. Employing temporary workers can ensure greater flexibility of the labour market, because in that situation it is easier to adjust the number of employees to changes in the supply and demand of products or services that are the subject of the company's operations.

Kulusic (2009, pp. 91-92; Karamanis and Gogos, 2022) points out that the number of employment relationships based on fixed-term work contracts is increasing in many countries, although it generally provides a lower degree of worker satisfaction than permanent jobs. This form of employment to a certain extent facilitates the access of young people to the world of work, but the question remains open as to whether these forms are really voluntarily chosen, as well as the question of the circumstances in which they can be transformed into a long-term employment relationship, i.e. for an indefinite period with good quality employment.

2.3 Part-time work

Part-time work is one of the traditional forms of non-standard employment. This form of work, according to Buselic (2017, p. 124) and Dobrovic et al. (2019), is considered suitable for harmonizing business and family life because it especially helps workers with children or other forms of obligations to stay on the labour market. Wojcak and Barath (2017, p. 74) state that part-time work has proven to be one of the most common flexible forms of work arrangement. It is defined as being assigned a smaller range of working hours in a predefined environment, in contrast to full-time work. In contrast to temporary employment, which is evenly distributed by gender, part-time work is mainly a form of employment in which the majority share is female, ranging from 65% in Greece to 90% in the Netherlands. (Fernandez-Kranz et al., 2015, p. 512). Table 1 shows part-time employment as a percentage of total employment at the European Union level in the period from 2008 to 2018 in Bulgaria, Greece, Croatia, Hungary and Romania in the period from 2008 to 2018. The data refer to the population aged 20 to 64.

Table 1. Part-time employment as a percentage of total employment at the level of the European Union in Bulgaria, Greece, Croatia, Hungary and Romania in the period from 2008 to 2018 (data shown in %)

Country Year	*EU-28*	*Bulgaria*	*Greece*	*Croatia*	*Hungary*	*Romania*	$\bar{x}$
2008	16,8	2	5,3	6,4	4,3	8,2	5,2
2009	17,3	2,1	5,7	6,4	5,2	8,2	5,5
2010	17,9	2,2	6,1	7	5,5	9,6	6,1
2011	18,2	2,1	6,6	7	6,4	9,1	6,2
2012	18,6	2,2	7,6	5,6	6,7	9	6,2
2013	19	2,5	8,3	5,4	6,4	8,8	6,3
2014	19	2,4	9,2	5,2	6	8,5	6,3
2015	19	2,2	9,3	5,9	5,7	8,4	6,3
2016	18,9	1,9	9,7	5,6	4,8	7,2	5,8
2017	18,7	2,1	9,6	4,8	4,3	6,5	5,5
2018	18,5	1,8	9	4,9	4,2	6,3	5,2
$\bar{x}$	18,4	2,1	7,9	5,8	5,4	8,2	

Source: author's work, based on Eurostat data (2021). Part-time employment (20-64) as percentage of the total employment.

If we look at the percentages shown in table 1, it is interesting to note that part-time employment in Croatia averaged 5.8% of total employment in the observed eleven years. In Romania, part-time employment is the highest, amounting to an average of 8.2% of total employment in the observed eleven years, while, on the other hand, Bulgaria has the lowest percentage of part-time employment, which was the lowest in 2018, and amounted to 1.8% of total employment, which is 0.7 percentage points less than the percentage of part-time employment in 2013, when it was the highest. If we analyse the data in the table related to the average values of part-time employees by year, there is a noticeable constant increase in their share expressed as a percentage of the total number of employees until 2018 only in the case of Greece. After 2013, in Bulgaria, Croatia, Hungary, and Romania, a gradual decline in part-time employment is visible, which can be explained by the fact that after 2013, there is a dispersion in flexible forms of employment contracts and the emergence of new flexible forms of work and occupations, such as a freelancer.

3. ANALYSING THE SHARE OF FLEXIBLE WORK WITH PERSONS OF DIFFERENT LEVELS OF EDUCATION IN BULGARIA, GREECE, CROATIA, HUNGARY AND ROMANIA

In this chapter, the variables used in the work and the methodology of their calculation are defined, the research sample is analysed, after which the data collected for the purposes of the research are statistically processed and analysed. The paper will analyse the data of employed and unemployed persons over the age of 15 and under the age of 64 living in households in Bulgaria, Greece, Croatia, Hungary and Romania in the period from 2008 to 2018 based on the EU LFS official data set from the RPP 35/2020-LFS project. Table 2 shows the analysed variables and their description.

Table 2. Description of the analysed variables

Variable	*Description of the variable*
T2	The total number of people with a temporary job / fixed-term employment contract
F2	The total number of persons employed on a part-time basis
HL	The total number of people with a lower level of education
HM	The total number of people with a medium level of education
HH	The total number of people with a higher level of education
T2HL	The total number of temporarily employed persons with a lower level of education
T2HM	The total number of temporarily employed persons with a medium level of education
T2HH	The total number of temporarily employed persons with a higher level of education
F2HL	The total number of people employed part-time with a lower level of education
F2HM	The total number of people employed part-time with a medium level of education
F2HH	The total number of people employed part-time with a higher level of education
T2HL/ T2HLMH	Share of the total number of temporarily employed persons with a low level of education in the total number of temporarily employed persons of all levels of education
T2HM/ T2HLMH	Share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all levels of education
T2HH/ T2HLMH	Share of the total number of temporarily employed persons with a higher level of education in the total number of temporarily employed persons of all levels of education
F2HL/ F2HLMH	The share of the total number of people employed on a part-time basis with a low level of education in the total number of persons employed on a part-time basis of all levels of education
F2HM/ F2HLMH	The share of the total number of people employed on a part-time basis who have a medium level of education in the total number of persons employed on a part-time basis of all levels of education
F2HH/ F2HLMH	The share of the total number of people employed on a part-time basis who have a higher level of education in the total number of persons employed on a part-time basis of all levels of education

Source: author's work

The following proportions were calculated: T2HL/T2HLMH, T2HM/T2HLMH, T2HH/T2HLMH, F2HL/F2HLMH, F2HM/F2HLMH and F2HH/F2HLMH, which will be presented in the statistical part of the analysis as follows: P11, P12, P13, P21, P22 and P23. The significance test of the difference between proportions was used for statistical analysis. The following table shows the total number of respondents in the sample according to classes, that is, age groups and EU countries (Bulgaria, Greece, Croatia, Hungary and Romania).

Table 3. Total number of respondents in the sample according to age groups and selected EU countries in the period from 2008 to 2018

Classes *Country*	*15 – 24 years*	*25 – 54 years*	*55 – 64 years*	*Total*
Bulgaria	1.871	9.232	2.766	13.869
Greece	31.277	163.993	20.381	215.651
Croatia	5.698	14.397	2.355	22.450
Hungary	20.800	72.087	10.712	103.599
Romania	17.989	46.173	5.076	69.238
∑	77.635	305.882	41.290	424.807

Source: author's work based on data from the RPP 35/2020-LFS project

According to table 3, it is evident that the largest representation of people in the sample is the age group of 25 to 54 years. This group also includes the largest number of working population with different levels of education. In the analysed sample, looking at the total number, there are 424,807 respondents in the period from 2008 to 2018. The following tables will analyse the significance of the level of education in terms of fixed-time employment and part-time employment in Bulgaria, Greece, Croatia, Hungary and Romania in the period from 2008 to 2018. Table 4 shows descriptions of labels used in tables 5. to 8.

Table 4. Descriptions of table labels

Label	Description
$P^1{}_1$	share of the total number of temporarily employed persons with a lower level of education in the total number of temporarily employed persons of all levels of education
$P^1{}_2$	share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all levels of education
$P^1{}_3$	share of the total number of temporarily employed persons with a higher level of education in the total number of temporarily employed persons of all levels of education
$P^2{}_1$	share of the total number of part-time employees with a lower level of education in the total number of part-time employees of all levels of education
$P^2{}_2$	share of the total number of part-time employees with a medium level of education in the total number of part-time employees of all levels of education
$P^2{}_3$	share of the total number of part-time employees with a higher level of education in the total number of part-time employees of all levels of education
χ^2	value of the chi-square test (χ2)
p	the level of statistical significance

Source: Blazevic Devic, 2023.

Table 5 shows the results of the significance test of the differences between the proportions, the share of the total number of temporarily employed persons with low education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all levels of education, and share of the total number of temporarily employed persons with a higher level of educated

in the total number of temporarily employed persons of all levels of education for Bulgaria. Table 5 also shows the results of the significance test of the differences between the proportions, the share of the total number of part-time employees with a lower level of education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with a medium level of education in the total number of part-time employees of all education levels and the share of the total number of part-time employees with a higher level of education in the total number of part-time employees of all education levels for Bulgaria.

Table 5. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Bulgaria

	P^1_1	P^1_2	P^1_3	χ^2	p	P^2_1	P^2_2	P^2_3	χ^2	p
2008	0,41	0,49	0,11	131,63	< 0,01	0,42	0,45	0,13	73,58	< 0,01
2009	0,48	0,43	0,09	171,60	< 0,01	0,35	0,49	0,16	59,63	< 0,01
2010	0,43	0,48	0,09	139,56	< 0,01	0,33	0,51	0,17	57,42	< 0,01
2011	0,41	0,49	0,10	121,09	< 0,01	0,32	0,50	0,18	46,89	< 0,01
2012	0,40	0,50	0,10	114,50	< 0,01	0,30	0,54	0,16	68,45	< 0,01
2013	0,43	0,49	0,08	179,41	< 0,01	0,34	0,47	0,19	43,32	< 0,01
2014	0,44	0,45	0,11	142,07	< 0,01	0,35	0,48	0,17	48,57	< 0,01
2015	0,46	0,42	0,11	103,16	< 0,01	0,36	0,49	0,15	53,22	< 0,01
2016	0,49	0,42	0,08	152,91	< 0,01	0,34	0,47	0,19	43,49	< 0,01
2017	0,51	0,41	0,08	210,74	< 0,01	0,42	0,47	0,11	90,64	< 0,01
2018	0,48	0,40	0,12	115,93	< 0,01	0,37	0,47	0,16	45,57	< 0,01

Source: Blazevic Devic, 2023.

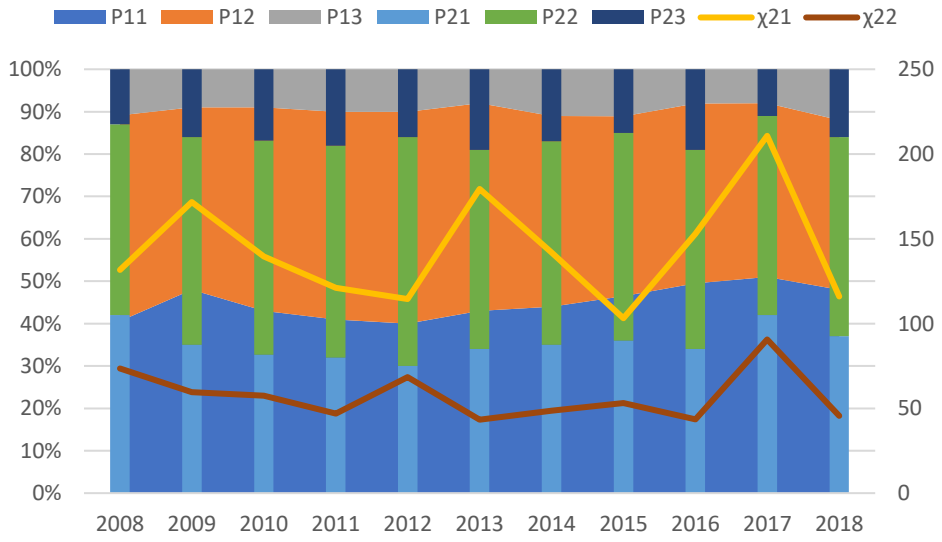

Figure 1. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Bulgaria

The table shows that the difference between the proportions is the share of the total number of temporarily employed persons with lower level of education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all educational levels, and the share of the total number of temporarily employed persons with higher education in the total number of temporarily employed persons of all levels of education for the period from 2008 to 2018 is statistically significant. Furthermore, the table shows that the difference between the proportions is the share of the total number of part-time employees with a lower level of education in the total number of part-time

employees of all levels of education, the share of the total number of part-time employees with a medium level of education in the total to the number of part-time employees of all levels of education and the share of the total number of part-time employees with higher education in the total number of part-time employees of all education levels for the period from 2008 to 2018 is statistically significant. Table 6 shows the results of the significance test of the differences between the proportions, the share of the total number of temporarily employed persons with a lower level of education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all levels of education, and share of the total number of temporarily employed persons with a higher level of education in the total number of temporarily employed persons of all education levels for Greece. Table 6 also shows the results of the significance test of the differences between the proportions, the share of the total number of part-time employees with a lower level of education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with a medium level of education in the total number of part-time employees of all education levels and the share of the total number of part-time employees with a higher level of education in the total number of part-time employees of all education levels for Greece.

Table 6. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Greece

	P^1_1	P^1_2	P^1_3	χ^2	p	P^2_1	P^2_2	P^2_3	χ^2	p
2008	0,39	0,38	0,23	417,82	< 0,01	0,51	0,34	0,15	1349,42	< 0,01
2009	0,40	0,39	0,21	604,88	< 0,01	0,50	0,34	0,16	1364,09	< 0,01
2010	0,40	0,39	0,21	649,20	< 0,01	0,50	0,35	0,15	1429,53	< 0,01
2011	0,42	0,37	0,21	521,89	< 0,01	0,50	0,35	0,15	1275,73	< 0,01
2012	0,40	0,36	0,24	183,72	< 0,01	0,45	0,38	0,16	872,67	< 0,01
2013	0,37	0,36	0,27	98,49	< 0,01	0,42	0,41	0,17	763,35	< 0,01
2014	0,33	0,41	0,26	200,91	< 0,01	0,40	0,41	0,19	640,90	< 0,01
2015	0,30	0,44	0,26	284,61	< 0,01	0,36	0,43	0,21	526,07	< 0,01
2016	0,28	0,45	0,27	363,94	< 0,01	0,34	0,45	0,20	686,87	< 0,01
2017	0,30	0,44	0,27	303,40	< 0,01	0,30	0,48	0,22	823,32	< 0,01
2018	0,29	0,45	0,26	398,43	< 0,01	0,30	0,47	0,24	587,92	< 0,01

Source: Blazevic Devic, 2023.

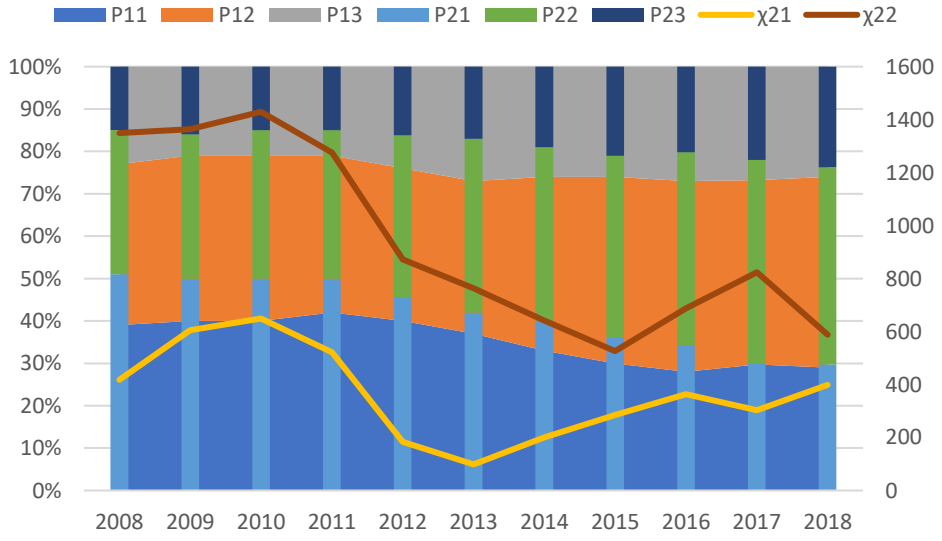

Figure 2. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Greece

The table shows that the difference between the proportions is the share of the total number of temporarily employed persons with a lower education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all educational levels, and the share of the total number of temporarily employed persons with a higher level of education in the total number of temporarily employed persons of all levels of education for the period from 2008 to 2018 is statistically significant. Furthermore, the table shows that the difference between the proportions is the share of the total number of part-time employees with a lower education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with medium level education in the total number of part-time employees of all levels of education and the share of the total number of part-time employees with higher level education in the total number of part-time employees of all education levels for the period from 2008 to 2018 is statistically significant. Table 7 shows the results of the significance test of differences between the proportions, the share of the total number of temporarily employed persons with low education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with medium-level education in the total number of temporarily employed persons of all levels of education and share of the total number of temporarily employed persons who are highly educated in the total number of temporarily employed persons of all education levels for Croatia. Table 7 also shows the results of the significance test of the differences between the proportions, the share of the total number of part-time employees with a low-level education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with a medium-level education in the total number of part-time employees of all education levels and the share of the total number of part-time employees with a high-level education in the total number of part-time employees of all education levels for Croatia.

Table 7. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Croatia

	P^1_1	P^1_2	P^1_3	χ^2	p	P^2_1	P^2_2	P^2_3	χ^2	p
2008	0,15	0,71	0,14	1059,17	< 0,01	0,57	0,36	0,07	594,76	< 0,01
2009	0,14	0,73	0,13	1042,28	< 0,01	0,56	0,37	0,06	587,11	< 0,01
2010	0,11	0,72	0,17	956,05	< 0,01	0,54	0,40	0,06	535,22	< 0,01
2011	0,11	0,72	0,18	900,48	< 0,01	0,52	0,42	0,06	490,79	< 0,01
2012	0,11	0,69	0,20	742,87	< 0,01	0,50	0,43	0,07	354,68	< 0,01
2013	0,10	0,66	0,24	674,97	< 0,01	0,48	0,44	0,08	278,02	< 0,01
2014	0,13	0,66	0,22	872,13	< 0,01	0,43	0,46	0,11	213,03	< 0,01
2015	0,11	0,67	0,22	1208,40	< 0,01	0,39	0,49	0,13	230,28	< 0,01
2016	0,12	0,68	0,20	1182,75	< 0,01	0,36	0,48	0,16	141,80	< 0,01
2017	0,13	0,68	0,20	1087,80	< 0,01	0,33	0,48	0,19	94,12	< 0,01
2018	0,12	0,69	0,19	1285,49	< 0,01	0,34	0,43	0,23	59,21	< 0,01

Source: Blazevic Devic, 2023.

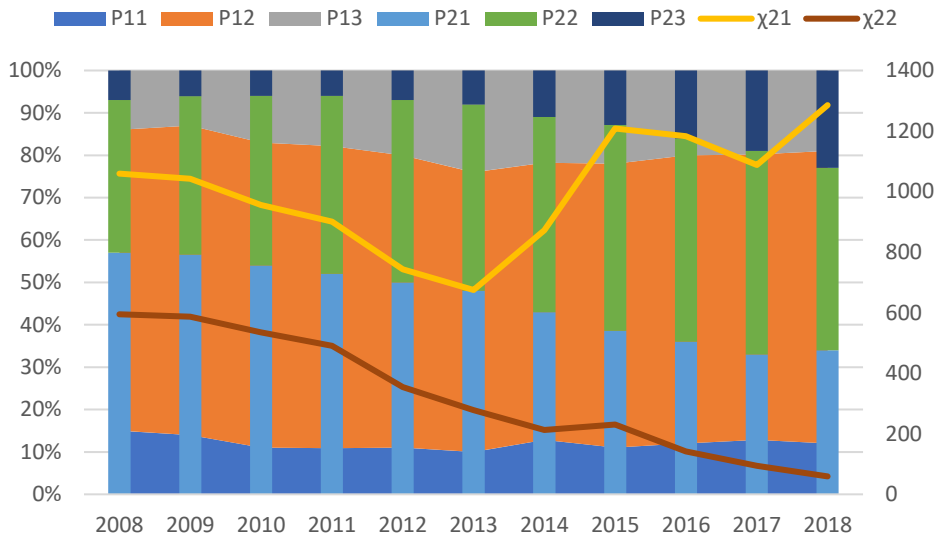

Figure 3. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Croatia

The table shows that the difference between the proportions is the share of the total number of temporarily employed persons with low education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with a medium level of education in the total number of temporarily employed persons of all educational levels, and the share of the total number of temporarily employed persons with higher education in the total number of temporarily employed persons of all levels of education for the period from 2008 to 2018 is statistically significant.

Furthermore, the table shows that the difference between the proportions is the share of the total number of part-time employees with low education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with medium level of education in the total to the number of part-time employees of all levels of education and the share of the total number of part-time employees with higher education in the total number of part-time employees of all education levels for the period from 2008 to 2018 is statistically significant.

Table 8 shows the results of the significance test of differences between the proportions, the share of the total number of temporarily employed persons with low education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with medium level education in the total number of temporarily employed persons of all levels of education, and share of the total number of temporarily employed persons with a high level of education in the total number of temporarily employed persons of all education levels for Hungary. Table 8 also shows the results of the significance test of the differences between the proportions, the share of the total number of part-time employees with a lower level of education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with a medium level of education in the total number of part-time employees of all education levels and the share of the total number of part-time employees with higher level of education in the total number of part-time employees of all education levels for Hungary.

Table 8. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Hungary

	P^1_1	P^1_2	P^1_3	χ^2	p	P^2_1	P^2_2	P^2_3	χ^2	p
2008	0,30	0,59	0,11	2879,72	< 0,01	0,27	0,60	0,13	1816,38	< 0,01
2009	0,32	0,57	0,11	2806,68	< 0,01	0,25	0,61	0,13	2239,22	< 0,01
2010	0,31	0,59	0,11	3484,11	< 0,01	0,23	0,63	0,14	2361,58	< 0,01
2011	0,30	0,58	0,12	2960,68	< 0,01	0,26	0,60	0,14	2469,94	< 0,01
2012	0,33	0,56	0,11	3094,21	< 0,01	0,21	0,64	0,15	3022,16	< 0,01
2013	0,34	0,56	0,10	3610,19	< 0,01	0,20	0,66	0,14	3133,01	< 0,01
2014	0,36	0,56	0,08	4077,44	< 0,01	0,22	0,64	0,15	2698,07	< 0,01
2015	0,40	0,52	0,08	4028,44	< 0,01	0,22	0,64	0,14	2553,84	< 0,01
2016	0,46	0,48	0,06	3808,47	< 0,01	0,23	0,63	0,14	2043,15	< 0,01
2017	0,47	0,47	0,05	3541,67	< 0,01	0,24	0,61	0,15	1656,28	< 0,01
2018	0,48	0,46	0,06	2821,74	< 0,01	0,21	0,61	0,18	1534,50	< 0,01

Source: Blazevic Devic, 2023.

The table shows that the difference between the proportions is the share of the total number of temporarily employed persons with a low level of education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with medium level of education in the total number of temporarily employed persons of all educational levels, and the share of the total number of temporarily employed persons with higher education in the total number of temporarily employed persons of all levels of education for the period from 2008 to 2018 is statistically significant. Furthermore, the table shows that the difference between the proportions is the share of the total number of part-time employees with low education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with medium level of education in the total number of part-time employees of all levels of education and the share of the total number of part-time employees with higher education in the total number of part-time employees of all education levels for the period from 2008 to 2018 is statistically significant.

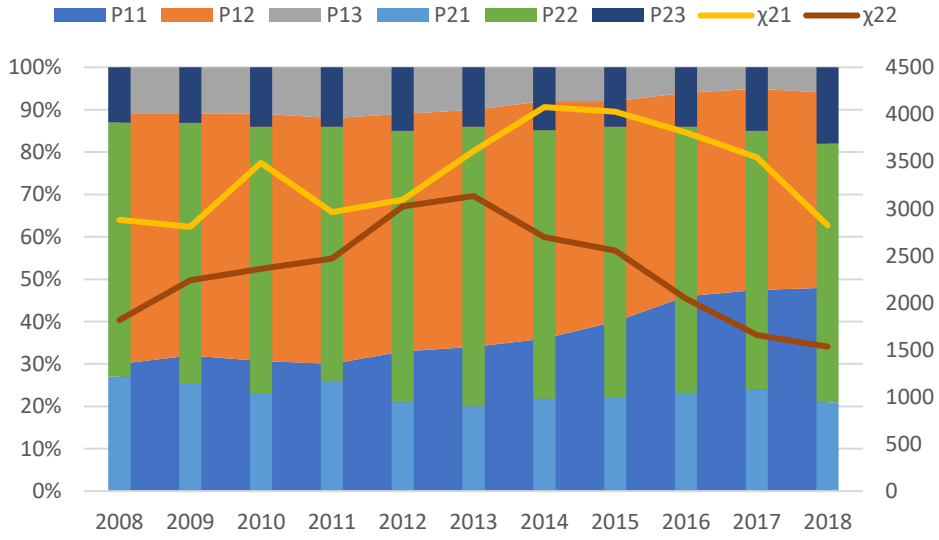

Figure 4. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Hungary

Table 9 shows the results of the significance test of differences between the proportions, the share of the total number of temporarily employed persons with low education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with medium-level education in the total number of temporarily employed persons of all levels of education

and share of the total number of temporarily employed persons with a higher level of education in the total number of temporarily employed persons of all education levels for Romania. Table 9 also shows the results of the significance test of the differences between the proportions, the share of the total number of part-time employees with lower level education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with medium level education in the total number of part-time employees of all education levels and the share of the total number of part-time employees with a higher level education in the total number of part-time employees of all education levels for Romania.

Table 9. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Romania

	P^1_1	P^1_2	P^1_3	χ^2	p	P^2_1	P^2_2	P^2_3	χ^2	p
2008	0,27	0,63	0,10	338,31	< 0,01	0,63	0,36	0,01	6606,39	< 0,01
2009	0,26	0,63	0,11	252,57	< 0,01	0,62	0,36	0,01	6326,09	< 0,01
2010	0,27	0,61	0,12	250,29	< 0,01	0,62	0,37	0,01	6731,28	< 0,01
2011	0,22	0,67	0,11	485,87	< 0,01	0,59	0,39	0,02	5570,82	< 0,01
2012	0,23	0,66	0,11	468,83	< 0,01	0,57	0,42	0,02	5378,39	< 0,01
2013	0,24	0,63	0,13	346,18	< 0,01	0,56	0,43	0,02	5085,86	< 0,01
2014	0,25	0,64	0,11	398,94	< 0,01	0,60	0,38	0,02	5576,88	< 0,01
2015	0,26	0,66	0,08	529,72	< 0,01	0,58	0,40	0,02	5500,71	< 0,01
2016	0,28	0,64	0,08	485,21	< 0,01	0,56	0,43	0,01	4508,63	< 0,01
2017	0,27	0,66	0,07	474,06	< 0,01	0,55	0,43	0,01	4165,20	< 0,01
2018	0,28	0,65	0,07	425,79	< 0,01	0,56	0,42	0,02	4024,05	< 0,01

Source: Blazevic Devic, 2023.

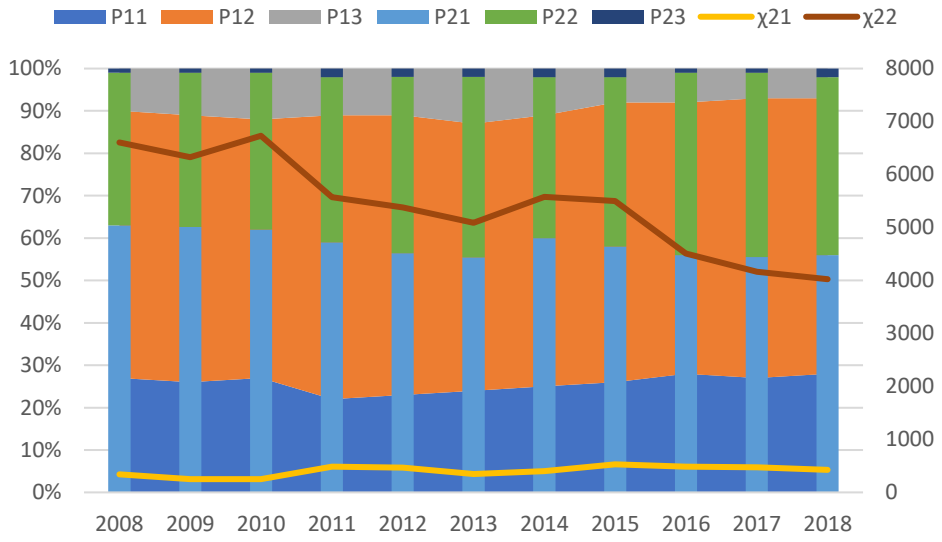

Figure 5. Results of the significance test of the differences between the proportions P11, P12 and P13 and the significance test of the differences between the proportions P21, P22 and P23 for Romania

The table shows that the difference between the proportions is the share of the total number of temporarily employed persons with lower education in the total number of temporarily employed persons of all levels of education, the share of the total number of temporarily employed persons with medium level education in the total number of temporarily employed persons of all educational levels, and the share of the total number of temporarily employed persons with higher education in the total number of temporarily employed persons of all levels of education for the period from 2008 to 2018 is statistically significant.

Furthermore, the table shows that the difference between the proportions is the share of the total number of part-time employees with lower education in the total number of part-time employees of all levels of education, the share of the total number of part-time employees with medium level education in the total number of part-time employees of all levels of education and the share of the total number of part-time employees with higher education in the total number of part-time employees of all education levels for the period from 2008 to 2018 is statistically significant.

CONCLUSION

The EU labour market is a dynamic integration made possible by the set of EU member states and the working population as a related fluid variable. In addition to the mentioned relevant factors, education, its availability, the institutions and legislative framework of the European Union labour market as well as the active policies of the EU labour market certainly have a great influence on the changes taking place in the labour market. Within the category of education, the European Union strives to provide all citizens with the right to education, the right to vocational training, professional guidance and various retraining. Also, great emphasis is placed on lifelong education, which helps workers remain competitive and enables them to continuously adapt to changes in the labour market.

The empirical part of this paper is based on the analysis of official data on the labour force survey of the European Union (EU LFS) obtained on the basis of the approved project RPP 35/2020-LFS by the European Commission and Eurostat and downloaded from the S-CIRCABC platform. In the statistical analysis, the significance test of the difference between proportions was used. The conducted analysis examined whether the proportion of fixed-time employment and the proportion of part-time employment differed among people of different levels of education. The results of the analysis of the set of relevant data indicate an absolute confirmation of the previously mentioned statement about the difference in the proportion of employment in flexible forms of work among people with different levels of education in all observed countries.

As previously stated, the results indicate an evident difference between the proportions of employment in flexible forms of work among people with low, medium and high level of education. In all analysed countries, it can be observed that the share of the total number of temporarily employed persons with lower-level education in the total number of temporarily employed persons of all education levels is higher than the share of the total number of temporarily employed persons with medium-level education and then higher education. Likewise, the results show that the share of the total number of part-time employees with lower-level education in the total number of part-time employees of all education levels is higher than the share of the total number of part-time employees with medium and higher-level education.

Based on the obtained results, it can be concluded that persons with a higher level of education in the period from 2008 to 2018 were less inclined to be employed on a fixed working time than medium and low-level educated persons. For the same analysed period, it was determined that people with a higher level of education were far less employed in part-time jobs than were medium-educated and low-educated people, which can be connected to a distorted perception of the safety and stability of the workplace and a more promising and stimulating work environment with the possibility of further education only with permanent full-time jobs. A recommendation for further research in this aspect would be to determine whether the perception of flexible forms of work among people with a higher level of education has changed after 2018 until today. In the empirical part of the paper, the analysis is limited to the flexibility of labour legal status and the flexibility of working hours in the context of the following variables: fixed-time work and part-time work. The recommendation for further research in this aspect, and in the sphere of constant growth and development of digital platforms, is to analyse the implementation and effect of new forms of employment such as: freelancer, group employment, job sharing, temporary management and other types of new forms of work in the digital economy of the EU.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Elvina, V., Rudiawarni, F., Sulistiawan, D., Topçu, G. (2024), "Does Conservatism Influence Earnings Management activities? The Case of Singapore and Indonesian Firms", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 43-52.

Does conservatism Influence Earnings Management Activities? The Case of Singapore and Indonesian Firms

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ARTICLE INFO

Received December 29, 2022
Revised from January 28, 2023
Accepted February 29, 2023
Available online April 15, 2024

JEL classification: F23, G17, G40, M41

DOI: 10.14254/1800-5845/2024.20-2.4

Keywords:

Conditional conservatism,
unconditional conservatism,
accrual earnings management,
real earnings management,
Indonesia,
Singapore

ABSTRACT

This paper aims to evaluate the impact of conservatism on earnings management (EM) in developed and emerging markets, Singapore and Indonesia, respectively. Conservatism is the principle requiring companies to recognize more on bad news than good news. Conditional conservatism (CC) is dependent conservatism that happens after news, but unconditional conservatism (UC) is independent conservatism that results for applying a conservative measure. We analyze both of conservatism towards accrual-based and real EM. The relation of those variables should be different between countries. Our research is based on 544 firms for accrual-based earnings management, 535 firms for real EM in Singapore, 777 firms for accrual-based EM and 654 for real EM in Indonesia from all sectors excluding the financial services industry from 2019 to 2021. We predict that conservatism affects EM, and the impact is different between emerging and developed markets. Earnings is often seen as the performance measure for a firm's analysis and valuation; thus, the conservative accounting choices used may impact the company's actions on EM. We find that CC negatively affects the company's accrual-based and real EM in the Indonesian market. UC firms tend to increase accrual-based EM. While in the Singapore stock exchange, the more conditional (unconditional) conservative the firms, the more likely the company to do more (less) real EM. Firms in Singapore present more real EM than firms in Indonesia. Conversely, firms in Indonesia have higher accrual-based EM. Our findings also provide evidence that the role of conservatism to EM is different between developed or emerging market. Our evidence supports the argument that conservatism limits accrual-based EM. Thus, more conservative firms shift to real EM.

INTRODUCTION

One of the main principles in accounting is the conservatism principle; the management recognizes all potential losses as soon as possible in contrast to gain recognition which happens only if gains are certain. However, management also must maintain the company's reputation and meet investors' expectations by ensuring a growing and smooth income, thereby implementing EM.

Previous research, such as Bertomeu et al. (2017), found that CC increases EM's marginal benefits by supporting executives' performance pay. Previous studies, such as Ball (2001), argue that there are limitations to the opportunities and incentives to manage earnings by applying the conservatism principle. That is, firms lose flexibility in managing their earnings. However, another study contradicts the findings of older studies by demonstrating that EM incentives coexist with conservative accounting, which limits accrual-based management (Garca Lara et al., 2020). Recent analytical research argues that conservatism can increase incentives in EM (Bertomeu et al., 2017). It is because when the conservatism principle is used, current earnings decrease, thus leading managers to implement steeper pay-for-performance contracts, which increase marginal utility in EM. Conservatism also gives the board of directors a higher opportunity to monitor top-level managers, increasing EM's utility.

Compared to developed markets, emerging markets lack the financial structure to support their capital bases (Dewandaru et al., 2017). On the other side, developed markets have a comprehensive legal system and better investor support (Lin and Wu, 2014). Moreover, developed markets tend to have more significant shareholder and creditor rights to reduce managerial discretion.

When we look at developing and developed markets from an EM perspective, we see that they have different characteristics. According to Burgstahler et al. (2006), developed countries with stronger legal systems have lower EM. Previous research has also found that countries with stronger legal protection reduce managers' tendency to manipulate earnings (Defond et al., 2007; Leuz et al., 2003).

This research investigates the impact of conservative accounting on EM in the Indonesian and Singapore stock exchange markets. First, we investigate whether more conservative firms have lower accrual-based EM and then whether managers of these companies on the same markets shift to real EM due to conservative accounting. Zang (2012) shows that such a relationship exists. Third, we evaluate the outcomes of conservative accounting and EM implementation on the Indonesian and Singapore stock exchange markets.

This research contributes to the existing literature in three dimensions. First, since most of the previous research has focused on developed markets such as the United States (Garca Lara et al., 2020; Kousenidis et al., 2014), we use the sample from the representation of developing and developed countries. Indonesia is different from developed markets such as Singapore because it is still in its early stages of development. From 2008 to 2017, Indonesia's average market growth rate was around 7.9% per year, higher than most emerging markets (Sharma et al.,2019). On the other hand, Singapore is classified as a developed market based on its equity performance as measured by the Morgan Stanley Capital International (MSCI) market index. In addition, with a GDP per capita of US $54,530 as of 2020, it is classified as a high-income country (Worldbank, 2017). Second, this research adds empirical evidence on whether firms shift to real EM as a response to the limitation of accrual-based EM. Third, it will guide investors by demonstrating how the coexistence of EM and conservative accounting can influence earnings quality.

This study employs a large sample of firms listed on the Indonesian and Singapore stock exchanges from 2019 to 2021 and uses multiple regression analysis to analyze the data. To conduct the test, this study uses a firm-specific measure of CC based on the model developed by Khan and Watts (2009). This research also measures accrual-based EM using the Kasznik (1999) model and real EM using the Roychowdhury (2006) model.

The remainder of the paper is organized as follows. Section 2 summarizes previous research and presents hypotheses developed; Section 3 provides the methodology used for analysis; Section 4 presents empirical findings and discusses them; and finally, Section 5 concludes the paper.

1. LITERATURE REVIEW AND RESEARCH HYPOTHESES

1.1 Conditional and Unconditional Conservatism

Conservatism is the principle that requires companies to be cautious and use a higher standard for recording gains while a lower standard is for recording losses. Conservatism can be differentiated into conditional and UC (Beaver and Ryan, 2005; Ball and Shivakumar, 2005). Firms can implement both conditional and UC simultaneously (Roychowdhury and Watts, 2007, Qiang, 2007); however, there can be a trade-off between the two. It is due to the nature of UC, which limits CC, that a certain asset cannot be written off twice.

CC (*ex-post*) is dependent conservatism that happens after news (Beaver and Ryan, 2005). It uses a higher benchmark for the recognition of gains. An example of CC is using lower cost or market value in the inventory valuation or the timely impairment of assets. Firms recognize promptly if there are probable economic losses in the near future. Firms with CC also use higher verifiability rates for recognizing the gains.

UC (*ex-ante*) is an independent conservatism that results from applying a conservative measure and recognition criteria when recording assets and liabilities (Beaver and Ryan, 2005). UC examples are an immediate expense of internally created intangibles and the accelerated depreciation method, which recognizes higher depreciation expense in the earlier year, like the double declining method instead of the straight-line method. Conditional and UC may be applied together, but there can be a trade-off. For example, since UC complies with the accounting standards, internally created intangibles are recognized as an expense instead of an asset; thus, firms no longer need to do the timely impairment test for the asset.

1.2 Accrual and Real EM

EM occurs when managers use their judgement in reporting the firm's financial performance. EM is a useful technique to meet analyst's earnings forecasts and control how the financial report looks for investors. Manipulating accounting by using different choices of accounting policy or real actions to achieve a specific goal is called EM. We discuss both accrual and real EM.

Accrual-based EM explains how EM based on accounting choices can be done from the timing of cash flows and accounting income recognition. Accruals can be manipulated by exploiting the accounting rules and using flexibility to mask the firm's actual performance (Dechow and Skinner, 2000). In accounting, managers can choose from a different set of policies. For example, managers can choose which depreciation method to use for fixed assets. Selecting from accounting alternatives when recording accruals can also be called "discretionary accruals".

Real EM is a practice that alters a firm's normal operations in order to give a desired accounting figure, which may mislead some parties into believing that the objective has been fulfilled in the normal operation (Roychowdhury, 2006). EM can be more difficult to track as it can be masked in usual business transactions by changes in timing or transaction structure (Cohen and Zarowin, 2010). Real EM is the process by which managers control earnings through real activities such as reducing advertising, research and development expenses, maintenance expenses, managing purchase timing, disposing of fixed assets, overproducing goods, and granting more accessible sales credit terms. Roychowdhury (2006) identifies three methods of EM: sales manipulation, reducing discretionary expenses manipulation, and overproduction manipulation. This type of EM doesn't violate the accounting policy from the accounting standard board, but it may affect the firm in the long term since it concerns the company cycle. Firms with earnings close to zero would increase reported earnings by managing the variables of real activities opportunistically, such as sales discounts, production levels, research and development expenses, and other discretionary expenditures. Managers tend to use both kinds of EM techniques to achieve their desired targets (Zang, 2012). Past research also conducts surveys which show that top-level management has greater motivation to manipulate earnings through real activities than accruals as doing so is less costly and harder to detect (Graham et al., 2005)

1.3 Conservatism and EM

Previous research argues that CC leads to lower EM because conservatism lowers the incentives for EM as it increases the cost due to the nature of recognizing losses as soon as possible (LaFond and Watts, 2008). CC also gives higher verifiability requirement to recognize good news and decrease managerial opportunities to increase reported earnings (Gao, 2013). When firms implement conservative accounting, a low earnings number is preferable, and it becomes less indicative of poor performance. Prior research also found that firms that implement conditional conservative accounting have easier access to debt financing, and those with better credit terms also have a lower cost of equity financing. According to studies, the less conservative policies are implemented, the higher future financing costs will be (Penalva and Wagenhofer, 2019; Li, 2015). Thus, we build the following hypothesis.

H1: Conditional (and unconditional) conservatism leads to lower accrual-based EM.

Furthermore, García Lara et al. (2020) predict that CC will decrease incentives for accrual-based EM because firms do not want to risk the conservatism-related benefits if they do not implement conservative accounting in their accounting choices, thus shifting to real EM. They also provide evidence that conservative firms have a lower probability of implementing either method of EM. There is also evidence that under tighter accounting standards, there is a trade-off between accrual and real EM because tighter monitoring increases real EM's marginal benefits (Demski, 2004; Ewert and Wagenhofer, 2005). Based on the concepts, the limitations of conservatism to EM lower accruals-based EM (Gao,2013), and it triggers a trade-off between real and accrual EM as the lower accrual-based EM increases real EM, then H2 is stated below.

H2: Conditional (and unconditional) conservatism leads to higher real EM.

Lin and Wu (2014) have previously found that managers in emerging markets have stronger incentives to implement EM than managers in developed markets. However, previous research has not empirically tested yet whether there will be any difference between conservative firms in emerging markets such as Indonesia and firms in developed markets such as Singapore in implementing the EM method. Based on the evidence, compared to developed markets, emerging markets have higher stock price volatility, lower liquidity, and uncertain policies (Lim and Brooks, 2011). Developed markets also have higher investor support and comprehensive legal systems than emerging markets (Lin and Wu, 2014). Therefore, emerging markets with stringent regulations could lead to higher incentives for managers to implement EM. According to Leuz et al. (2003), developed countries with stronger investor support have lower EM. Shen and Chih (2007) also shows that more transparent accounting disclosure which required by countries with stricter legal disclosures, have lower EM. Due to the different characteristics between emerging and developed markets, which could lead to higher or lower EM, we developed the following hypothesis:

H3: The relationship between conservatism and EM is different between emerging and developed markets.

2. RESEARCH METHOD

Our methodological procedure begins with the construction of the dependent variables, so we use the following two equations:

$$EM_{i,t} = \propto_0 + \propto_1 CC_{i,t-1} + \propto_2 UC_{i,t-1} + \propto_3 D + \propto_4 (D\ x\ CC_{i,t-1}) + \propto_5 (D\ x\ UC_{i,t-1}) + \\ + \delta \sum Controls_{i,t-1} + \varepsilon_{i,t} \quad \ldots.(1)$$

In this study, we investigate EM using accrual (ABS_EM) and real (REM) earnings management. ABS_EM is the absolute value of accrual-based EM and REM is real EM. CC and UC are CC and UC, respectively, with t as a time indicator and i represent individual firm. Controls is a vector of the control variables that includes natural logarithm of total assets (LNSIZE), tax expense divided by pre-tax income (TAX), and return on assets (ROA). If CC leads to lower accrual-based EM, we expect β_1 to be negative and significant. However, we also want to know whether another type of conservatism, namely, UC, can also impact lower accrual-based EM, and thus we expect γ_1 to also be negative and significant. If conservatism leads to an increase in the manipulation of its operations or real EM, we expect to see a positive and significant association between the CC and REM and the UC and REM. The dummy variable D in the equation is one for Indonesia and 0 for Singapore.

2.1 Measurement of EM

To calculate accrual-based EM, we use the Kasznik (1999) model. For each sample firm-year, we estimate the following cross-sectional Modified Jones model (Dechow et al., 2005), using data for all firms matched by year and industry:

$$\frac{NDACC_{i,t}}{TA_{i,t-1}} = \gamma_0 + \gamma_1 \times \left(\frac{1}{TA_{i,t-1}}\right) + \gamma_2 \times \left(\frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{TA_{i,t-1}}\right) + \gamma_3 \times \left(\frac{PPE_{i,t}}{TA_{i,t-1}}\right) + \gamma_4 \times \left(\frac{\Delta CFO_{i,t}}{TA_{i,t-1}}\right) + \varepsilon_{i,t} \quad (2)$$

$$DACC_{i,t} = TACC_{i,t} - NDACC_{i,t} \quad ...(3)$$

TACC represents total accruals, derived by subtracting cash flow from operation (CFO) from net income (NI). ΔREV is the change in revenues, ΔREC is for the change in receivables, PPE is gross property, plant, and equipment, and ΔCFO is the change in cash flow from operations. i denotes individual firm. All variables are deflated by total assets (TA) at the beginning of the year. NDAC represent non-discretionary accruals. DACC refers to accrual-based EM. In this study, we use absolute value of DACC to represent our EM variable (ABS_EM).

To calculate real EM, we use the Roychowdhury (2006) model. Finally, we calculate REM as the sum of abnormal cash flow from operation (AbnCFO), abnormal discretionary expense (AbnDISEXP) and abnormal production (AbnPROD):

$$REM_{i,t} = (-AbnCFO_{i,t}) + (-AbnDISEXP_{i,t}) + AbnPROD_{i,t} \quad ...(4)$$

2.2 Measurement of Conservatism

To calculate the CC, we follow the Khan and Watts (2009) model using the following equation:

$$EPS_{i,t} = \beta_1 + \beta_2 NEG_{i,t} + R_{i,t}(\mu_1 + \mu_2 MCAP_{i,t} + \mu_3 MBV_{i,t} + \mu_4 DTA_{i,t}) + NEG_{i,t}R_{i,t}(\lambda_1 + \lambda_2 MCAP_{i,t} + \lambda_3 MBV_{i,t} + \lambda_4 DTA_{i,t}) + (\delta_1 MCAP_{i,t} + \delta_2 MBV_{i,t} + \delta_3 DTA_{i,t} + \delta_4 D_{i,t} MCAP_{i,t} + \delta_5 D_{i,t} MBV_{i,t} + \delta_6 D_{i,t} DTA_{i,t}) + \varepsilon_{i,t} \quad ...(5)$$

Equation 5 has a rolling window of 3 years (Ahmed and Duellman, 2013), and the coefficients from λ_1 to λ_4 of the regression equation (5) are used to calculate the C-score of each company. C-score refers to the CC measure. EPS (earnings per share) is the function of stock return (R), negative return (NEG=1, zero otherwise), market capitalization (MCAP), market to book value (MBV), and debt to total assets (DTA).

$$CC = C_{score} = \lambda_1 + \lambda_2 MCAP_{j,t} + \lambda_3 MBV_{j,t} + \lambda_4 DTA_{j,t} \quad ...(6)$$

To measure the UC, we follow Kousenidis et al (2014) and use the three years moving average (MA) of TACC before depreciation divided by MA of TA.

$$UC = UC_{score} = -1\left(\frac{MA\ (TACC + Depreciation)}{MA\ Total\ Assets}\right) \quad ...(7)$$

2.3 Data and Sample

The data used in this research are from Unicorn Data Services, the Indonesian Stock Exchange's (IDX) website (www.idx.co.id), and the Singapore Stock Exchange's (SGX) website (www.sgx.com). Objects of this research are companies listed in IDX and SGX from 2019 to 2021, with financial statements ending on December 31.

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

Table 1. Descriptive Statistics for Indonesia Accrual-Based EM

	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*

$EM_{i.t}$	777	-5.088	22.428	0.018	0.836
$CC_{i.t-1}$	777	-11.120	376.092	4.765	14.619
$UC_{i.t-1}$	777	-0.446	2.005	-0.011	0.109
$LNSIZE_{i.t-1}$	777	17.928	33.495	27.949	2.959
$TAX_{i.t-1}$	777	-17.211	76.751	0.346	3.284
$ROA_{i.t-1}$	777	-4.799	0.921	0.012	0.267
$Abs\_EM_{i.t-1}$	777	0.000	22.428	0.109	0.829

Table 2. Descriptive Statistics for Singapore Accrual-Based EM

	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
$EM_{i.t-1}$	544	-0.724	3.622	0.006	0.200
$CC_{i.t-1}$	544	-57,959.306	126,635.125	3,724.216	12,906.852
$UC_{i.t-1}$	544	-1.298	0.642	0.001	0.089
$LNSIZE_{i.t-1}$	544	13.361	28.645	19.691	1.997
$TAX_{i.t-1}$	544	-2.246	15.524	0.182	0.789
$ROA_{i.t-1}$	544	-1.322	12.294	0.030	0.546
$Abs\_EM_{i.t-1}$	544	0.000	3.622	0.085	0.181

Based on Table 1 and 2, the total sample for accrual-based EM is 777 (544) Indonesian (Singaporean) firm-years. For real EM, we use the sample of 654 (535) Indonesian (Singaporean) firm-years. Based on our correlation tests (untabulated), there is a correlation between conditional and unconditional conservative Indonesian (Singaporean) firms towards the Abs_EM (REM).

3.2 Multiple linear regression results

Table 3. Indonesia results

	REM	*ABS(EM)*	*EM > 0*	*EM < 0*
	(1)	*(2)*	*(3)*	*(4)*
C	-55.570***	0.589**	2.385***	-0.042
t-statistic	-5.094	2.046	3.416	-0.634
$CC_{i.t-1}$	-1.835***	-0.005*	0.078***	0.007***
t-statistic	-4.703	-1.414	3.182	9.550
$UC_{i.t-1}$	-9.654	1.379***	0.714	-1.415***
t-statistic	-0.830	3.788	0.813	-17.616
$LNSIZE_{i.t-1}$	2.228***	-0.016*	-0.090***	-0.003
t-statistic	5.157	-1.489	-3.310	-1.124
$TAX_{i.t-1}$	-0.004	-0.000	-0.002	0.000
t-statistic	-0.020	-0.019	-0.119	0.025
$ROA_{i.t-1}$	9.440*	-0.394*	-1.221**	0.433***
t-statistic	1.352	-1.626	-1.764	8.561
F statistic	3.847***	3.907***	2.738***	9.936***
Adj. R^2	0.041	0.054	0.047	0.747

Durbin Watson	0.205	0.045	0.053	1.909
Fixed Effects	Yes	Yes	Yes	Yes

Table 3 columns (2), (3), and (4) provide regression results for H_1. In Indonesia, UC increases accrual-based EM. UC in Indonesian firms leads to higher absolute value of accrual-based EM (UC= 1,379). CC leads to higher income-increasing accrual-based EM (CC= 0,078) and income-decreasing accrual-based EM (CC= 0,007). We find that UC firms in Indonesia use the decreasing income strategy of accrual-based management. The higher the UC, the more firms tend to use income decreasing to record more gains in the next period to minimalize their loss in the next period. The income-decreasing method can present stable financial conditions for the investors or control the management's bonus-based performance. When the management has achieved specific target earnings, they can use the remaining income to be recognized in the next period.

Table 3 column (1) support our second hypothesis, showing that CC reduces real EM (CC=-1,840). The results are also contrary to our prediction, whereas conservative firms shift to real EM. In Indonesia, the more conservative the firms, the more they use accrual-based EM. Previous studies, including Garcia et al. (2020) show evidence that US firms, whereas in developed countries, it has stronger security regulations. So, companies in the US firms prefer to use real EM as it is less risky in EM detection. We also find evidence that firm's size (SIZE) and return on assets (ROA) also influence firm's action in real activities manipulation.

Table 4. Singapore results

	REM	*ABS(EM)*	*EM > 0*	*EM < 0*
	(1)	*(2)*	*(3)*	*(4)*
C	-0,615***	0,461***	0,440***	-0,367***
t-statistic	-2,472	5,885	3,142	-6,017
$CC_{i.t-1}$	0,000**	0,000	-0,000	0,000
t-statistic	2,204	0,221	-0,107	0,094
$UC_{i.t-1}$	-0,576*	-0,037	-0,203	-0,164**
t-statistic	-1,490	-0,301	-0,920	-1,754
$LNSIZE_{i.t-1}$	-0,029**	-0,019***	-0,018***	0,015***
t-statistic	2,290	-4,822	-2,472	4,827
$TAX_{i.t-1}$	0,013	0,005	-0,005	-0,042***
t-statistic	0,430	0,533	-0,330	-3,631
$ROA_{i.t-1}$	0,091*	-0,002	-0,287***	-0,030**
t-statistic	1,477	-0,118	-3,050	-2,331
F statistic	3,847***	3,907***	2,738***	9,936***
Adj. R^2	0,036	0,036	0,042	0,192
Durbin Watson	0,957	1,492	0,393	0,929
Fixed Effect	Yes	Yes	Yes	Yes

Using Singapore data, Table 4 in columns (2), (3), and (4) shows that conservatism does not influence Singaporean firms in accrual-based EM. We find larger firms will do the income-decreasing strategy of

earnings. The tax has also influenced income-decreasing EM; the higher the tax expense, the firms will try to decrease their earnings to pay a lower rate of taxes.

Column (1) show that the more conservative the firms, the more real EM. It supports the argument of (Garcia et al., 2020) that conservative firms will be more likely to implement real activities manipulation. However, unconditionally conservative firms avoid doing real EM as they believe it could decrease the earnings quality.

Table 5. Comparison of Indonesia and Singapore

	REM	*ABS(EM)*	*EM > 0*	*EM < 0*
	(1)	*(2)*	*(3)*	*(4)*
C	-21,276***	0,489***	1,366***	-0,226***
t-statistic	-4,829	3,623	4,122	-5,846
$CC_{i.t-1}$	-0,000	0,000	0,000	0,000
t-statistic	-0,677	0,331	0,495	0,201
$UC_{i.t-1}$	7,482	-0,263	-0,584	0,014
t-statistic	0,8172	-0,646	-0,695	0,116
D	-5,612***	0,216***	0,381***	-0,063***
t-statistic	-3,355	3,221	2,825	-3,196
$D*CC_{i.t-1}$	-0,974***	-0,001	0,060***	0,002***
t-statistic	-4,146	-0,600	3,505	4,090
$D*UC_{i.t-1}$	-25,593**	1,946***	1,799*	-1,860***
t-statistic	-2,197	4,448	1,756	-15,494
$LNSIZE_{i.t-1}$	1,085***	-0,020***	-0,065***	0,007***
t-statistic	4,868	-3,041	-3,897	3,741
$TAX_{i.t-1}$	0,008	-0,000	-0,002	-0,001
t-statistic	0,057	-0,008	-0,157	-0,318
$ROA_{i.t-1}$	1,487	-0,052	-0,549*	0,005
t-statistic	1,043	-0,828	-1,836	0,325
F statistic	3,443***	8,273***	3,517***	124,165***
Adjusted R-squared	0,020	0,052	0,038	0,646
Durbin Watson	0,164	0,091	0,046	1,132
Fixed Effect	Yes	Yes	Yes	Yes

Table 5 shows that real EM is lower in Indonesia compared to Singapore, while accrual-based EM in Indonesia is higher than in Singapore. Indonesian firms are more likely to decrease earnings or use discretionary expenses as their strategy in EM. Conditional and unconditional conservative firms in Indonesia lower real EM but increase accrual-based EM more than in Singapore. Developed markets have stronger legal structures; thus, the usage of accrual-based EM is lower because accrual manipulation carries more risks. The accrual manipulation attracts more auditor's attention than real manipulation (Roychowdhurry, 2006); the accrual-based strategy can also become weak when the earnings in the current period doesn't meet the target resulting in less bonus for the managers. Thus, real earnings manipulation is safer as it can be done throughout the company's operating period

CONCLUSIONS

Based on our findings and results, conservatism in Indonesian firms increases accrual-based EM, while it doesn't influence EM act in Singapore. Conservative firms in Indonesia also lower real EM, while in Singapore, it increases real earnings manipulation. The result for developed market is in line with the evidence provided by Garcia et al. (2020) that conservatism increases real EM and engages in less accrual-based EM. However, Indonesia, which represents emerging markets, is different because emerging markets have weaker legal structures and security regulations. The developed markets shifted to real EM as it is more difficult to detect the manipulation throughout operating activities compared to accrual-based EM.

This study has limitations that can be considered for subsequent research; that is, this research only analyzed companies in 2019-2021. Further research can use a more extended period. Other variables can influence EM, such as big 4 and non-big four auditors, leverage, and market shares. The opportunistic management behaviour in EM is different because the characteristics and culture in each country are different. The difference in financial accounting standards usage can also be used as development for future research.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Jurkėnaitė, N. (2024), "Pork Market Price Transmission During the Covid-19 Pandemic: The Lithuanian Case",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 53-62.

Pork Market Price Transmission During the Covid-19 Pandemic: The Lithuanian Case

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ARTICLE INFO

Received January 09, 2022
Revised from February 09, 2023
Accepted March, 2023
Available online April 15, 2024

JEL classification: L11, Q02, Q11, Q18

DOI: 10.14254/1800-5845/2024.20-2.5

Keywords:

ARDL model,
COVID-19,
spatial price transmission

ABSTRACT

The COVID-19 pandemic had a severe impact on the EU economic system and showed the vulnerability of the food system. The paper investigates spatial price transmission patterns of the Lithuanian pork market during the COVID-19 pandemic. The methodological framework of research is based on linear and nonlinear autoregressive distributed lag models, error correction model, and Wald test that allow describing price relations and detecting the asymmetric price behavior. The spatial price transmission analysis is focused on the role of the selected main producing countries (Poland, Germany, France, Denmark, Spain, and the Netherlands) in price development of the small market. Results suggest that the pandemic period does not introduce a fundamental shift in the behaviour of the Lithuanian market and domestic prices are explained by the price evolution in main producing countries. Indeed, the role of foreign markets in price setting differs. In case of Lithuania, the main price leading countries are Poland, Germany, and the Netherlands. During the COVID-19 pandemic, test results for the main producing countries confirm long-term symmetry, but some countries demonstrate asymmetric price behaviour in the short-term dynamics. The dependence of the small market on price changes of countries with lower pork prices than the EU average makes domestic pig farming vulnerable and puts prospects of business development at a disadvantage.

INTRODUCTION

At the end of 2019, global news shows reported a previously unknown and highly infectious disease in China. The local authorities did not manage to control the outbreak in the country of virus origin. As a result, in early 2020, the global society had faced an unprecedented COVID-19 challenge that transformed the functioning of economic systems and changed our social life. Elleby et al. (2020) compares the devastating impact of the global COVID-19 downturn with the Great Depression, while Swinnen and Vos (2021) argue that the introduced pandemic control measures resulted in a deeper recession than the global financial crisis in 2008-2009. However, the most important lessons to be learnt from the global downturn deal with the functioning of food systems and food security. The COVID-19 pandemic became a sophisticated litmus test for the food supply chains that showed vulnerability of global food systems. Lockdowns

and subsequent pandemic control measures transformed consumer and business behavior, disturbed the functioning of agricultural markets, and highlighted numerous challenges.

Laborde et al. (2021) describe the changes in behavior patterns introduced by lockdowns and report the pandemic influence on diets, including a shift from meat and other nutrient-dense foods to higher consumption of basic staple food, as an inevitable reaction to income loss. However, only limited research focuses on the price transmission in meat markets (for example, Ramsey et al., 2021; Erol and Saghaian, 2022) during the COVID-19 pandemic. The accumulation of deeper knowledge about this period is critical to improve policy response to similar situations in the future.

This paper sheds light on spatial price behavior of the small EU pork market, namely Lithuania, during the pandemic period. In the EU, pork has the highest per capita consumption level, compared with other types of meat, while the Lithuanian pork market has demonstrated a remarkable shrinking in pig population over the recent decades. The research by Emmanouilides and Proskynitopoulos (2020) suggests that the EU market covers national pork markets with different price-driving power, and high power "hubs" influence the development of prices in countries with lower market power. This knowledge encourages the strong focus of academic studies on price transmission mechanisms of main producing countries that lead prices, while the situation of low power markets attracts less attention. Nevertheless, the knowledge about small markets and price transmission patterns during the pandemic period is important for policymakers that deal with the development of sustainable and resilient food systems at the EU level, while for the academic society this study becomes a contribution to the niche research area.

The paper aims to carry out a spatial price transmission analysis for the Lithuanian pork market during the COVID-19 pandemic period. The further structure of this paper includes generalized results of the literature review on the related price transmission studies. Section 2 provides important reference to data description, introduces the research hypothesis, and the methodological research framework. Section 3 focuses on main results of unit root tests, linear and nonlinear autoregressive distributed lag (ARDL and NARDL) modelling, bounds test, error correction modelling (ECM), while the following section compares empirical results of the study with findings of previous academic papers. Main findings are highlighted in Conclusions.

1. LITERATURE REVIEW ON PRICE TRANSMISSION RESEARCH

Listorti and Esposti (2012) identify two types of academic studies on price transmission, namely vertical and horizontal price transmission research. The first niche sheds light on vertical price passes in value chains and mainly includes farmer, processor, and consumer or retailor levels. The examples of such studies for the EU pork market are provided by Cechura and Sobrová (2008), Capitanio et al. (2019), Rudinskaya (2019). This research area introduces the diversity of challenges that arise from the malfunctioning of domestic supply chains and depicts unique characters of national structures. Meanwhile, a wide range of sophisticated econometric techniques and research periods inconveniences cross-country comparisons and generalizations.

According to Listorti and Esposti (2012), horizontal price transmission studies could be additionally grouped into the cross-commodity and spatial price transmission for the same commodities. The former research investigates how changes in prices of related commodities influence the price evolution of the pork market. For example, Karikallio (2015) studies the integration of the EU livestock markets, Zhou and Koemle (2015) analyse the nexus between price changes in hog and feed sectors. Cross-commodity studies shed light on possible aftermaths of policy interventions and expand the selection of support measures providing a better understanding of food systems. The knowledge about spatial price transmission between the same commodities is important, because it shows the progress towards the well-functioning integrated markets or allows to identify market malfunctioning, investigate and predict the reaction of prices after various shocks. Although most of the conducted studies focus on specific groups of the EU countries (for example, Emmanouilides and Fousekis, 2012; Holst and von Cramon-Taubadel, 2013; Fousekis, 2015), some academics include all member states (Emmanouilides and Proskynitopoulos, 2020).

The academic interest in the COVID-19 impact on the functioning of the pork market around the world was driven by the importance of this meat in diets, but most of the studies omitted price transmission aspect. For example, the impact of the COVID-19 pandemic on the pork market of the United States of America (USA) is analysed by Hayes et al. (2021) who carry out a descriptive analysis of the pork market and Lusk et al. (2021) who focus on spreads of pork prices and marketing margins. The comparative analysis of important indicators is carried out by D'Souza and Dunshea (2021) and by McEwan et al. (2021) who investigate the COVID-19 impact on the Australian and Canadian pork industries. The research on the pandemic impact on price transmission in the pork and other meat sectors is modest and often covers vertical price transmission. For example, Ramsey et al. (2021) investigate vertical pork price transmission and find that the pandemic introduced a price surge in the USA, while the wholesale level reacted to the shock faster than the retail level. Erol and Saghaian (2022) focus on the value chain of beef in the USA and conclude that farmers and consumers had slower adjustments to price changes and experienced the stronger aftermaths of the COVID-19 pandemic.

Although price transmission studies cover three different niches, the same methodological approaches are applied to carry out the research. The in-depth discussion on the evolution of econometric models employed for price transmission analysis is provided by von Cramon-Taubadel (2017). Frey and Manera (2007) also provide a detail list of econometric models, however, they additionally enrich the academic discourse by the list of models that are applied to investigate different types of asymmetric behavior. The aforementioned empirical research helps to assess the research framework based on the available data properties.

2. DATA AND METHODOLOGY

2.1 Data

This research utilizes the secondary data collected in accordance with Regulation (EC) No 1249/2008 (Article 25). Weekly prices for pig carcase (E class) cover price changes from March 2020 to February 2022. EU countries introduced various countermeasures (lockdowns and other movement restrictions, limiting of gatherings, closure of catering establishments and other businesses, mandatory vaccination for the certain activities, etc.) to stop the spread of the virus, while pork markets experienced changes in supply, consumption and consumer behavior during this period. After an outbreak of a war in Ukraine in February 2022 and the following economic sanctions, the war became a dominant explanation of agricultural price surges due to growing input costs and availability of important commodities. Thus, this research focuses on the period with a clear reference to the COVID-19 pandemic.

The previous research suggests that price changes of small markets in the EU are determined by price developments in main producing countries. This paper investigates whether the pandemic-induced market failures and changes influence spatial pork price relations and formulates the hypothesis as follows: *The COVID-19 pandemic period had influenced the price leading role of the main producing countries on the Lithuanian pork market in the long run*.

Table 1. Descriptive statistics for the selected countries and the EU

	DK	*DE*	*ES*	*FR*	*LT*	*NL*	*PL*	*EU*
Min (€/100 kg)	122.71	123.15	123.88	132.00	99.86	110.99	111.53	127.65
Max (€/100 kg)	206.51	207.77	191.64	167.00	198.46	185.76	199.41	195.39
Average (€/100 kg)	153.68	146.03	155.74	146.10	138.21	131.45	139.42	147.01
STDEV	20.53	20.74	19.39	10.86	22.67	17.99	19.71	16.90

Source: author's elaboration is based on data from the Directorate-General for Agriculture and Rural Development of the European Commission

In order to confirm or reject the hypothesis, the study covers Lithuania (LT) and the main EU pork producers, namely Poland (PL), Germany (DE), France (FR), Denmark (DK), Spain (ES), and the Netherlands (NL). The descriptive statistics of the analysed price series is reported in Table 1. During the selected period, the highest price volatility is recorded in Lithuania, while price changes in Germany and Denmark also demonstrate high standard deviation. The comparison of the average prices shows that the Netherlands, Poland, and Germany are highly competitive main producing countries with the lowest average prices.

2.2 Methodological framework

The selection of the appropriate econometric technique starts from the unit root testing that allows grouping data into stationary and nonstationary. Although the previous research employs a wide variety of unit root tests, this study applies Augmented Dickey-Fuller and Phillips-Perron tests (Dickey and Fuller, 1979; Phillips and Perron, 1988), hereinafter referred as the ADF and PP tests. Both tests investigate the null hypothesis (H_0) that the data contain a unit root and the confirmation of the H_0 means that price series are nonstationary. Stationary data reject the H_0 at level (I(0)), while nonstationary data reject H_0 in first difference (I(1)) or after further steps of data processing. If the order of integration is lower than I(2), the appropriate econometric technique for the mixed data is the ARDL model. The ARDL model enables the analysis of the long- and short-term dynamics in price relationships. The adapted for the bipatrtite price analysis Pesaran et al. (2001) model is described in Eq. 1:

$$\Delta LP_t = \gamma_0 + \sum_{i=1}^{p} \alpha_i \, \Delta LP_{t-1} + \sum_{i=0}^{q} \beta_i \Delta \, FP_{t-1} + \rho LP_{t-1} + \varphi FP_{t-1} + \mu \quad (1)$$

where Δ is referred as the first difference of the variable, LP_t denotes the natural logarithms of prices on the Lithuanian market (t=1,2,...,T), FP_t – the natural logarithms of prices on the investigated foreign market (t=1,2,...,T), γ_0 – constant term, α_i and β_i – coefficients of the short-term dynamics, p and q – lags of dependent and explanatory variables, φ and ρ – coefficients of the long-term dynamics, μ – term of random disturbance.

The selection of lags p and q relies on two steps. First, the bipartite Vector Autoregression (VAR) models that describe price relationships between the Lithuanian and the foreign market are investigated. The VAR lag order selection criteria, namely sequential modified LR test statistic, Schwarz information criterion, final prediction error, Akaike information criterion (AIC), and Hannan-Quinn information criterion, are calculated up to the 8th lag for those bipartite models. The maximum lag for the ARDL modelling is selected as a dominant solution suggested by most calculated criteria. Second, the ARDL models are run starting from the maximum selected lag and reducing it. The appropriate model is selected employing the lowest AIC criterion.

Additional tests on the estimated ARDL models are run to avoid the selection of the alternative that faces serial correlation, heteroscedasticity or stability problems. The outcomes of the Breusch-Godfrey serial correlation Lagrange multiplier test, the Breusch-Pagan-Godfrey heteroskedasticity test (Godfrey, 1978; Breusch and Pagan, 1979), the cumulative sum and cumulative sum of square tests (Brown et al., 1975) empower a proper assessment of the ARDL model, while the consideration of changes in lags allows to overcome the aforementioned problems.

After the selection of the ARDL model, the long-run form of the ARDL model (Eq. 1) allows us to run the bounds test (Pesaran and Shin, 1999) and draw conclusions concerning the presence of the long-term relations between two markets. The H_0 suggests that prices have no level relationships, while the rejection of the H_0 shows the cointegration in the long-term dynamics. The decision is based on the comparison of the calculated F-statistic with the lower and upper critical bounds of F-test. The presence of the cointegration shows F-statistic value that is higher than the upper critical bound level, while the F-statistic between bounds provides inconclusive results. If F-statistic is lower than the lower critical bound, the data are not cointegrated.

The confirmation of the cointegration between the Lithuanian and the foreign market by the bounds test allows to interpretate short- and long-term coefficients of the ARDL model and run the ECM that provides the error correction term (ECT) or speed of price adjustment to the equilibrium as the most important result of the modelling. The ARDL model is specified as the ECM in Eq. 2:

$$\Delta LP_t = \gamma_0 + \sum_{i=1}^{p} \alpha_i \Delta LP_{t-1} + \sum_{i=0}^{q} \beta_i \Delta FP_{t-1} + \delta_1 ECT_{t-1} + \mu \quad (2)$$

where δ_1 is a coefficient that describes the adjustment towards the long-term equilibrium, *ECT* – error correction term.

However, in some cases the linear ARDL model could hide important differences between the impact of explanatory variable price increases and declines on the development of the dependent variable, but this impact becomes visible in a nonlinear ARDL model. As the COVID-19 pandemic introduced a significant shock on agricultural markets, some evidence of asymmetric price behaviour could be presumed, while NARDL models could have a better explanatory power in such cases. Thus, the research is extended including a NARDL modelling introduced by Shin et al. (2014). NARDL specification is based on the linear ARDL model (Pesaran and Shin, 1999; Pesaran et al. 2001), however, it shows the decomposition of regressors into partial sums of positive and negative price changes. The adapted for the research Shin et al. (2014) model is provided in Eq. 3:

$$\Delta LP_t = \gamma_0 + \sum_{i=1}^{p-1} \alpha_i \Delta LP_{t-1} + \sum_{i=0}^{q-1} \beta_{1i} \Delta FP_{t-1}^{+} + \sum_{i=0}^{q-1} \beta_{2i} \Delta FP_{t-1}^{-} + \rho LP_{t-1} + \varphi_1 FP_{t-1}^{+} + \varphi_2 FP_{t-1}^{-} + \mu \quad (3)$$

where α_i, β_{1i}, β_{2i} – coefficients of the short-run dynamics, FP^+ and FP^- – partial sum processes of price growth and decline in FP_t, φ_1, φ_2, ρ – coefficients of the long-term dynamics.

NARDL model is derived from the selected ARDL model and follows the similar assessment procedure that includes tests for serial correlation, heteroscedasticity, stability, and the bounds test. If the aforementioned tests do not show model's misspecification and confirm the cointegration in the long-term dynamics, the ECM is run for the estimation of bipartite price relations in the short term. NARDL model empowers the analysis of long- and short-term asymmetric behaviour applying the Wald test (see Shin et al., 2014, Rezitis, 2019). The long-term dynamics investigates the H_0 that $-\varphi_1/\rho = -\varphi_2/\rho$, while the H_0 of the short-term dynamics is that $\sum_{i=0}^{q} \beta_{1i} = \sum_{i=0}^{q} \beta_{2i}$. The rejection of the H_0 means the asymmetric price behaviour, while the opposite outcome confirms the symmetric price passes. The comparison of the ARDL and NARDL models shows the importance of asymmetric price behavior in price setting on the Lithuanian market.

3. EMPIRICAL RESULTS

The ADF and PP tests report on conflicting outcomes. The ADF test classifies price movement trajectories in Lithuania, France, and Poland as stationary at 5.00% significance level (Table 2). However, the PP test for the same countries does not allow rejecting the H_0 at 5.00% significance level.

Table 2. Results of the ADF and PP tests with the constant for the selected seven countries

Price series	*ADF test: I(0)*	*ADF test: I(1)*	*PP test: I(0)*	*PP test: I(1)*
LT	-3.0357[B]	-5.6945[A]	-2.6947[C]	-4.7896[A]
DE	-2.5364	-4.0451[A]	-2.7242[C]	-3.9567[A]
DK	-1.9866	-7.3313[A]	-1.8618	-8.0480[A]
FR	-2.9740[B]	-3.9091[A]	-2.0777	-3.9091[A]
ES	-2.9722[B]	-2.4330	-2.0796	-4.0595[A]
NL	-2.6141[C]	-4.7163[A]	-2.4358	-10.1268[A]
PL	-3.0334[B]	-5.3203[A]	-2.7825[C]	-4.6928[A]

Note: the significance level is described by *p*-values, i.e. [C] - 10.00%, [B] - 5.00%, [A] - 1.00%.

Source: own calculations.

The PP test confirms the stationarity of series at I (1), although results for three countries imply that price movements are characterized as stationary at 10.00% significance level. According to tests, prices could be classified as I(0) or I(1), while the conclusion depends on the selected test and the significance level. This important data characteristic is overcome applying ARDL modelling. Bounds test confirms the highest *F*-statistic results and proves 1.00% significance level for the nearest countries, namely Poland and Germany (Table 3). The presence of the long-term relations between the Lithuanian market and those countries remains important for the price setting during the COVID-19 pandemic.

Table 3. ARDL and NARDL bilateral modelling results

	DE–LT		PL–LT		DK–LT	
	ARDL(3,3)	*NARDL(3,3,3)*	*ARDL(3,1)*	*NARDL(3,1,1)*	*ARDL(4,3)*	*NARDL(4,1,3)*
C	-0.0147	1.0974[A]	-0.0558	1.2630[A]	0.1446	0.7195[A]
LP(-1)[a]	-0.2093[A]	-0.2082[A]	-0.2393[A]	-0.2374[A]	-0.1083[A]	-0.1409[A]
FP(-1)	0.2100[A]		0.2502[A]		0.0770[C]	
FP(+)(-1)		0.2183[A]		0.2405[A]		0.1641[C]
FP(-)(-1)		0.2081[A]		0.2459[A]		0.1262[B]
ΔLP(-1)	0.4830[A]	0.4807[A]	0.3302[A]	0.3338[A]	0.5756[A]	0.5794[A]
ΔLP(-2)	0.2706[A]	0.2834[A]	0.3143[A]	0.3133[A]	0.2686[B]	0.2698[B]
ΔLP(-3)					-0.2317[B]	-0.2177[B]
ΔFP	0.3814[A]		0.5698[A]		0.7582[A]	
ΔFP(+)		0.3247		0.5184[A]		0.9256[B]
ΔFP(-)		0.2839		0.6529[A]		0.7591[B]
ΔFP(-1)	0.5078[A]				0.0031	
ΔFP(+)(-1)		1.0890[B]				
ΔFP(-)(-1)		0.4308[B]				0.0698
ΔFP(-2)	-0.4852[A]				-0.4830[B]	
ΔFP(+)(-2)		-1.0966[A]				
ΔFP(-)(-2)		-0.3455[C]				-0.7536[B]
Bounds test						
F-statistic	10.5221[A]	7.6526[A]	14.4921[A]	10.8460[A]	3.7197[C]	3.6992[C]
Symmetric price behavior						
Long-term		yes		yes		yes
ARDL Error Correction Regression						
ECT	-0.2094[A]	-0.2082[A]	-0.2393[A]	-0.2374[A]	-0.1083[A]	-0.1409[A]
R^2	0.6758	0.6997	0.7478	0.7503	0.60012	0.6132
Adjusted R^2	0.6589	0.6736	0.7400	0.7400	0.5746	0.5841
AIC	-4.4667	-4.4732	-4.7569	-4.7474	-4.2265	-4.2398

Note: The significance level is described by *p*-values, i.e. [C] - 10.00%, [B] - 5.00%, [A] - 1.00%. [a] denotes *p*-value that is not compatible with *t*-Bounds distribution.

Source: own calculations.

The calculated *F*-statistic indicates higher values for the ARDL models, and the decomposition of prices does not show an essential improvement of the model. The stability test for the NARDL(3,3,3) model (DE–LT) shows that CUSUMQ line has minor violations of the lower 5.00% significance boundary, while the linear ARDL(3,3) model passes all tests. According to Table 3, the first lag of prices on the domestic and foreign markets is important explaining the price development on the Lithuanian market in the long-term dynamics. The decomposition of the coefficient describing the long-term dynamics indicates that price declines on foreign markets are associated with positive coefficients. The previous price developments on the Lithuanian market and price level in Poland and Germany are important in the short-term dynamics. The NARDL (3,3,3) model (DE–LT) also includes lagged values of the German price differences as significant explanatory short-term coefficients.

The ECM regression demonstrates the fastest speed of adjustment to equilibrium in case of price relations between Lithuania and Poland (ECT is approx. 24.00%). The models that describe the links between the Lithuanian and German prices also estimate a high speed of adjustment (approx. 21.00%). As ECT must be negative and demonstrate a statistical significance (Rose et al., 2019), the results suggest that the price setting direction is appropriate. Although the price transmission between the Lithuanian and both foreign markets evidence symmetric behaviour in the long-term dynamics, the transmission of the German prices is asymmetric in the short term, while the Wald test for the pair Poland–Lithuania confirms symmetric price movements.

Bounds test for the pair Denmark–Lithuania confirms the cointegration only at 10.00% significance level, while test results at 5.00% level are inconclusive. The ARDL (4,3) model evidences low significance

of the long-term coefficient that explains dependent variable based on price changes in the foreign market, while the decomposition of this coefficient demonstrates that positive and negative changes have different significance. In the short-term dynamics, the development of lagged price differences on the domestic market is an important explanatory factor, but lagged price differences' developments in Denmark are also important. The nonlinear model shows higher ECT value than the ARDL; however, the speed of adjustment is lower than 15.00% in both cases. Wald tests suggest the presence of the short-term asymmetry, while the long-term dynamics confirms symmetric price changes.

Table 4. ARDL and NARDL bilateral modelling results

	FR–LT		*ES–LT*		*NL–LT*	
	ARDL (4,3)	*NARDL(4,0,2)*	*ARDL(4,0)*	*NARDL(4,1,0)*	*ARDL(3,4)*	*NARDL(3,3,4)*
C	-0.1098	0.5207^{A}	0.1777	0.5558^{A}	0.0408	1.0810^{A}
LP(-1)[a]	-0.1078^{A}	-0.1025^{A}	-0.1229^{A}	-0.1111^{A}	*-0.1846*^{A}	*-0.2071*^{A}
FP[b]			0.0843^{B}			
FP(+)[b]		0.1054				
FP(-)				0.0665[b]		
FP(-1)	0.1281				*0.1776*^{A}	
FP(+)(-1)				0.0576		*0.2019*^{A}
FP(-)(-1)		0.1159				*0.2064*^{A}
ΔLP(-1)	0.5231^{A}	0.5553^{A}	0.6298^{A}	0.5866^{A}	0.4235^{A}	0.4551^{A}
ΔLP(-2)	0.2198^{B}	0.2291^{B}	0.2355^{B}	0.2049^{C}	0.3064^{A}	0.3021^{A}
ΔLP(-3)	-0.2060^{B}	-0.2398^{B}	-0.2395^{B}	-0.2273^{B}		
ΔFP	1.3821^{A}				0.4918^{A}	
ΔFP(+)				0.6204^{B}		0.5940^{A}
ΔFP(-)		2.1062^{A}				0.3262^{B}
ΔFP(-1)	-0.3374				0.2579^{B}	
ΔFP(+)(-1)						0.2127
ΔFP(-)(-1)		-1.4089^{A}				0.2147
ΔFP(-2)	-0.5434				-0.2134^{B}	
ΔFP(+)(-2)						-0.5267^{B}
ΔFP(-)(-2)						0.0297
ΔFP(-3)					-0.3156^{A}	
ΔFP(-)(-3)						-0.3841^{B}
Bonds test						
F-statistic	3.4861	2.2305	4.6452^{B}	3.8680^{B}	8.7306^{A}	6.8982^{A}
Symmetric price behavior						
Long-term		-		yes		yes
ARDL Error Correction Regression						
ECT	-0.1078^{A}		-0.1229^{A}	-0.1111^{A}	-0.1846^{A}	-0.2071^{A}
R^2	0.5919		0.5472	0.5693	0.6677	0.6576
Adjusted R^2	0.5659		0.5332	0.5514	0.6453	0.6234
AIC	-4.2061		-4.1615	-4.1917	-4.3989	-4.3103

Note: The significance level is described by *p*-values, i.e. ^{C} - 10.00%, ^{B} - 5.00%, ^{A} - 1.00%. [a] denotes *p*-value that is not compatible with *t*-Bounds distribution, [b] means that the outcome is interpreted as Z = Z (-1) + D(Z).

Source: own calculations.

France and Lithuania demonstrate essential price development differences during the COVID-19 period (Table 4). Thus, the bounds test fails to confirm the cointegration between two markets. The comparison of bipartite relations including Spain and the Netherlands allows to observe important differences in estimated models. Although the bounds test confirms the fact of the long-term relations, ARDL (3,4) model (NL–LT) indicates possible stability problems plotting CUSTUMQ line within borders. The NARDL (3,3,4) model is better specified, because it does not face serial correlation, heteroscedasticity, and stability problems. In the long-term dynamics, the main explanatory variables are the first lag of the domestic and foreign

prices, while the short-term coefficients of lagged price differences in both countries are significant too. Wald tests do not provide evidence of asymmetric price behaviour in case of the Netherlands and Lithuania.

The comparison of NARDL (4,1,0) and ARDL (4,0) models (ES-LT) implies that for the former model the domestic prices have a higher explanatory power than the changes of prices on the Spanish market in the long term. The short-term coefficients also show lagged domestic price differences as significant explanatory variables; however, the nonlinear model includes positive price changes in the Spanish market as important variable. The investigation of price transmission behavior confirms the symmetric pattens in the long-term dynamics, while NARDL (4,1,0) includes only one significant short-term coefficient related to positive price changes on the Spanish market.

4. DISCUSSION

Results go in line with findings of Emmanouilides and Proskynitopoulos (2020) who argue that pork price changes in Lithuania are mainly driven by the German, Polish, and Dutch markets; however, their study classifies Denmark as a market that could be dependent on the price evolution in Lithuania, while Spain and France are attributed to the same group of power as Lithuania. Econometric modelling suggests that the role of neighbouring Poland is the most remarkable, while this conclusion is supported by Holst and Cramon-Taubadel (2013) finding that price transmission is faster between markets with a common border. This study allows arguing that the aforementioned countries with high market power had maintained their leading position during the COVID-19 pandemic crisis and demonstrated the highest speed of adjustment to the equilibrium. The research hypothesis could be rejected, because there is no empirical evidence of higher price-setting autonomy on the Lithuanian market during the pandemic period, and country retains the long-term dependence on the price changes in main producing countries that played an important role during the pre-pandemic period.

The research reveals that the price evolution trajectory in France differs significantly during the COVID-19 period, and the bounds test fails to confirm the bipartite cointegration. Although bilateral models, including Spain and Denmark, confirm the long-term relations at lower significance levels, the results also imply more individual price trajectories, compared to the Lithuanian market. In fact, the findings touch the issue of the EU market integration efficiency, because a well-functioning integrated market is supposed to transmit price changes and shocks bidirectionally, while individual reactions to crises in Member States and differences in price volatility could be associated with failures of the integrated market. Emmanouilides and Proskynitopoulos (2020) link the existence of market power groups with inefficient EU market too. The previous academic study by Fousekis (2007) also explains the situation in the EU pork market invoking the idea of the “price club” and draws the similar conclusion that the situation in pork market is featured by multiple markets rather than represents the single EU market. Aforementioned studies and the current research show that the “price club” phenomenon survived over decades and bilateral links between club members remain strong even during such crisis as the COVID-19 pandemic. The conducted study found no evidence of asymmetric bipartite price transmission in the long term, but the short-term price dynamics in many analysed bilateral models is characterized by asymmetric price passes.

Indeed, the case of Lithuania shows that such dependence and the competition from the neighbouring main producing countries make small markets more vulnerable. Since Lithuania had joined the EU, the shrinking of the local pig faming was startling. The change of the trade focus from the Russian Federation to the EU market demanded large investments in new breeds and tools that empower the higher productivity, while the high pork price declined and remained below the EU average. Although profit cuts were critical, the situation was exacerbated by periodic animal diseases and other crises. As the Lithuanian pork market is characterized by the relatively low consumer loyalty to domestic agricultural products, it became a place of destination for countries with the high price-setting power that experience overproduction. As a result, the market power and profits of local producers declined, and the EU policy was inadequate to overcome these challenges and protect small markets. Indeed, the further research on the crisis-induced volatility of small markets and impact of main producing countries is critical to understand the short-term

responses and ensure viability of pig farming in all Member States by proposing improved policy responses to crises.

CONCLUSIONS

Research results suggest that the COVID-19 pandemic period did not introduce fundamental price transmission changes in the long term. Modelling results also imply that the patterns of price drift in main producing countries differed, however, this feature is hardly an outcome of the COVID-19 pandemic. During the investigated period, the Lithuanian market retains dependence on the countries with high price-setting power and the "price club" membership with Poland, Germany, and the Netherlands. The bipartite models with these countries demonstrate the highest speed of adjustment to the equilibrium after the experienced price shock. In fact, the membership of the small pig producing country in a "price club" of large markets that offer the EU market pork at prices below the EU average introduces negative prospects on the local business development. The Lithuanian market reacts to the dramatic price declines on highly competitive markets and the small market is forced to operate under unfavourable conditions that introduce losses and reduce investment opportunities.

ARDL models show higher F-statistic values of the bounds test, while NARDL models demonstrate symmetric price passes in the long run and do not confirm pandemic-induced impact on symmetric price passes. However, some countries had asymmetric price passes in the short-term dynamics during the COVID-19 period.

Given the fact that the selected research period includes various countermeasures that were applied during different time intervals of the pandemic, the patterns of price transmission could be influenced by the selection of period or econometric technique allowing to investigate more specific research questions. Thus, the promising direction of the research could be the price transmission analysis focused on the application of different countermeasures. The comparison of price transmission patterns during COVID-19 crisis with other types of crises could also improve the knowledge and assist in selecting better-targeted policy measures at the EU level.

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ELIT
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Montenegrin Journal of Economics

For citation:

Bang, N.H., Nga, P.T.H., Dao, L.T. (2024), "Determinants Affecting the Green Bank Development in Vietnam",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 63-74.

Determinants Affecting the Green Bank Development in Vietnam

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ARTICLE INFO

Received: January 19, 2022
Revised from: February 19, 2023
Accepted: March 19, 2023
Available online: April 15, 2024

JEL classification: B26, C58, G18, M38

DOI: 10.14254/1800-5845/2024.20-2.6

Keywords:

Green,
policy,
legal,
commercial bank,
economics.

ABSTRACT

To contribute to the implementation of the national action plan on green growth. Green banks will be an essential resource in implementing the green growth strategy until 2025 because the banking system can contribute to limiting environmental and social risks by not lending to customers with projects that pollute or have adverse impacts on the environment and people's lives. On the other hand, strict control from the bank appraisal stage also encourages businesses to move towards cleaner and safer production and business activities. Therefore, the paper's primary objective is to explore determinants affecting green bank development in Vietnam. The authors surveyed the data by developing a formal survey for the research topic with 950 surveyed officers and employees related to 15 commercial banks and used structural equation modeling (SEM) and SPSS 20.0, Amos software. The paper finds eight factors affecting the green bank development in Vietnam with a significance level of 0.01, and all eight hypotheses are accepted. The article's value determines the banking technology's most substantial impact on green bank development. Finally, the authors had important recommendations for improved banking technology and the goal of green and sustainable growth. Building and developing a green bank in Vietnam is an urgent requirement. Green banking is an essential strategy in the sustainable development orientation of the banking system.

INTRODUCTION

Many countries worldwide have chosen to develop a green economy for long-term sustainable development. Green growth and banking development strategies play an essential role in the Vietnamese economy. Besides, the banking industry plays a vital role in greening investment capital flows; directing financial resources into green fields; restricting capital flows to projects that affect the environment; contributing to promoting borrowers to convert projects and loan purposes into environmentally friendly projects. Green banking policies are essential to realizing the goal of saving energy and reducing harmful emissions, driving the economy towards green growth. Following the global trend of sustainable development, the banking

industry has been participating due to its critical role in economic life (Aboelmaged and Gebba, 2013; Janakiraman and Karthikeyan, 2016). Therefore, the interest in sustainable banking has gradually grown and become a strategic goal that banks aim for greed development.

The banking sector has taken steps to stimulate sustainable development. However, more needs to be done. International organizations must continue to raise awareness of banks and thereby encourage the development of new "green and clean" products. The World Bank must pay attention to the relationship between the environmental impacts of investments and financing decisions on bank performance. At this stage, It is widely understood that sustainable banking means conducting banking activities and activities with conscious consideration of the environmental and social impacts of such activities (Bailey, 2015; Masukujjaman et al., 2015). Therefore, green banking refers to the banking business activities conducted in the areas where the bank finances, the products and services that the bank provides, and the day-to-day operations of the banks. The bank aims to help reduce external and internal carbon emissions. To be able to support external and internal carbon emissions reductions, what should banks do? Management policy and business strategy? This study's objective is to develop initiatives to raise the awareness of employees in the bank. Therefore, the paper's primary value is to study factors affecting green bank development in Vietnam and propose policy recommendations for green bank development in Vietnam.

1. LITERATURE EMPIRICAL REVIEW

1.1 Green Bank Development (PTNHX)

Many countries worldwide have chosen to develop a green economy for long-term sustainable development. The green bank development strategy plays an essential role in the green growth strategy. This article will study the experiences of some countries in developing green banks, as well as the current situation of green banking development in Vietnam, thereby giving some policy suggestions for Vietnam. According to Bennett and Iqbal (2013), green banking can be understood in two aspects: (i) Banks carry out direct activities to minimize environmental impacts, such as saving energy, water, and waste treatment. (ii) The bank indirectly impacts the environment by increasing support for environmentally friendly projects such as factories using gas from waste, factories providing renewable and solar energy, and bio-manufacturing plants (Jha and Bhome, 2013; Masukujjaman et al., 2017; Meena, 2013). Green Bank has the following main characteristics: (i) Deployment of electronic and automation services; (ii) Prioritize lending or investing in projects with an assessment of risks related to the environment; (iii) Pay attention to social goals, sustainable development goals, and green development; (iv) Monitor and guide clients' projects to reduce environmental pollution; (v) Changing the capacity of bank staff and customers to evaluate environmentally friendly activities.

1.2 Quality of human resources (NNL)

People are the central factor for the bank's business activities to be more and more expanded. It is necessary to have a team of bank staff with enthusiasm, a high sense of responsibility, and professional knowledge (Anna, 2018; Aizawa & Yang, 2010). Therefore, human resource solutions play a crucial role in the development of green banking, helping the bank to limit environmental and social risks in business operations (An & Pivo, 2020; Al-Ahmad et al., 2012). Vietnam is also gradually following this trend but still faces many difficulties and needs solutions to promote this capital flow further. Therefore, the first hypothesis that the authors propose for this study is:

Hypothesis H1: Human resource quality positively impacts green banking development in Vietnam.

1.3 Marketing strategy (MK)

A bank, like an enterprise, must have capital, revenue, and purchase and sale... However, the bank's activities are mainly monetary business and other services. In the era of technology 4.0, implementing marketing solutions for banks is even more focused. Bank marketing is a system and process of banks

trying to implement solutions to satisfy customers' needs and proactively wants to meet the needs and desires of the bank.

Hypothesis H2: Marketing strategy positively impacts green banking development in Vietnam.

1.4 Financial capacity (TC)

The context of deep integration into the world economy poses many difficulties and challenges for the banking system, especially commercial banks (Alwahaishi and Snasel, 2013; Bhardwaj and Malhotra, 2013). Because according to international practice, commercial banks' capital adequacy ratio (CAR) must be 9% or more. If this ratio is not guaranteed, commercial banks will be unable to expand operations, even in danger of bankruptcy. Although capital is a fundamental factor in evaluating a bank's financial aspects, we need to consider a series of other factors such as liquidity, asset risk structure, volatility of deposit types, and quality of bank management.

Hypothesis H3: Financial capacity positively impacts green banking development in Vietnam.

1.5 Banking technology (CN)

The fourth industrial revolution (Industry 4.0), with technological achievements of artificial intelligence, blockchain, big data, Internet of things, has had significant impacts, significantly changing several aspects of the economy, including the banking sector (Jin and Mengqi, 2011; Kianpour et al., 2014). Commercial banks build data banks on green banking risks and use a modern risk analysis and handling tools. This factor significantly affects the quality and effectiveness of bank governance, including risk management in general. Investment in developing the bank's information technology system is also significant, especially when there is a sufficient basis for assessing and quantifying the risks of green banking in the future. The author proposes the following hypothesis:

Hypothesis H4: Banking technology positively impacts green banking development in Vietnam.

1.6 Risk management (RR)

To implement effective operational risk management, banks must implement effective loss data collection practices, improve behavior and culture towards bank-wide risk management, and improve the quality of risk management amount of data loss (Miah et al., 2020; Kristin and Morten, 2016; Kandavel, 2013). Risk management at banks by 2025 will be very different from the present. These differences may come from state management agencies changing regulations and policies in banking operations, from customers having higher expectations for product sales and interaction channels, or because risk types vary in a more complex direction. Therefore, the bank must always be ready to change itself to promptly meet the requirements and expectations of customers, partners, state management agencies, and other stakeholders in the long term to contribute to the future to improve the quality of green banking. The authors hypothesized this factor is:

Hypothesis H5: Risk management positively impacts green banking development in Vietnam.

1.7 Legal framework (PL)

Green banking is an inevitable trend in the global financial industry, an effective solution for preventing and limiting the increasingly adverse impacts of climate change. For Vietnam, green banks play a critical role in promoting sustainable development and realizing the Government's green growth strategy (Jan et al., 2019; Afshan and Sharif, 2016). From the theoretical bases of this factor, The completion and development of the legal framework for the development of green banking are critical in improving the efficiency of monetary policy management and market regulation along with the development of the green economy. The authors propose the 6th hypothesis as follows:

Hypothesis H6: Legal framework positively impacts green banking development in Vietnam.

1.8 Supporting policies (HT)

Green bank is one of the green financial tools to sponsor green and environment-friendly programs, projects, and initiatives, to encourage consumers and businesses to optimize and regenerate energy sources. Concern about environmental issues. In particular, green banks often finance initiatives and projects that are expected to have a clear and positive impact on the environment, so they often have preferential interest rates and longer payment terms than other projects. with regular loans (Aleem and Bowra, 2020; Jayadatta and Nitin, 2017). It can be said that green projects are considered priority areas for loans. From the theoretical bases of this factor, the authors propose the seventh hypothesis as follows:

Hypothesis H7: Supporting policies positively impact green banking development in Vietnam.

1.9 Environmental policy (MT)

The context of paying attention to green economic development. Environmental protection has been paid great attention to by our Party and State and is a cross-cutting point in the process of leading the country. The system of policies and laws on the environment is still overlapping and inadequate; environmental management tools have not been effective and efficient (Bahl, 2012; Antonio et al., 2017). New management approaches and tools have not been institutionalized in a timely manner and cannot keep up with the rapid developments of environmental issues and the country's socio-economic development and international integration requirements. From the theoretical bases of this factor, the authors propose the 8th hypothesis as follows:

Hypothesis H8: Environmental policy positively impacts green banking development in Vietnam.

To contribute to the implementation of the national action plan on green growth. Green banks will be an essential resource for implementing the green growth strategy in 2025 because the banking system can contribute to limiting environmental and social risks by not lending capital to customers with projects that pollute or have adverse impacts on the environment and people's lives. On the other hand, strict control right from the bank appraisal stage also encourages businesses to move towards cleaner and safer production and business activities. Therefore, the authors research and propose the following factors affecting the development of green banking in Vietnam.

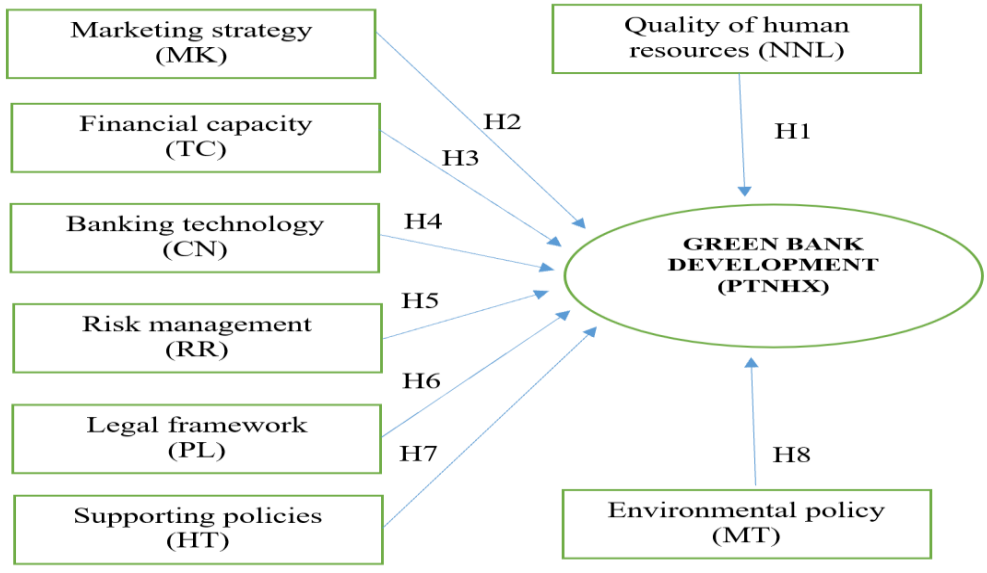

Figure 1. A research model for critical factors affecting green banking development in Vietnam

Source: The authors proposed

2. METHODOLOGY AND DATA

The study applies mixed methods, including qualitative and quantitative in preliminary research and quantitative in a formal investigation, with the data source used as primary data source obtained through the questionnaire survey. The sequential research method through the two main approaches is as follows.

Qualitative research methods: With a qualitative research method, the target groups of 30 managers of the 15 largest commercial banks in Vietnam were invited to participate in a face-to-face discussion to explore the elements of the green banking development scale. In addition, the authors study the theoretical basis to develop a research model and design a scale to calibrate the model and ranking following the research context.

Specifically, the authors consulted with 30 managers in the banking sector related to banking and banking activities, including deputy heads of branches, deputy heads of transaction offices, and heads of banking departments. Based on the opinion of 30 managers knowledgeable about management in the banking sector related to banking and banking activities, the authors determined precisely what information to collect from the managers' comments and from that form the survey.

Quantitative research methods: The detailed steps in qualitative research are as follows: (1) Collect and synthesize theories related to the research topic. (2) Design a preliminary question through the opinions of 30 managers in the banking sector related to banking and banking activities. (3) Conduct trial interviews with officers, bankers, and managers and adjust the questions. (4) Conduct test interviews and run samples of the survey questionnaires from officials and employees from commercial banks to verify the scale. (5) Develop a formal survey for the research topic with 950 officers and employees surveyed. The authors delve into the survey and survey of each commercial bank with about 65 staff and representative staff participating in answering to test the research model and hypothesis. The direct interview technique is also applied with a revised questionnaire after preliminary qualitative and quantitative research. The authors surveyed 950 officers and employees related to commercial banks from September 2022 to December 2022 in Vietnam.

Collected data with a sample size of at least the model on an observed variable. The sampling method is convenient and mailed to each individual, but 865 samples were processed. The authors measured the level of impact of factors using by SEM model. In this article, the total number of observed variables is 39, so based on the technique, the minimum number of enterprises needed to achieve this study is 39 x 5 = 195 (Hair et al., 2021). Check the model's goodness of fit, and GFI, AGFI, CFI, and NFI with a value > 0.9 is considered a good fit. After that, the data was collected to evaluate the scale's reliability, such as Cronbach's Alpha and exploratory factor analysis (EFA), to shorten the observed variable in the factor. The steps in the research process must follow a particular sequence mentioned above.

3. EMPIRICAL RESULTS

3.1 Analysis of the situation for the green banking development in Vietnam

Green banking is understood as providing and characterizing banking services to support activities that positively impact the environment, reduce carbon emissions, save natural resources, and promote sustainable economic development (Kanak Tara & Ritesh Kumar, 2015). In a broad sense, green banking is understood to mean that a bank has built a sustainable business strategy, reflected in the provision of banking services that satisfy the criteria of ensuring environmental responsibility and society. The use of the definition of the green bank in a broad sense is consistent with the development orientation of green banks in Vietnam in Decision 1604/QD-NHNN dated August 7, 2018, of the State Bank on approval of the development project. Green bank in Vietnam, Accordingly, the main objective is to increase the awareness and social responsibility of the banking system for environmental protection, combat climate change, and gradually greening banking operations. The banks' direct credit capital into sponsoring environmentally friendly projects, promoting green production, service and consumption industries, clean energy and renewable energy, and actively promoting green growth and sustainable development.

Striving to 2025, 100% of construction banks will have internal environmental and social risk management regulations in credit granting activities, and 100% of banks will carry out a socio-environmental risk assessment in the future. Besides, credit-giving activities; applying environmental standards to projects financed by banks; incorporating an ecological risk assessment as part of a bank's credit risk assessment step by step greening banking activities, directing credit capital flows to finance environmentally friendly projects, promoting green production, service and consumption industries, clean energy and renewable energy; actively contribute to promoting green growth and sustainable development. Striving to 2025, 100% of construction banks will have internal environmental and social risk management regulations in credit granting activities, and 100% of banks will carry out a socio-environmental risk assessment in the future.

Credit granting activities; apply environmental standards to projects financed by banks; incorporate an ecological risk assessment as part of a bank's credit risk assessment step-by-step greening banking activities. Directing credit capital flows to finance environmentally friendly projects, promoting green production, service and consumption industries, clean energy, and renewable energy actively contributes to green growth and sustainable development. By 2025, 100% of construction banks will have internal environmental and social risk management regulations in credit granting activities, and 100% of banks will carry out a socio-environmental risk assessment in the future.

Credit granting activities; apply environmental standards to projects financed by banks; incorporate an environmental risk assessment as part of a bank's credit risk assessment. Clean energy and renewable energy; actively promote green growth and sustainable development. Credit granting activities; apply environmental standards to projects financed by banks; incorporate an ecological risk assessment as part of a bank's credit risk assessment, clean energy, and renewable energy; actively contribute to promoting green growth and sustainable development. Apply environmental standards to projects financed by banks; incorporate an environmental risk assessment as part of a bank's credit risk assessment. Apply environmental standards to projects funded by banks; include an environmental risk assessment as part of a bank's credit risk assessment.

Vietnam's recent efforts to promote green banking development have mainly focused on forming a legal framework for green banking development. Encourage green credit; require banks to develop frameworks, standards, and implement environmental and social risk management in lending operations; and some incentives for commercial banks and credit institutions to perform banking greening operations. To improve the capacity of banks and credit institutions in the assessment and appraisal of green investment projects, in which capacity building for credit officers and research to establish a specialized department in the bank on green investment, building specialized financial products and tools to support green investment. Sustainable economic development is a common development trend in countries around the world. Along with the goal of green and sustainable growth, the construction and development of a green bank in Vietnam is an urgent requirement. Green banking is an essential strategy in the sustainable development orientation of the banking system. The authors continued the analysis of descriptive statistics and Cronbach's alpha for factors affecting green banking development in Vietnam.

3.2 Analysis of descriptive statistics and Cronbach's alpha for factors affecting the green banking development in Vietnam

Table 1. Testing descriptive statistics and Cronbach's alpha for the green banking development

Code	*Items*	*Cronbach's alpha*	*Mean*	*Std. Deviation*
Quality of human resources (NNL)		**0.964**	-	-
NNL1	Socially responsible human resources in green banking development	0.942	3.086	0.988
NNL2	Policy to attract and select high-quality human resources to realize the goal of green banking development	0.963	3.082	1.000

NNL3	Human resources ensure flexibility and creativity in implementing green banking	0.959	3.112	0.969
NNL4	Human resources ensure the knowledge, skills, and professional ethics to meet the development of green banks	0.946	3.083	1.005
	Marketing strategy (MK)	**0.957**	-	-
MK1	Increasing equity to meet capital needs for green credit growth	0.811	3.386	0.877
MK2	Improve credit quality to meet green banking development goals	0.812	3.515	0.967
MK3	Diversify green products and services to meet integration and environmental protection	0.844	3.332	0.981
MK4	Ensure good liquidity for green consumer credit, green projects	0.806	3.388	0.913
	Financial capacity (TC)	**0.955**	-	-
TC1	Increasing equity to meet capital needs for green credit growth	0.935	3.046	0.974
TC2	Improve credit quality to meet green banking development goals	0.947	3.063	0.984
TC3	Diversify green products and services to meet integration and environmental protection	0.944	3.096	0.944
TC4	Ensure good liquidity for green consumer credit, green projects	0.936	3.077	0.978
	Banking technology (CN)	**0.964**	-	-
CN1	Building and implementing a digital transformation strategy	0.947	3.076	0.979
CN2	Investing in information technology infrastructure, applying new and modern technologies	0.963	3.061	1.004
CN3	Expanding international cooperation on digital banking and with modern technology	0.955	3.105	0.963
CN4	Invest, build and complete electronic payment infrastructure for all transactions	0.943	3.102	0.977
	Risk management (RR)	**0.958**	-	-
RR1	Completing the organizational structure, apparatus, and risk management process according to international standards	0.938	3.059	0.989
RR2	Completing the entire system information database system	0.950	3.063	0.999
RR3	Applying digital technology to strengthen risk management capacity	0.951	3.096	0.964
RR4	Develop methods to measure, assess and identify risks	0.940	3.072	1.003
	Legal framework (PL)	**0.949**	-	-
PL1	Detailed and clear regulations on green bank development criteria	0.940	3.400	0.946
PL2	Clear and detailed regulations on mechanisms and policies to encourage the development of green banks	0.895	3.334	0.957
PL3	Develop mechanisms and policies to support green development capital	0.941	3.275	0.995
	Supporting policies (HT)	**0.918**	-	-
HT1	Capital support policy encourages banks to develop green capital	0.917	2.353	0.655
HT2	National Green Development Fund to mobilize capital for green development	0.895	2.426	0.676
HT3	Appropriate interest rate policy when implementing green projects, green consumption	0.918	2.388	0.646
HT4	Develop processes and regulations on risk prevention in green projects	0.881	2.438	0.699
HT5	Develop mechanisms and policies for coordination among banks in green development	0.885	2.448	0.710
	Environmental policy (MT)	**0.881**	-	-

MT1	Preferential loan interest policy for environmental protection projects	0.855	2.352	0.653
MT2	Reducing the required reserve ratio for the portion of funds for green credit development	0.823	2.442	0.669
MT3	Incentives, refinancing, rediscounting for the purpose of environmental protection	0.869	2.395	0.649
MT4	Prioritize terms and sources of loans for green projects and green consumption	0.843	2.459	0.707
Green bank development (PTNHX)		**0.952**	-	-
PTNHX1	Deploying electronic services and automation for green economy goals	0.943	3.425	0.937
PTNHX2	Prioritize lending or investing in green projects to protect the environment	0.901	3.368	0.948
PTNHX3	Meet environmental and social responsibility criteria	0.944	3.323	0.970

Source: Authors collected and processed from SPSS 20.0

Table 1 tests the reliability of the scale, including eight independent factors (1) Quality of human resources (NNL), (2) Marketing strategy (MK), (3) Financial capacity (TC), (4) Banking technology (CN), and (5) Risk management (RR), (6) Legal framework (PL), (7) Supporting policies (HT) and (8) Environmental policy (MT). Besides, table 1 shows that Cronbach's alpha for various factors affecting green banking development is higher than 0.7.

Table 2. Testing critical factors affecting the green banking development

Relationships			Standardized estimate	S.E	C.R	P	Result
PTNHX	<---	NNL	0.091	0.023	3.349	***	Accepted
PTNHX	<---	HT	0.089	0.045	3.123	0.002	Accepted
PTNHX	<---	PL	0.077	0.030	2.999	0.003	Accepted
PTNHX	<---	TC	0.081	0.025	2.880	0.004	Accepted
PTNHX	<---	CN	0.533	0.028	17.833	***	Accepted
PTNHX	<---	RR	0.087	0.028	2.914	0.004	Accepted
PTNHX	<---	MT	0.083	0.047	4.218	***	Accepted
PTNHX	<---	MK	0.154	0.031	4.991	***	Accepted

Source: Authors collected and processed from SPSS 20.0, Amos

Table 2 shows eight factors affecting green banking development, with a significance level of 0.01. The article's novelty is finding out the banking technology factor that substantially impacts green banking development, with a standardized estimate of 0.533. Testing for various factors affecting green banking development showed that the assessment of the critical factors affecting green banking development: CMIN/DF = 3.389 (<5.0), GFI = 0.903 (>0.800), TLI = 0.956 (>0.900), CFI = 0.963 (> 0.900) and RMSEA = 0.053 (<0.08). The article aims to determine the eight factors affecting green banking development in Vietnam, especially the banking technology factor, which is the most important.

Table 3. Testing Bootstrap 60.000 samples for factors affecting the green banking development

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
PTNHX	<---	NNL	0.022	0.000	0.077	0.000	0.001
PTNHX	<---	HT	0.044	0.001	0.141	0.002	0.001
PTNHX	<---	PL	0.034	0.001	0.084	-0.006	0.004
PTNHX	<---	TC	0.024	0.001	0.068	-0.004	0.003

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
PTNHX	<---	CN	0.039	0.001	0.493	-0.001	0.001
PTNHX	<---	RR	0.032	0.001	0.082	0.002	0.002
PTNHX	<---	MT	0.044	0.001	0.193	-0.006	0.005
PTNHX	<---	MK	0.035	0.001	0.152	-0.002	0.003

Source: Authors collected and processed from SPSS 20.0, Amos

Table 3 shows that testing Bootstrap with 60.000 samples for factors affecting the green banking development, with a significance level of 0.01.

3.3 Result discussion

Vietnam's recent efforts to promote green banking have mainly focused on forming a legal framework for development. Vietnam should encourage green credit, require banks to develop frameworks and standards, implement environmental and social risk management in lending operations, and provide some incentives for commercial banks and credit institutions to perform banking greening functions, specifically:

First is the green investment or the establishment of green financial intermediaries and the development of indirect green capital channels. The gradual forming of a legal framework for green banking development in Vietnam. The basis for implementing green banking activities in Vietnam is the National Green Growth Action Plan for 2014 - 2020. The State Bank is assigned the task of perfecting the institutions and strengthening the financial-credit operation capacity of commercial banks for green growth. However, these regulations are only intended to encourage, encourage and promote the development of green banking through the enhancement of green capital sources and green capital mobilization tools, not paying attention to policies on green banking. The banks increase demand for green credit, and approaches to support green credit access for businesses, such as incentives on interest rates, taxes, fees, loan procedures, and collateral, need to be done in parallel. To create an environment for businesses to invest in green projects, it is necessary to continue to reform administrative procedures and create a transparent and favorable investment environment to reduce the risks of green projects.

Secondly, Vietnam should encourage to development of green credit. The policy to promote green recognition was mentioned for the first time in Resolution No. 24-NQ/TW dated June 3, 2013, of the 7th Plenum of the 11th Central Committee on climate change combat, resource management, and protection. Promoting green growth and managing environmental risks in credit-granting activities, which requires credit institutions. Environment and green growth orientation. Focus on giving priority to granting green credit to some economic sectors. Continue to improve the legal framework, preferential policies, and support mechanisms to encourage the development of green banking. The definition of a green bank or the nature, characteristics, and criteria to be labeled a "green bank" should be clearly stated in the legal regulations, creating a basis and basis for the issuance and application of such facilities.

Thirdly, Government should require banks to develop frameworks and standards and implement environmental and social risk management in lending operations. In 2018, the State Bank of Vietnam (SBV) cooperated with the International Finance Corporation (IFC) to develop and issue the "Handbook of environmental and social risk assessment" for 10 economic sectors in credit extension activities. Accordingly, the 10 sectors are agriculture, chemicals, construction and infrastructure, energy, food processing, textiles, oil and gas, waste treatment, mining, and products from non-metallic minerals. Without a specialized green bank, the Government needs to create a legal mechanism, rules, and environment for banks to develop motivation and bind the banking system to green growth and sustainable development.

Fourthly, Vietnam has preferential/supportive policies for banks that lend to environmentally and climate sensitive areas, such as offering preferential loans, applying low-interest rates, or providing interest rate differentials. In the past period, the green credit program has been integrated by the SBV into some legal documents. The Government encourages banks to apply high technology in agricultural and rural

development, increasing the total outstanding loans for banks. Banks with a large balance of green credit use reduction of funding interest rates for banks, perform good environmental risk assessment when granting credit, and increase requirements on required reserve ratio and liquidity for banks that lend to projects with significant loss and damage to the environment.

Finally, The Government should organize training, training, and seminars to exchange experiences and knowledge on green banking development to strengthen the capacity of commercial banks and financial institutions in green finance-credit activities. In the past, the State Bank and IFC have coordinated to organize training for key staff on environmental and social risk management and credit appraisal at credit institutions, building a team of lecturers with knowledge and skills. , understanding of green credit and environmental-social risk management. Vietnam Banks Association has organized many seminars, training courses, green finance, sustainable development, and environmental and social risk assessment in operations credit. The Vietnam Banks Association also compiles and publishes the book Banking and Sustainable Development to disseminate to its member organizations.

Although some initial results on green banking development have been achieved, promoting green banking development in Vietnam still reveals many issues that need to be addressed: The legal framework on green banking has not been completed and supplemented under the international context and good practices. At present, the primary green banking regulations are still directional. There is still a lack of specific rules, no unified definition/concept of green banking, and a lack of banking standards/conditions for green goods.

CONCLUSIONS

The banking industry has been participating in the global trend of sustainable development due to its significant role in economic life. Besides several problems posed during the development of green banks in Vietnam over the past, in the coming period, promoting the development of green banks is also facing many challenges, such as The capacity of banks in the assessment and appraisal of green investment projects is still limited. Although more and more banks are interested and integrated with building the process of environmental and social risk assessment when granting credit, the implementation capacity is still limited. Besides, green investment projects always have potential risks, and feasibility is not high.

The paper's primary objective is to explore determinants affecting green bank development in Vietnam. In contrast, the Government does not have concepts, regulations, standards/conditions on the list of green industries/fields, leading to difficulties and challenges for commercial banks and credit institutions in the process of implementing the process of selecting, appraising, evaluating, and monitoring green credit activities. The authors severed the data from developing a formal survey for the research topic with 950 surveyed officers and employees related to 15 commercial banks and used structural equation modeling (SEM) and SPSS 20.0, Amos software.

The paper finds eight factors affecting the green bank development in Vietnam with a significance level of 0.01, and all eight hypotheses are accepted. The article's value determines the legal framework's most substantial impact on green bank development. The results of the research model are determined according to the standardized Beta coefficient, including (1) Quality of human resources (NNL), (2) Marketing strategy (MK), (3) Financial capacity (TC), (4) Banking technology (CN), and (5) Risk management (RR), (6) Legal framework (PL), (7) Supporting policies (HT) and (8) Environmental policy (MT) focus on performing well the following specific vital tasks. The article's value determines the Banking technology's most substantial impact on green bank development. Finally, the authors had important recommendations for improved banking technology and the goal of green and sustainable growth. Thus, the Bank's leadership improves the capacity of banks and credit institutions in the assessment and appraisal of green investment projects, in which capacity building for credit officers and research to establish a specialized department in the bank on green investment, building specialized financial products and tools to support green investment.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Musyaffi, A.M., Baxtishodovich, B.S. Johari, R.J., Wolor, C.W., Afriadi, B., Muna, A. (2024), "Can Financial Advantages and Digital Payments Adoption Provide Effective Solutions to Improve SMEs' Performance?",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 75-89.

Can Financial Advantages and Digital Payments Adoption Provide Effective Solutions to Improve SMEs' Performance?

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ARTICLE INFO

Received January 21, 2022
Revised from February 22, 2023
Accepted March 22, 2023
Available online April 15, 2024

JEL classification: 033, M15, M21, M31

DOI: 10.14254/1800-5845/2024.20-2.7

Keywords:

Digital payment,
financial advantage,
SMEs performance,
satisfaction,
technology adoption.

ABSTRACT

The impact of COVID-19 has affected all industries, including SMEs. Digitalization is increasing, so it requires SMEs to adapt. This study's goal is to gain a general understanding of merchant acceptability of the digital payments through the integration of the TAM, Information system success and ECT. The target of this research is SMEs that use digital payments in Indonesia. By using accidental sampling, 342 respondents were obtained. Then, Data were analyzed using SEM-PLS. The main finding show that SMEs satisfaction (SMS) is the most significant factor in improving the performance of SMEs (SP). All TAM constructs, such as perceived usefulness (PUD), perceived ease of use (PEOD) and intention to use digital payment (IUDP), are confirmed to have significant interrelationships. Financial advantage (FA) in this study also has a positive relationship with IUDP. Meanwhile, digital payment quality (DPQ) also relates to PUD and IUDP. Meanwhile, DPQ, PUD, and PEOD were confirmed to have a relationship with SMS. The results of this study also illustrate that FA does have a positive impact, but the contribution of SMEs satisfaction has the most impact in improving the performance of SMEs. So it is crucial to evaluate the satisfaction of SMEs both in terms of quality and features, convenience, and security of digital payment technology. To increase awareness, Digital payment service providers should focus on the system's use and safety. so that SMEs can use digital payment services comfortably. In addition, from the government aspect, it also improves the cashless climate by making supportive policies, such as increasing financial literacy for SMEs and increasing standardized data security.

INTRODUCTION

The Covid-19 has evolved the awareness of companies to collaborate with digital tools. Various companies have steadily increased the efficiency of business operational through digitization in order to secure business sustainability (Heredia et al., 2022). Technology adoption in SMEs is considered an important strategy to improve performance. Several studies present that digital capabilities can have a positive impact by reducing costs and increasing flexibility (Heredia et al., 2022), the more digital resources are used in business processes, the more the impact on the development of more effective strategies. Heredia et al. (2022) added that the concept of the collaboration economy had allowed the wide use of digitalization by decreasing cost, expenses, and boosting performance. This study demonstrates the importance of digital capabilities to the global economy. One of them is the achievement achieved by SMEs.

SMEs are a significant industry to drive the world economy. This is evidenced by the Asian Development Bank, which presents economic growth in Southeast Asia over the last 10 years, supported by SMEs (ADB, 2020). However, the entry of the Covid-19 pandemic in 2020 worsened global trade in almost all countries worldwide. Nevertheless, in many ways, SMEs provide fresh air in the world of trade; SMEs contribute significantly to economic recovery in Asia, a developing country. The COVID condition has changed consumer habits to make purchases without going through physical contact. One is digital payment through various platforms such as mobile banking and mobile wallet. Research conducted by Visa states that 80% of consumers tend to be motivated to make payments online compared to paper money (Visa, 2020). The research also stated that 54% of SMEs revealed an increase of 15% since adopting digital payments (Visa, 2020). In addition, the existence of digital payments also creates security problems. There is an inherent risk attached to technology, including digital payments. Even before the pandemic, the risk of fraud in digital payments increased (Mikkelsen et al., 2022).

ADB (2020) also reviews the condition of SMEs in Indonesia. Based on 2019 data, SMEs accounted for 99.9% of the total companies across the archipelago. The trading pattern that dominates these SMEs is traditional wholesale and retail. It is undeniable that most SMEs still prefer the traditional way through personal contact, but digital technology has come to grow SMEs. Through the help of technology-based start-up companies, SMEs are more prominent in the Indonesian economy. The Indonesian Ministry of Industry has also issued an E-Smart IKM Indonesia program to support the advancement of SMEs since 2018. The same thing has happened in Southeast Asia, such as the SMEs eCommerce Adoption Acceleration program in Malaysia, the Philippines digital jobs program, and the Singapore Go Digital SME program.

Previous research has widely used the TAM to look at adoption in various fields, including digital payments (Mikkelsen et al., 2022; Musyaffi et al., 2021). The researchers agree that TAM can measure the level of acceptance comprehensively. One of the crucial elements in TAM is usefulness and ease of use. Both constructs act as predictors in making users adopt technology (Abdullah & Toycan, 2017). Users will use technology when it has the quality offered according to user needs (Aparicio et al., 2019). In expectation confirmation theory (ECT), it is revealed that one of the essential elements in making someone adopt technology is because they are already satisfied with the features and facilities offered (Niu et al., 2021). The more satisfied a person is with using technology, the more likely he or she will use the technology continuously according to the user's needs (Qalati et al., 2021). As a result, the performance of SMEs will increase because digital payments can facilitate SMEs, especially in company operations. Based on this explanation, this study aims to determine the performance of SMEs as measured by the adoption of digital payment technology. Therefore, this research can contribute to the technology adoption theory through TAM, IS success model and ECT.

1. LITERATURE REVIEW

In carrying out their daily operations, SMEs need to be supported by technology to improve their business performance. However, the technology must have ease of use and features that meet the needs of SMEs. In TAM theory, usefulness and ease of use allow users to get great benefits from using technology. TAM theory allows it to be measured in various types of technology used, including digital payments (Franque et al., 2021; Musyaffi et al., 2021). The technological context in this study refers to digital payments where users can carry out business operational transactions through online payments.

1.1 Perceived Ease of Use (PEOD)

PEOD in this study is the convenience users feel when using digital payments in business operations. The simpler a technology is to utilize, the often users adopt the technology. The increase in convenience shows that the process of acceptance of use is improving. Previous research says that ease of use has a significant role in usefulness, especially in using technology (Musyaffi, Johari, et al., 2022). The easier it is for SMEs to use digital payments; the more SMEs feel that digital payments have the features and facilities that SMEs need. So, when the impact generated by digital payments can increase company efficiency, these users will feel satisfied, allowing SMEs to continue using digital payments for daily business operations. Previous research has proven that the PEOD has a significant positive impact on user satisfaction with a technology (Ashfaq et al., 2020; Musyaffi, Sulistyowati, et al., 2022).

H1: PEOD has a significant and relatively positive to PUD

H2: PEOD has a significant and relatively positive to SMS

H3: PEOD has a significant and relatively positive to IUDP

1.2 Perceived Usefulness (PUD)

Perceived usefulness is seen as one of the most critical indicators in making someone use technology for their business activities (Musyaffi et al., 2021). Because technology users, especially SMEs, are concerned with the main features and usability to increase the effectiveness of their business. So that makes SMES satisfied with the technology. Technology has many advantages for SMEs. For example, a fast data input and report output process can increase satisfaction with the technology (Haddara et al., 2022; Qalati et al., 2021). In addition, the use of technology can also reduce costs and improve security quality. These key factors make perceived usefulness a strong predictor of adopting technology (Musyaffi, Johari, et al., 2022). So that when the technology used has the required features, users will tend to adopt the technology, as previous literature shows that usefulness has a close positive relationship to satisfaction and behaviour to continuously use technology (Ashfaq et al., 2020; Franque et al., 2021; Musyaffi, Johari, et al., 2022).

H4: PUD has a significant and relatively positive to SMS

H5: PUD has a significant and relatively positive to IUDP

1.3 Security (SCR)

User perceptions of the security of technology adoption can have negative and positive sides (Chang, 2020) that can motivate other SMEs to adopt technology (Christiansen et al., 2022). Therefore, previous literature reveals how vital the security of technology provided by vendors is so that users can continue to adopt technology (Johnson et al., 2020; Musyaffi, Johari, et al., 2022). When users feel safe against the risks of technology used, they will tend to adopt it. Previous literature states that security significantly influences the continuity of user adoption of the technology (Hanif & Lallie, 2021; Johnson et al., 2020).

H6: SCR has a significant and relatively positive to IUDP

1.4 Digital Payment Quality (DPQ)

Digital payment quality (DPQ) in this study is the level of effectiveness and efficiency in using the digital payment. The quality of a system shows the superiority of the output of the technology itself (Ebnehoseini et al., 2021). The quality of technology can be seen from the response time, and good navigation tools (Abdullah & Toycan, 2017; Musyaffi, Sulistyowati, et al., 2022). By using digital payments, SMEs can gain experience operating a business more effectively and efficiently. So, it can reduce operational costs. This is evidenced by previous research results where the usefulness of information technology can be explained by the quality of the technology (Musyaffi, Johari, et al., 2022). Therefore, the higher the quality of the

digital payment platform used, the higher the satisfaction of SMEs with using digital payments (Bossman & Agyei, 2022; Musyaffi, Johari, et al., 2022). Also, the quality of a system can increase a person's adoption use the technology more frequently (Alrousan et al., 2021; Musyaffi, Sulistyowati, et al., 2022). So the seventh, eighth and ninth hypotheses in this study are:

H7: DPQ has a significant and relatively positive to PUD

H8: DPQ has a significant and relatively positive to IUDP

H9: DPQ has a significant and relatively positive to SMS

1.5 Financial Advantage (FA)

Financial advantage refers to the user's advantages in digital payments, including cost savings and payments (Chang, 2020). The existence of financial benefits allows SMEs to adopt digital payments by utilizing promotions or utilizing digital payment differentiation. So that users can make digital payments with various types of platforms, financial advantage is one of the main factors in making users, especially SMEs, decide to use technology in their daily business operational (Christiansen et al., 2022).

H10: FA has a significant and relatively positive to IUDP

1.6 SMEs Satisfaction

In using technology, user satisfaction is crucial to pay attention to continuously attracting users to use technology (Musyaffi et al., 2021). The more satisfied the use of technology, the level of technology adoption tends to increase (Qalati et al., 2021). User satisfaction also has positive and negative sides when used in everyday life. Digital payments can have a good impact when used to increase the effectiveness and efficiency of the company. When SMEs feel that using digital payments can help their daily business operations, they tend to use digital payments. As a result, SMEs will tend to recommend digital payments to consumers and others. The relationship between user satisfaction and user adoption has been carried out by previous literature, especially those related to technology (Bossman & Agyei, 2022; Liébana-Cabanillas et al., 2020). SMEs who are satisfied with the features and convenience of digital payments will create a positive perception of digital payments that can make SMEs use continuously and improve SMEs' performance optimally (Musyaffi, Sulistyowati, et al., 2022; Niu et al., 2021).

H11: SMS has a significant and relatively positive to IUDP

H12: SMS has a significant and relatively positive to SP

1.7 Intention to use digital payment (IUDP)

Performance is defined as one of the critical goals of business organizations to achieve goals. Effective adoption and integration of technology into the company will increase the company's added value in improving performance in general (Ilmudeen et al., 2019). The adoption of the use of technology in SMEs, if used correctly, can improve the overall performance of SMEs. SMEs can provide goods and services that can be accessed and paid for online transactions. So it is very profitable for SMEs because there is no need to recruit new employees. In addition, system implementation can help organizations improve operational performance; for example, it can save costs and time (Thathsarani & Jianguo, 2022). SMEs can provide goods and services that can be accessed and paid for online transactions. So it is very profitable for SMEs because there is no need to recruit new employees. In addition, system implementation can help organizations improve operational performance; for example, it can save costs and time. Implementing technology for SMEs is also helpful for decision-making, especially in optimizing the core business of SMEs so that they can increase revenue and minimize operational costs (Khayer et al., 2020). This statement is supported by previous research showing that technology adoption can significantly improve SMEs' performance (Garrison et al., 2015; Ooi et al., 2018).

H13: IUDP has a significant and relatively positive to SP

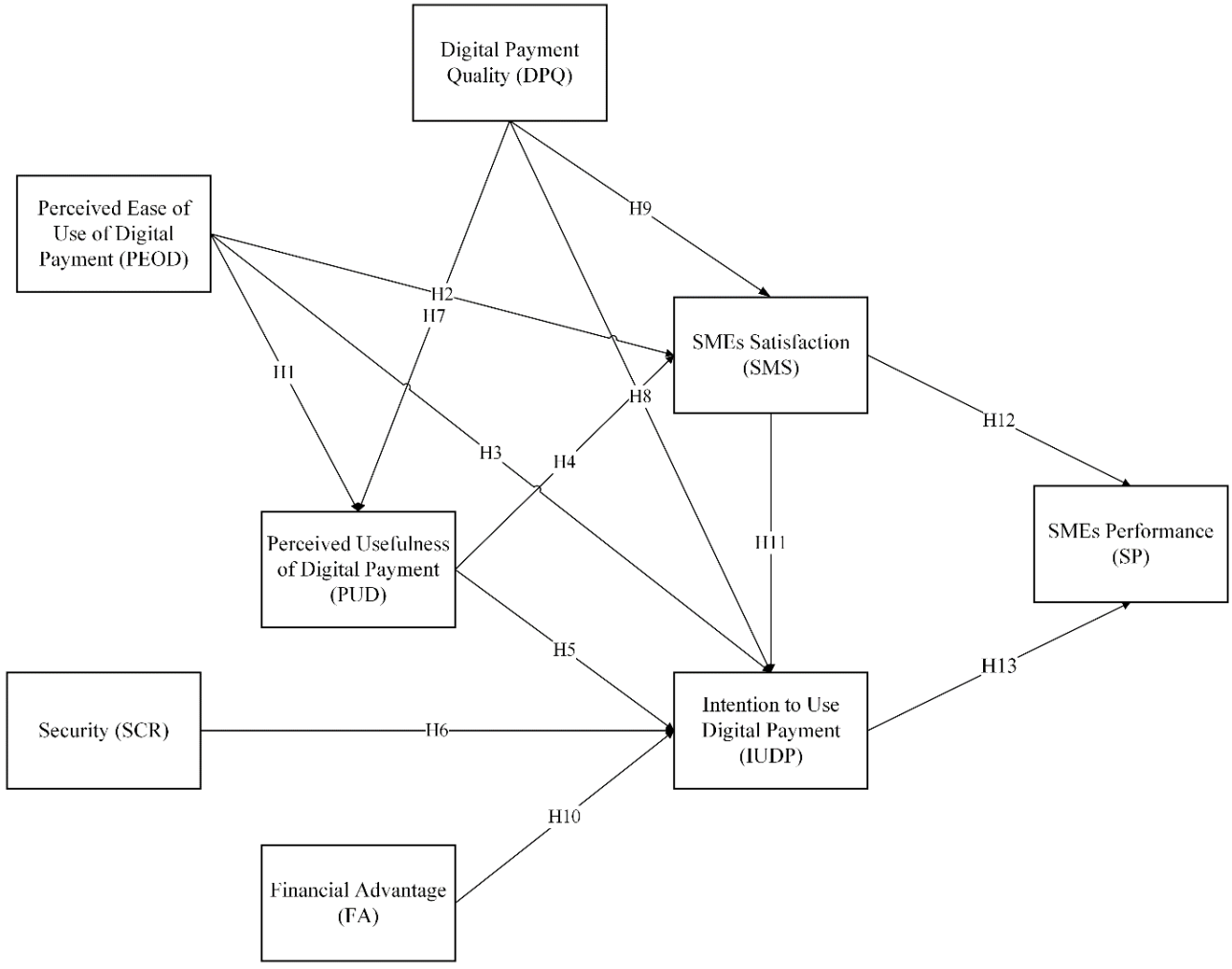

Figure 1. Research Model

Source: own

2. METHODOLOGY

2.1 Research Design

This research targets SMEs managers or employees in Indonesia who use digital payment as a payment method in their daily operational activities. This study uses non-probability sampling using the accidental sampling method, with respondents responding to the questionnaire based on their availability and interest (Gravetter & Forzano, 2018) when asked to fill out the questionnaire. After that, the number of respondents was 342. We chose the sampling method because it is faster and easier to use. Accidental sampling is also commonly used in data collection related to technology adoption (Khayer et al., 2020). We distributed 432 questionnaires, but only 342 questionnaires were possible to use or 79.17%. The results of collecting respondents based on gender, age, business ownership, and type of business. Most respondents in this study were male at 66.4%, while the female was 33.6%. Then based on age category, the majority were in the age range of 31 – 40 years (54.1%). This study's SMEs respondents were self-employed (92.1%). Meanwhile, SMEs in this study were dominated by the fashion industry (38%), innovative products (22.5%), and culinary (18.1%).

Table 1. Respondent characteristic

		N	*Percentage*
Gender	Male	202	66.4%
	Female	140	33.6%
Age	<25	0	0
	25 – 30	48	14.04%
	31 – 40	185	54.1%
	41 – 50	85	24.9%
	>50	24	7.02%
Business Ownership	Business owner	315	92.1%
	Employee	14	4.09%
	Owner and employee	13	3.8%
Type of business	Culinary	75	18.1%
	Fashion	143	38.0%
	Automotive	23	6.7%
	Creative products	110	22.5%
	Internet technology	26	7.6%
	Beauty	24	7.0%

2.2 Instrument

This research questionnaire consists of 32 question items regarding the acceptance of digital payments on the performance improvement of SMEs. The questionnaire in our study consisted of numbers 1 to 5, adopting a Likert scale. A value of 1 when the respondent answered firmly disagreed and 5 when the respondent answered strongly agreed. Each question in this study refers to an adaptation of previous research. Questionnaire items from the PUD, PEOD and IUDP constructs each consist of 4 questions adapted from several sources (Musyaffi, Johari, et al., 2022). At the same time, the DPQ questions were adapted from system quality derived from the Delone & Clean information success model with a total of 4 questions (Musyaffi, Sulistyowati, et al., 2022). The financial advantage item consists of 4 questions adapted from (Chang, 2020). Then the security item was adapted from various researchers (Hanif & Lallie, 2021), which consisted of 4 questionnaire items. While other variables also have 4 question items adapted from various researchers, namely SMEs performance (Isaac et al., 2017) and SMEs satisfaction (Musyaffi, Sulistyowati, et al., 2022).

2.3. Data Analysis

To answer the research problem, the author uses SEM PLS as an analytical tool to evaluate the dataset that has been collected. PLS is very appropriate because it can model a relatively new research theory. This follows this research where the author integrates several frameworks of thought, namely TAM, ECT and IS success model with financial advantage and security variables as extension variables. There are several stages in analyzing PLS: measurement models, structural models and hypothesis testing (Hair & Alamer, 2022). In analyzing the measurement model, researchers evaluate reliability through outer loading, and CR. In comparison, the validity evaluation is through the analysis of CA and AVE. Then testing the model structure is done by evaluating R square, f square, path coefficient, and Q square. The evaluation of hypothesis by comparing the predetermined error rate with the PLS output, namely the p-value.

3. RESULT

3.1 Measurement Model

The validity of the data is indicated by the AVE value and outer loading. The minimum outer loading value must meet 0.7 and AVE value must meet 0.5 (Hair & Alamer, 2022). According to table 2, the outer loading value for all constructs has the lowest value (0.75) (SP4) and the highest value of 0.909 (SCR2). thus, the data in this study has good validity.

Meanwhile, the reliability of the data is shown by evaluating the CA and CR values with a suggested value greater than 0.70 (Hair & Alamer, 2022). The highest CA value is owned by the security construct (SCR) of 0.903. while the lowest CA value was owned by IUDP of 0.859 (CA> 0.7). Meanwhile, based on the value of A, the lowest value comes from security (ρA=0.907) and IUDP (ρA=0.859) which means it has a value above the standard, which is 0.7. Another way to evaluate reliability is with CR. The highest CR is in the security of 0.932. in contrast, the smallest CR is in the SP of 0.901. it means that the CR value is greater than the standard, which is 0.7. so that all constructs meet reliability if based on CR evaluation. Therefore, based on the evaluation of CA, CR, and A, all constructs have good reliability.

Table 2. Result of discriminant validity

Item	*Questioner*	*Outer loading*	*CA*	*Dijkstra–Henseler's rho (ρA)*	*CR*	*AVE*
	Perceived ease of use of Digital Payment (PEOD)		0.886	0.889	0.921	0.745
PEOD1	Digital payments can be utilized anywhere and at any time.	0.858				
PEOD2	The digital payment platform that I use has a straightforward and easy-to-understand display	0.872				
PEOD3	The digital payment platform is easy to use for my business operations	0.854				
PEOD4	I feel that the digital payment platform can be quickly learned	0.869				
	Perceived Usefulness of Digital Payment (PUD)		0.880	0.887	0.917	0.735
PUD1	The digital payment platform that I use has more advantages compared to traditional transactions	0.848				
PUD2	Using digital payments, I can see the input and output of transaction information quickly	0.897				
PUD3	I like the use of digital payment because it has attractive features and appearance	0.857				
PUD4	By using digital payment, I can manage my business transactions more flexibly	0.826				
	Security (SCR)		0.903	0.907	0.932	0.774
SCR1	The digital payment platform has strong security	0.871				
SCR2	The digital payment platform has the facility to verify the user's identity	0.909				
SCR3	The digital payment platform protects data from users	0.833				

SCR4	When using digital payment, there is a password that the user has created	0.905				
	Digital Payment Quality (DPQ)		0.863	0.869	0.907	0.710
DPQ1	The interface and display on the digital payment platform are comfortable to look at	0.883				
DPQ2	The use of the digital payment platform is easy to navigate in conducting business transactions	0.842				
DPQ3	I find features and services that suit my business when using digital payments	0.862				
DPQ4	In business operations, I feel that using digital payments is convenient because it suits my needs	0.778				
	Financial Advantage (FA)		0.900	0.902	0.926	0.715
FA1	Digital payments can reduce employee recruitment costs in operating technology (e.g., cashiers who operate computers, software development, and maintenance)	0.825				
FA2	Digital payments can make customers pay for their own needs using digital payment methods (for example, account creation, data storage, and processing time)	0.882				
FA3	Digital payments can allow customers to take advantage of various structured payments (monthly or annually).	0.866				
FA4	The use of digital payments can make me superior because I have invested in business infrastructure	0.808				
	SMEs Satisfaction (SMS)		0.868	0.870	0.910	0.717
SMS1	I am satisfied with digital payment because the information displayed is correct	0.863				
SMS2	When using the digital payment platform, I am satisfied with the digital payment output so that business transactions run smoothly	0.874				
SMS3	I am satisfied with digital payment because it can provide complete information	0.808				
SMS4	Overall, I am satisfied with all the features and benefits of digital payment in meeting my business needs	0.841				
	Intention to use Digital Payment (IUDP)		0.859	0.859	0.904	0.703
IUDP1	I intend to use digital payments continuously because it is helpful for my business	0.872				
IUDP2	I try to use digital payment when doing business transactions	0.852				
IUDP3	I quite often use digital payments in my business transactions	0.841				

IUDP4	I recommend digital payment to others	0.787				
	SMEs Performance (SP)		0.853	0.864	0.901	0.695
SP1	My business decisions become more effective when viewing transaction reports from digital payments	0.839				
SP2	Digital payments in my store can increase customer loyalty	0.868				
SP3	Digital payments in my store can increase the number of consumers who buy	0.872				
SP4	Digital payment can improve my business reputation	0.750				

Table 3. Fornell–Larcker criterion

	DPQ	*FA*	*IUDP*	*PEOD*	*PUD*	*SP*	*SMS*	*SCR*
Digital Payment Quality (DPQ)	0.842							
Financial Advantage (FA)	0.290	0.845						
Intention to Use Digital Payment (IUDP)	0.553	0.483	0.839					
Perceived Ease of Use of Digital Payment (PEOD)	0.700	0.393	0.601	0.863				
Perceived Usefulness of Digital Payment (PUD)	0.565	0.489	0.612	0.641	0.858			
SMES'S Performance (SP)	0.597	0.520	0.677	0.629	0.552	0.834		
SMEs Satisfaction (SMS)	0.580	0.565	0.694	0.654	0.634	0.732	0.847	
Security (SCR)	0.666	0.485	0.505	0.557	0.429	0.590	0.598	0.880

The subsequent stage in determining discriminant validity is the application of the Fornell–Larcker criterion. The standard for measuring this value is that the value of root AVE must be greater than the other values. For example, DPQ to DPQ has the highest value (0.842) compared to DPQ with other constructs such as FA (0.290), IUDP (0.553), PEOD (0.700), PUD (0.565), SP (0.597), SMS (0.580), and SCR (0.666). Thus, DPQ meets the criteria of Fornell-larcker. If you look at table 2 above, the root square AVE values between variables are DPQ – DPQ (0.842), FA – FA (0.845), IUDP – IUDP (0.839), PEOD – PEOD (0.863), PUD – PUD (0.858), SP – SP (0.834), SMS – SMS (0.847), and SCR – SCR (0.880), it can be concluded that all AVE square root values have the highest value compared to the construct below.

Table 4. Heterotrait-monotrait (HTMT) ratio

	DPQ	*FA*	*IUDP*	*PEOD*	*PUD*	*SP*	*SMS*	*SCR*
Financial Advantage (FA)	0.329							
Intention to Use Digital Payment (IUDP)	0.637	0.548						
Perceived Ease of Use of Digital Payment (PEOD)	0.798	0.435	0.686					
Perceived Usefulness of Digital Payment (PUD)	0.633	0.550	0.700	0.712				
SMES'S Performance (SP)	0.697	0.590	0.789	0.720	0.629			
SMEs Satisfaction (SMS)	0.666	0.636	0.803	0.745	0.720	0.842		
Security (SCR)	0.757	0.539	0.572	0.622	0.475	0.668	0.675	

In addition, the evaluation of discriminant validity can also be done through Heterotrait-monotrait (HTMT). The purpose of the HTMT evaluation is to ensure that no correlation exists. HTMT is said to have no correlation when the value is below 0.9 (Hair & Alamer, 2022). The maximum value for the constructs DPQ (0.798), FA (0.435), IUDP (0.572), PEOD (0.622), PUD (0.475), SP (0.668), and SMS (0.675) does not exceed 0.9.

3.2 Structural Model

Structural model testing aims to find out how the model built by the researcher provides a good model framework. Table 5 below shows the values of Q^2, R^2, and R Square adjusted to show the impact of the model framework created. Predictive relevance (Q^2) assesses the suitability of the model the researcher has built. Evaluation of Q^2 shows sufficient predictive power ($Q^2 > 0$) (Hair & Alamer, 2022). The value of Q^2 ranges from 0.309 to 0.402 (the value > 0). So, it can be concluded that the model built by the researcher is reasonable. Another structural analysis model is to use R Square (R2). The R2 value category is classified based on several categories, namely Substantial (R^2 value 0.75), moderate (R^2 value 0.50), and weak (R^2 value 0.25) (Hair & Alamer, 2022). R^2 value of the IUDP is 0.557, so there is a joint influence between DPQ, PEOD, PUD, PEOD, SCR, and FA with an IUDP of 55.7% or moderate category. While the R2 value of PUD is 0.557, meaning that DPQ and PEOD together affect PUD by 43.7% or in the weak category. The R^2 value of SP is 0.592, meaning there is a mutual influence between INDP and SMS of 59.2%.

Table 5. Structural model evaluation

	Predictive Relevance (Q^2)	*R^2*	*R^2 adjusted*
Intention to Use Digital Payment (IUDP)	0.383	0.557	0.549
Perceived Usefulness of Digital Payment (PUD)	0.309	0.437	0.434
SMES'S Performance (SP)	0.402	0.592	0.589
SMEs Satisfaction (SMS)	0.366	0.519	0.514

F square is used to measure the relationship between path models. The most significant effect size value is on SMS to SP with a value of 0.326 or in the medium category. At the same time, other constructs have minimal effect sizes since their values are less than 0.15.

Table 6. f square

	IUDP	*PUD*	*SP*	*SMS*
Digital Payment Quality (DPQ)	0.011	0.047		0.027
Financial Advantage (FA)	0.012			
Intention to Use Digital Payment (IUDP)			0.135	
Perceived Ease of Use of Digital Payment (PEOD)	0.010	0.210		0.094
Perceived Usefulness of Digital Payment (PUD)	0.036			0.129
SMEs Satisfaction (SMS)	0.123		0.326	

3.3 Hypotheses Testing

This section discusses the hypotheses analysis according to the data processing results. Based on the 13 hypotheses proposed, 12 hypotheses have a positive impact. Meanwhile, there is 1 hypothesis that

does not have a significant impact, namely the 6th hypothesis. The 6th hypothesis talks about the impact of security on IUDP. The p-value of H6 is 0.367 (p-value> 0.1). Thus, security does not have a significant impact with only a 1.9% relationship (original sample (O)=0.019).

The value of the most extraordinary significant association between variables resides in the twelfth hypothesis: SMS to SP by 50.7% (O=0.507). In addition, the p-value in hypothesis 12 is 0.000 (p-value < 0.1). So, SMS significantly impacts the satisfaction of traditional traders with the use of digital payments. Then the second hypothesis also has the second largest significant relationship, 48.1% (o=0.481). Meanwhile, based on trials regarding the positive impact of PEOD on PUD, it was found that the second hypothesis was rejected (p-value = 0.000 < 0.1). In other words, there is a positive and significant impact between PEOD and PUD of 48.1%.

The first hypothesis regarding PEOD with PUD has a p-value of 0.043. when compared with the specified error rate (0.05), PEOD has a large beneficial impact on PUD, amounting to 10.9% of its total (O=0.109). Then in the third hypothesis, the p-value of the relationship between PEOD and SMS is 0.000. then the results of the calculation also support hypothesis 3. Therefore, PUD has a significant positive impact of 32.7% (O=0.327) on SMS. The fourth hypothesis regarding PUD to SMS has a p-value of 0.000 (p-value <0.1). Then the fourth hypothesis on the PUD construct to SMS has a significant positive relationship of 33.2% (O=0.332). Likewise, the fifth hypothesis regarding PUD and IUDP has a significant positive relationship (p-value=0.001, <0.1) of 18.7% (O=0.187). So, DPQ has a significant positive relationship with PUD of 22.8% (O=0.228).

The constructs related to IDUP, namely the eighth hypothesis (p-value=0.45), ten (p-value=0.35), and eleven (p-value=0.000), have p-values smaller than 0.05. So, there is a positive relationship between DPQ (O=0.115), FA (O=0.097), and SMS (O=0.371) with IUDP. In contrast, the ninth hypothesis regarding DPQ to SMS has a p-value below 0.05. So, the presence of DPQ can positively affect SMS by 16.3% (O=0.163). Finally, in testing the thirteenth hypothesis, the p-value of the two hypotheses is below 0.05. So, IUDP and SMS have a positive and significant relationship of 32.6% (O=0.326).

Table 7. Result of hypotheses testing

	Hypotheses	*Path*	*p-value*	*Decision*
H1	PEOD -> IUDP	0.109	0.043	Supported
H2	PEOD -> PUD	0.481	0.000	Supported
H3	PEOD -> SMS	0.327	0.000	Supported
H4	PUD -> SMS	0.332	0.000	Supported
H5	PUD -> IUDP	0.187	0.001	Supported
H6	SCR -> IUDP	0.019	0.367	Not Supported
H7	DPQ -> PUD	0.228	0.001	Supported
H8	DPQ -> IIUDP	0.115	0.045	Supported
H9	DPQ -> SMS	0.163	0.008	Supported
H10	FA -> IUDP	0.097	0.035	Supported
H11	SMS -> IUDP	0.371	0.000	Supported
H12	SMS -> SP	0.507	0.000	Supported
H13	IUDP -> SP	0.326	0.000	Supported

4. DISCUSSION

This research is a development of the results of previous research by adding an extension model in the form of security and financial advantage. This factor is essential because it can affect the performance of SMEs themselves. Previous researchers have proven that financial advantages can increase the company's added value in terms of financial (cost reduction and increased income) and non-financial

(intangible value). The more intuitive and user-friendly a system is, the users will adapt to the new technology, thereby increasing performance directly (Musyaffi et al., 2021).

One thing that makes SMEs adopt digital payments is that they have the required quality. This study indicates that DPQ has a substantial connection with PU (11.5%) and INTD (16.3%). The reason why digital payments are considered quality is that having an interface and display on the digital payment platform is comfortable to look at. In addition, digital payments also have easy navigation when making transactions. This argument is reinforced by other researchers where the quality of technology can be seen from the response time, and easy navigation (Abdullah & Toycan, 2017; Musyaffi, Gurendrawati, et al., 2022). Therefore, it is not surprising that this study reveals a substantial link between DPQ, PU, and INTD. The findings also support the findings of this study by other researchers, who found that the perception of technology's utility increases as its quality increases (Abdullah & Toycan, 2017; Ebnehoseini et al., 2021; Garrison et al., 2015; Musyaffi, Sulistyowati, et al., 2022) and user adoption continuously (Alrousan et al., 2021; Musyaffi, Sulistyowati, et al., 2022)

The use of the right technology, of course, will increase the company's main competencies, whose impact is an increase in performance (Khayer et al., 2020; Musyaffi, Gurendrawati, et al., 2022; Thathsarani & Jianguo, 2022). Most SMEs continue to use digital payments in their daily transactions and operations. One of the features that SMEs like the most is that digital payments have many features in one application, such as payments, e-commerce purchases, credit purchases, electricity and insurance bills, bank transfers, and other features. In addition, digital payment is also straightforward to use because the menu is familiar with similar applications. Other researchers suggest that implementing information technology can increase added value in the company's operational processes (Khayer et al., 2020; Ooi et al., 2018) so that digital payments can accelerate the company's business processes. The easier the system to use, SMEs will think that digital payments are proper (Haddara et al., 2022; Musyaffi, Johari, et al., 2022; Thathsarani & Jianguo, 2022). PEOD has a considerable favorable influence in the relationship with PUD by 48.1%. one of them is because the digital payment platform is straightforward to use to process business transactions.

This research also shows that SMEs are satisfied with digital payments. The more satisfied users are with the technology used, the tendency to use it continuously increases (Ashfaq et al., 2020; Hanif & Lallie, 2021; Liébana-Cabanillas et al., 2020; Musyaffi, Sulistyowati, et al., 2022). Every time merchants attach digital forms of payment at their place of commerce. They are always ready if consumers make payments using digital payments. Even some SMEs direct consumers to choose digital payments because it is more accessible and more practical. This fact shows that SMEs are satisfied with the features and benefits of digital payments, which impact the continuous adoption of digital payments. Another reason SMEs use digital payments continuously is that it can reduce costs and time in conducting transactions. SMEs become freer of time because consumers or vendors make transactions online. However, the results differ on the security aspect. The security framework investigated in this study has no consequence on the degree to which SMEs utilize technology. This is evident from SMEs not checking the incoming funds. The main thing SMEs dare to take is that buyers also respond to digital payments. So SMEs prefer to use digital payments. Hanif & Lallie (2021) concur with this study's findings that there is no positive correlation between security and the propensity to utilize mobile banking. According to the results of his study, people utilize mobile banking applications only when they have no other option (Hanif & Lallie, 2021).

The adoption of digital payments also increases the performance of SMEs, especially in increasing the company's business value (Ilmudeen et al., 2019). When SMEs use digital payments as a means of payment, consumers can see that SMEs are trustworthy companies. So that the use of digital payments can provide great interest in making consumers actively buy products and services at the store. In addition, the use of digital payments is also able to reduce costs economically. To make a purchase, SMEs do not need to withdraw money at an ATM or branch office. SMEs also do not need to meet in person, so that costs for operational costs are reduced. SMEs satisfaction has the most significant positive impact on SMEs performance, which is 50.7%. SMEs satisfied with the benefits and convenience of digital payments will try to continue using digital payments. One of the reasons why SMEs are satisfied with the use of digital payments is because there are features that can make payments quickly on various other platforms such as e-commerce, digital wallets, and bill payments. In addition, when consumers make payments, consumers can independently make payments online. So, SMEs do not need much time and energy to transact

with consumers. The availability of access to financial products and services shows an increasing performance of SMEs (Thathsarani & Jianguo, 2022). (Garrison et al., 2015) revealed that one of the keys to improving performance is using the right information technology. Adopting information technology for SMEs' input and output processes will significantly increase SMEs' performance (Khayer et al., 2020). In addition, technology adoption can also improve company performance in non-financial aspects such as flexibility and quality. While several other researchers also agree with the results of this study, where technology adoption can improve the company's overall performance (Garrison et al., 2015; Ooi et al., 2018; Qalati et al., 2021).

CONCLUSION

This research is the development of several theories, such as the TAM, Information success model, ECT, and additional constructs, such as security and financial advantage and performance. All constructs except security against IUDP. The constructs that have a significant influence include PEOD with IUDP, PUD and SMS. Meanwhile, the PUD construct has a significant relationship with SMS and IUDP. Then DPQ with PUD and IUDP. Meanwhile, the financial advantage construct has a positive correlation with the IUDP. Then SMS has a significant positive impact on several other constructs such as IUDP and SP. Lastly, IUDP has a positive relationship with SP. Meanwhile, the non-significant construct is owned by security with IUDP. There is an insignificant impact because the orientation of SMEs is to consumer needs. Because the trend of digital payments is increasing, there are offers from these digital payment service providers. This is evidenced by the fact that SMEs rarely check balances on digital payment accounts. The findings show that the most significant factor in improving the performance of SMEs is when they are satisfied with using digital payments. This means that the technology adoption factor can strengthen overall user satisfaction so that it has an impact on the performance of SMEs. Other findings also show that the SMEs' adoption factor for digital payments is due to the ease of access to the smartphones used. SMEs also revealed that the features and services in digital payments are sufficient to cover the needs of SMEs in business operations. The main finding confirms that there is a good model integration between the TAM and IS success model as well as the construct of financial advantage and SMEs performance, especially in the field of digital payment technology.

Further research can develop other integrations, such as technology readiness to measure readiness to use digital payments, Innovations resistance theory to find out the resistance factor for the use of digital payments for users and non-users, and expectation confirmation theory (ECT) for the purpose of determining the level of satisfaction felt by users when using digital payments. Digital payments. Meanwhile, regulators such as the government can improve regulations that make it easier for digital payment service providers to continue to grow. Then for digital payment service providers, programs such as discounts are an attraction for buyers and SMEs. So, it is also essential for service providers to manage profitable discount programs between consumers and SMEs. In addition, service providers should also perform various integrations with other platforms such as e-commerce, digital wallets, or even banking.

ACKNOWLEDMENT

The author would like to thank Jakarta State University for providing financial and non-financial support. We also thank the SMEs who are willing to be research respondents.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Gonos, J., Culkova, K., Tomkova, A., Lisuch, J. (2024), "Unemployment and GDP Analysis in Accord With R&D Expenses in the Individual Autonomies of Slovakia", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 91-106.

Unemployment and GDP Analysis in Accord With R&D Expenses in the Individual Autonomies of Slovakia[1]

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ARTICLE INFO

Received January 25, 2023
Revised from February 26, 2023
Accepted March 26, 2023
Available online April 15, 2024

JEL classification: E00, E20, I15, I25, M48

DOI: 10.14254/1800-5845/2024.20-2.8

Keywords:

Unemployment,
Autonomy,
GDP,
Investnemt to the research and development,
Regression analysis,
Slovakia.

ABSTRACT

The phenomenon of unemployment is a complex element of the economic system. Unemployment has acquired the concept of a life experience with a probably inevitable occurrence at a certain point in the existence of every person. The aim of the paper is to analyze the aspect of unemployment in the context of the quality of life in the individual autonomies of the country, verify its connection and define possible opportunities for influencing it. For these purposes, regression analysis was used, which determined the relationship of dependence of this phenomenon with the development of the volume of investments directed to research and development and GDP. The analysis demonstrated in this work the existence of a relationship between investments in research and development and unemployment. The results can be used for development of sustainable job market.

INTRODUCTION

The aim of the paper is to analyze the aspect of unemployment in the context of the quality of life in the individual autonomies of the country, verify its connection and define possible opportunities for influencing it.

1 This study was supported of the project „Research of alternative energy sources' implementation impact on industries of energy management processes" supported by Operational Program Integrated Infrastructure (ITMS: 3131011T564).

The performance of employment and work, which has a productive character, is a dominant source of social and economic growth of a person, as well as a determinant of the formation of factors of his personal identity. Employment in its effective and full form acts as an eliminator of the undesirable phenomenon of poverty and social exclusion, while it is closely connected with economic prosperity and sustainable economic growth of society (Rievajová 2016).

1. LITERATURE REVIEW

Unemployment affects individuals, groups and society as a whole, which led to the extensive need for its investigation (King and Morley, 2007). Number of authors had already studied the unemployment development and its relations to the other indicators (Clark and Lepinteur, 2019; Engbersen et al., 2018). For example, Simionescu and Zimmermann (2017) focus on the analysis of unemployment by means of internet activity data, providing literature review with results of the unemployment analysis. An increase in U.S. aggregate labor demand reflected in rising job vacancies has not been accompanied by a similar decline in the unemployment rate (Valletta and Kuang, 2010). Dimian et al. (2017) studied development of unemployment in EU countries from the view of labor market mismatch. Ferreiro and Gomez, (2020) provided similar study in EU conditions, found there is necessity to follow up unemployment development in individual countries.

Currently within the framework of the Slovak Republic, the historically lowest values of unemployment indicators of the country as a whole were reported over the last year (Rievajova and Klimko, 2016; Zofcinova and Hrabovska, 2019). There are still municipalities, cities and parts of the country with a large number of unemployed, vulnerable on the labor market, and population groups at risk of poverty, with a corresponding change in the level of their quality of life. Therefore, the achieved positive and negative differences in the indicators of the development of individual autonomies, even for a country as large as Slovakia, are a suitable opportunity for research and the search for connections, leading to individual targeting of solutions, with the hope to the subsequent prosperity of the more backward units, and especially their population.

Employment development is connected with economic development of the country (Dzakula and Danon, 2015), which can be reflected in GDP development in the country (Gibescu, 2013; Vakulenko and Gurvich, 2015).

Luchko et al. (2019) claim that in the conditions of innovative development of the country, it is important to actively use the skills of the personnel potential. The main priority is the sustainable development of the economy, which contributes to the realization of opportunities and the development of human resources as the main excellent factor.

2. METHODOLOGY AND RESEARCH METHODS

The object of searching is Slovakia with its individual autonomies. Table 1 provides location and population structure of autonomies to 2019. The mentioned facts may also indicate the economically achieved regional distribution of the country's productivity, or, on the contrary, its concentration.

Table 1. Review of basic information of the Slovakian autonomies

Autonomy	*% rate of the SR territory*	*Number of inhabitants*	*% rate of the SR inhabitants*	*Population density per 1 km2*	*Economically active inhabitants in thousands*	*% rate of regional GDP*	*Regional GDP per inhabitant in %*
Slovakia	100,00	5 450 421	100,00	111,08	2 746,0	100,00	100,00
BSK	4,19	659 598	12,10	319,21	354,4	28,37	235,73
TTSK	8,46	563 591	10,34	135,78	289,1	11,24	108,76
TSK	9,18	585 882	10,75	130,31	300,9	8,98	83,41
NSK	12,94	676 672	12,42	106,83	343,6	10,40	83,58
ŽSK	13,89	691 368	12,68	101,52	344,5	10,84	85,46
BBSK	19,28	647 874	11,89	68,63	333,0	8,73	73,23
PSK	18,30	825 022	15,14	91,88	398,4	9,54	63,06
KSK	13,77	800 414	14,69	118,42	382,4	11,90	81,05

Source: own processing according to Statistical Office, SR, 2020

We focused individual parts of the analysis on the analysis of the development of the total investments volume directed to research and development, in connection with the development of regional GDP and unemployment as a whole (Di Iorio and Triacca, 2022), but also its independent effect, on the most vulnerable and problematic subgroups of the unemployed in the Slovak Republic. The numbers of employed and unemployed people in the regions were determined using the VZSP method, unless otherwise stated.

3. RESULTS

3.1 Analysis of the dependence between research and development expenses and GDP

Hypothesis H0: We assume that there is no linear relationship between the development of research and development expenses and the development of regional GDP in autonomies of the Slovak Republic.

Hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of regional GDP autonomies of the Slovak Republic.

Table 2. Chosen indexes of regression analysis 1

Indexes	*Resulting values*
Pearson correlation coefficient r	0.94861769
Spearman rho	0.79800629
Coefficient of determination R2	0.899876
F- Fisher criteria test (1, 110)	988.632
Value P	8.56e-057
Bootstrap 95 % interval of reliability	47.8256 < β1 < 57.2088

Source: own processing

Through the most important indexes of statistical regression, we found out if the regression model is statistically important.

Pearson correlation coefficient r (verification of the existence of the relation between variables)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Based on the significance level $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables, since $\rho \neq 0$. Estimation of the correlation coefficient, calculated for the mentioned variables is $r = 0.95$, which means relatively strong direct relationship.

Spearman rho (we verify validity of Pearson r findings for possible existence of outliers – mainly in BSK)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Since the value of Spearman's rho coefficient is not significantly higher in absolute value than Pearson's r, its use for verifying the existence of a relationship is significant. Also, based on the significance level $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables.

The value of the coefficient of determination $R2 = 0.899876$ of the indicated indicators indicates that the given relationship of the development of research and development expenditures explains 90% of the variability of the regional GDP development. The remaining 10% of variability must be attributed to the influence of other factors on regional GDP. However, this figure may be biased by the sample size.

Fisher criteria test (critical value of the importance level alfa = 0,05)

H0: $\rho = 0$ Regression model is not statistically important

H1: $\rho \neq 0$ Regression model is statistically important

Since the level of significance $F = 8.56e\text{-}57 < 0.05$, we reject the hypothesis H0 and consider the model to be statistically highly significant, because the level of significance F is less than our chosen level of significance alpha.

The regression form of the equation:

Regional GDP = 5598.99 + 51.6828 * research and development expenses

It means that if research and development expenses were to increase by one point (million €), the regional GDP would increase by 51.683 points (million €).

Importance of the P coefficients – Value = 8.56e-57< 0.05: this parameter is statistically important and demonstrable.

Bootstrap 95 two-sided interval of reliability for β0 and β1: Interval of reliability β1: P (47.8256 < β1 < 57.2088). It says that with a reliability of 95%, an increase in research and development expenditures in self-governing regions of the Slovak Republic by one unit (€1 million) will cause an increase in the region's regional GDP in current prices by an average of 47.825 – 57.208 million. €.

Based on the theoretical relationship of Okun's law on the existence of a connection between the volume of GDP achieved and unemployment (Cosar and Yavuz, 2021), we investigated the relationship between spending on research and development and the achievement of regional GDP. We found the existence of a strong direct linear dependence, which is possible with the linear regression function y =

5598.99 + 51 .6828x and a correlation coefficient of 0.94861769. The constant b0 tells about the position of the regression line. The constant b1 determines that if the volume of expenditures on research and development in autonomies of the Slovak Republic increases by one unit (1 million €), the regional GDP of the region in current prices will increase by an average of 47.825 – 57.208 million. €, which is also shown in figure 1 and 2.

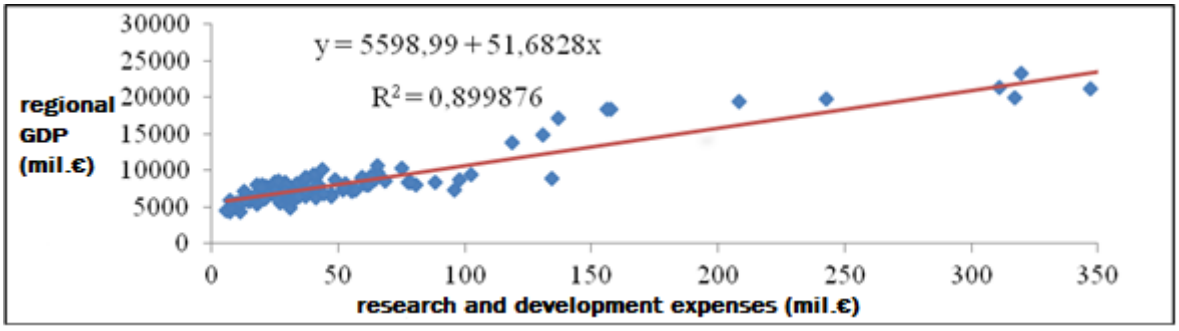

Figure 1. Dependence of the research and development expenses on the regional GDP

Source: own processing

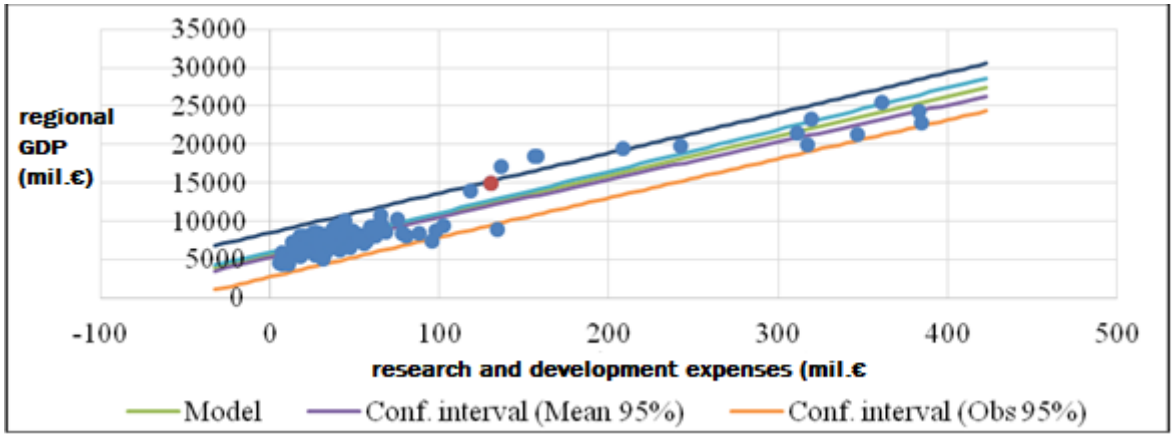

Figure 2. Model of the dependence of research and development expenses on regional GDP

Source: own processing

3.2 Analysis of the Dependence Between Research and Development Expenses and Total Number of Unemployed in Individual Autonomies of Slovakia

Based on the results of the research by F. Bogliacino and M. Vivarelli (2010), we decided to pay attention to the investigation of this relationship in the conditions of the Slovak Republic, at the level of its autonomies.

Hypothesis H0: We assume that there is no linear relationship between the development of research and development expenditures and the development of the number of unemployed people in autonomies of the Slovak Republic

Hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of unemployed people in autonomies of the Slovak Republic

Through the most important indicators of the statistical regression analysis, we determined whether

this regression model is statistically significant.

Table 3. Chosen indexes of regression analysis 2

Indexes	*Resulting values*
Pearson correlation coefficient r	- 0.46308146
Spearman rho	- 0.55365231
Coefficient of determination R2	0.214444
F- Fisher criteria test (1, 110)	30.02829
Value P	0,000000273
Bootstrap 95 % interval of reliability	- 0.145059 < β1 < - 0.0884936

Source: own processing

Pearson correlation coefficient r (verifying existence between the variables)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Based on the level of significance $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables, because $\rho \neq 0$. The correlation coefficient estimate calculated for the mentioned variables is r = - 0.46, which means medium strong inverse relationship.

Spearman rho (validity verification of the Pearson r findings for possible existence of outliers – mainly in BSK)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Since the value of Spearman's rho coefficient is not significantly higher in absolute value than Pearson's r, its use for verifying the existence of a relationship is significant. Also, based on the significance level $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables.

The value of the coefficient of determination R2 = 0.214444 of the indicated indicators indicates that the mentioned relationship of the development of research and development expenditures explains 21% of the variability of the development of the total number of unemployed people in the Slovak Republic measured Labor Office. The remaining 79% of the variability must be attributed to the action of other factors.

Fisher criteria test (critical value of the importance level alpha = 0, 05)

H0: $\rho = 0$ Regression model is not statistically important

H1: $\rho \neq 0$ Regression model is statistically important

Since the significance level F = 0.000000273 < 0.05, we reject the null hypothesis H0 and consider the model to be statistically highly significant because the significance level F is less than our chosen alpha significance level.

Regression form of the equation:

*Number of unemployed = 47.3354 − 0.108627 * research and development expenses*

It means that if research and development expenditures were to increase by one point (million €), the number of unemployed people would decrease by 108 points (people).

Significance of coefficients P – Value = 0.000000273 < 0.05, this parameter is statistically significant and evident.

Bootstrap 95 % two-sided interval of reliability for β0 and β1. Interval of reliability β1: P (-0.145059 < β1 < -0.0884936) with 95% reliability, an increase in research and development expenditures in autonomies of the Slovak Republic by one unit (€1 million) will cause a decrease in the number of unemployed people on average by 88-145 people.

With the indicated indicators, we investigated the relationship between the volume of research and development expenditures and the total number of unemployed people, where we found the existence of a moderately strong indirect linear dependence, which could subsequently be expressed by the linear regression function y = 47.3354 − 0.108627x and the correlation coefficient -0.46308146. They rejected the hypothesis H0 and accepted the alternative hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of unemployed people in autonomies of the Slovak Republic, and showed its dependence in the following Figure 3. The constant b0 determines the position of the regression line and the constant b1 states that if there is an increase in research and development expenses in self-governing regions of the Slovak Republic by one unit (€1 million), it will cause a decrease in the number of unemployed people by an average of 88-145 people.

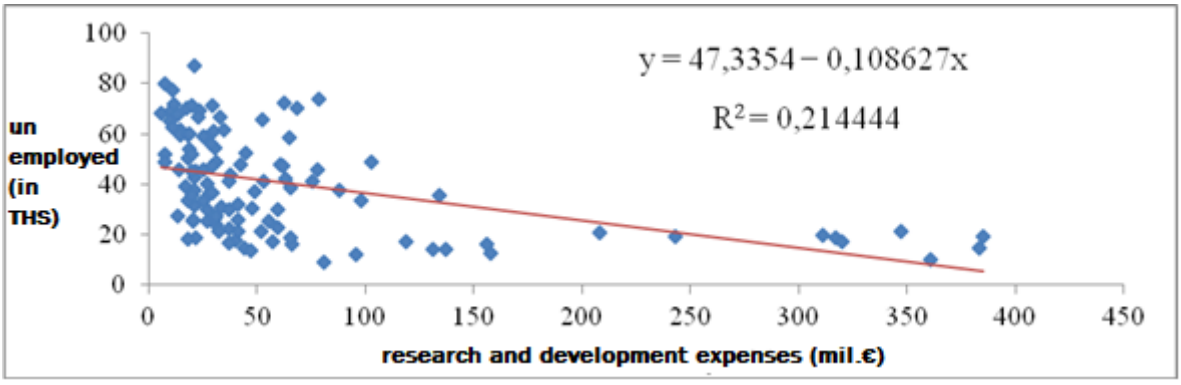

Figure 3. Dependence of research and development expenses on development and number of unemployed

Source: own processing

The first investigated subgroup of the unemployed population was the one that contains people who have not achieved any or only a low level of education, specifically unemployed without primary education, with primary and incomplete secondary vocational education. We will also examine dependence in the context of the volume of investments in research and development.

Hypothesis H0: We assume that there is no linear relationship between the development of research and development expenditures and the development of the number of unemployed people with a low level of education in the Slovak Republic.

Hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of unemployed people with a low level of education in the Slovak Republic.

Table 4. Chosen indexes of regression analysis 3

Indexes	*Resulting values*
Pearson correlation coefficient r	- 0.53269928
Spearman rho	- 0.64988831
Coefficient of determination R2	0.283769
F- Fisher criteria test (1, 110)	43.5816
Value P	0,00000000149
Bootstrap 95 % interval of reliability	- 0.115909 < β1 < - 0.0730437

Source: own processing

Pearson correlation coefficient r (verifying existence between the variables)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Based on the level of significance $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables, because $\rho \neq 0$. The correlation coefficient estimate calculated for the mentioned variables is r = - 0.53, which means medium strong inverse relationship.

Spearman rho (validity verification of the Pearson r findings for possible existence of outliers – mainly in BSK)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Since the value of Spearman's rho coefficient is not significantly higher in absolute value than Pearson's r, its use for verifying the existence of a relationship is significant. Also, based on the significance level $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables.

The value of the coefficient of determination R2 = 0.283769 of the indicated indicators indicates that the mentioned relationship of the development of research and development expenditures explains 28% of the variability of the development of the unemployed with low level of education in the Slovak Republic measured by Labor Office. The remaining 72% of the variability must be attributed to the action of other factors.

Fisher criteria test (critical value of the importance level alpha = 0.05)

H0: $\rho = 0$ Regression model is not statistically important

H1: $\rho \neq 0$ Regression model is statistically important

Since the significance level F = 0.000000149 < 0.05, we reject the null hypothesis H0 and consider the model to be statistically highly significant because the significance level F is less than our chosen alpha significance level.

Regression form of the equation:

*Number of unemployed with low level of education = 29.7799 − 0.0884507 * R&D expenses*

It means, when the volume of R&D expenses would increase by 1 point (1 mil. €), the number of unemployed with low level of education would decrease by 88 points (people).

Importance of P-value coefficient = 0.00000000149 < 0.05 the parameter is statistically important and evident.

Bootstrap 95 % two-sided interval of reliability for β0 and β1. Interval of reliability β1: P (-0.115909 < β1 < -0.0730437) with 95% reliability, an increase in research and development expenditures in autonomies of the Slovak Republic by one unit (€1 million) will cause a decrease in the number of unemployed people on average by 73-115 people.

With the expressed indicators, we found the existence of a moderately strong indirect linear dependence between the volume of research and development expenditures and the number of unemployed people with a low level of education, which could subsequently be expressed by the linear regression function y = 29.7799 − 0.0884507x and the correlation coefficient -0.53269928. They rejected the hypothesis H0 and accepted the alternative hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of unemployed people with a low level of education in the Slovak Republic. Figure 4 shows its dependence. The constant b0 determines the position of the regression line and the constant b1 indicates that if there is an increase in research and development expenses in autonomies of the Slovak Republic by one unit (€1 million). It will cause a decrease in the number of unemployed people with a low level of education by an average of 73-115 people.

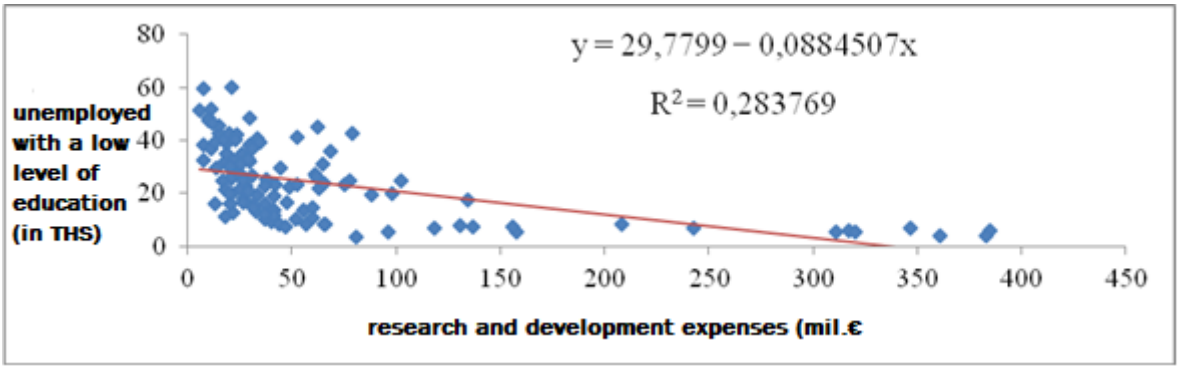

Figure 4. Dependence of R&D expenses on development and number of unemployed with low level of education

Source: own processing

3.3 Analysis of the Dependence Between Research and Development Expenses and Total Number of Unemployed in Individual Autonomies of Slovakia

Another studied subgroup is employed citizens over the age of 55, whose number will also be examined depending on the volume of R&D.

H0: We assume that there is no linear relationship between the development of research and development expenditures and the development of the number of employed people over the age of 55 in the Slovak Republic.

H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of employed people over the age of 55 in the Slovak Republic.

Table 5. Chosen indexes of regression analysis 4

Indexes	Resulting values
Pearson correlation coefficient r	0.68103949
Spearman rho	0.67695022
Coefficient of determination R2	0.463815
F- Fisher criteria test (1, 110)	95.153
Value P	1.43e-016
Bootstrap 95 % interval of reliability	0.086843 < β1 < 0.118158

Source: own processing

Pearson correlation coefficient r (verifying existence between the variables)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Based on the level of significance $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables, because $\rho \neq 0$. The correlation coefficient estimate calculated for the mentioned variables is r = 0.68, which means very strong proportional relationship.

Spearman rho (validity verification of the Pearson r findings for possible existence of outliers – mainly in BSK)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Since the value of Spearman's rho coefficient is not significantly higher in absolute value than Pearson's r, its use for verifying the existence of a relationship is significant. Also, based on the significance level $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables.

The value of the coefficient of determination R2 = 0.463815 of the indicated indicators indicates that the mentioned relationship of the development of research and development expenditures explains 46% of the variability of the development of the employed over 55 year in the Slovak Republic measured by Labor Office. The remaining 54% of the variability must be attributed to the action of other factors.

Fisher criteria test (critical value of the importance level alpha = 0, 05)

H0: $\rho = 0$ Regression model is not statistically important

H1: $\rho \neq 0$ Regression model is statistically important

Since the significance level F = 1.43e-016 < 0.05, we reject the null hypothesis H0 and consider the model to be statistically highly significant because the significance level F is less than our chosen alpha significance level.

Regression form of the equation:

Number of employed over 55 years = 31.3881+0.0992949* R&D expenses

It means that if research and development expenses were to increase by one point (€1 million), the number of employed people over 55 would increase by 99 points (people). Significance of coefficients P – Value = 1.43e-016 < 0.05, this parameter is statistically significant and demonstrable.

Bootstrap 95% two-sided reliability interval for β0 and β1. Confidence interval β1: P (0.086843 < β1 < 0.118158) with 95% reliability that an increase in research and development expenditures in Slovakian autonomies by one unit (€1 million) will cause an increase in the number of employed people over the age of 55 by an average of 86 - 118 people.

Through the analyzed indicators, we found the existence of a strong direct linear dependence between the volume of research and development expenditures and the number of employed people in the over 55 year, which could subsequently be expressed by a linear regression function y = 31.3881+0.0992949x and a correlation coefficient of 0.68103949. We rejected the hypothesis H0 and accepted the alternative hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of employed people over the age of 55 in the Slovak Republic, and showed its dependence in Figure 5. The constant b0 determines the position of the regression line and constant b1 indicates that if there is an increase in research and development expenses in Slovakian autonomies by one unit (€1 million), it will cause an increase in the number of employed people over the age of 55 by an average of 86-118 people.

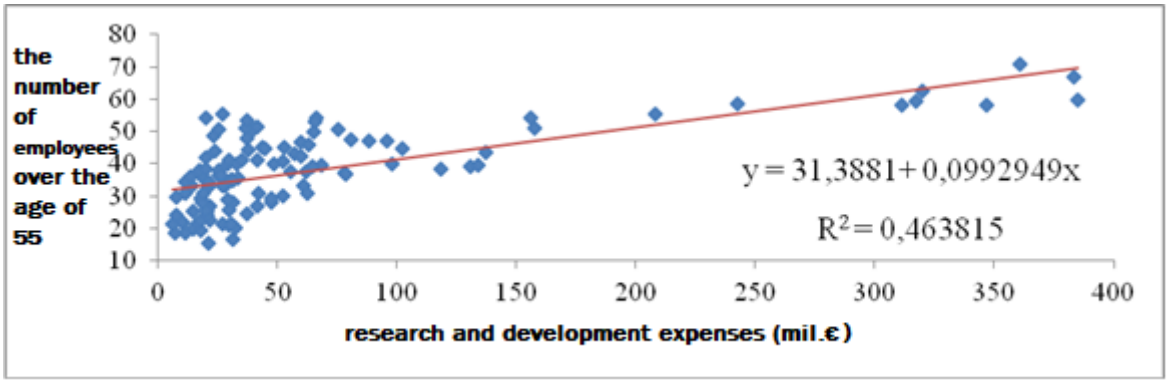

Figure 5. R&D expenses dependence on development and number of unemployed ower 55 year

Source: own processing

3.4 Analysis of Dependence Between Volume of R&D Expenses and Development and Number of Long-Term Unemployed in Slovakian Autonomies

The last studied subgroup are long-term unemployed job seekers, whose number will also be examined depending on the volume of research and development investments.

H0: We assume that there is no linear relationship between the development of research and development expenditures and the development of the number of registered long-term unemployed people in the regions of Slovakia.

H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of registered long-term unemployed people in the regions of Slovakia.

Table 6. Chosen indexes of regression analysis 5

Indexes	*Resulting values*
Pearson correlation coefficient r	-0.38620640
Spearman rho	-0.45114805 s p=0,000
Coefficient of determination R2	0.149155
F- Fisher criteria test (1, 110)	19.2833
Value P	0.000026
Bootstrap 95 % interval of reliability	-0.0880458 < β1 < -0.0504016

Source: own processing

Pearson correlation coefficient r (verifying existence between the variables)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Based on the level of significance $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables, because $\rho \neq 0$. The correlation coefficient estimate calculated for the mentioned variables is r = - 0.39, which means medium strong inverse relationship.

Spearman rho (validity verification of the Pearson r findings for possible existence of outliers – mainly in BSK)

H0: $\rho = 0$ (there is no statistically important linear relation /correlation dependence/ between variables)

H1: $\rho \neq 0$ (there is statistically important linear relation /correlation dependence/ between variables)

Since the value of Spearman's rho coefficient is not significantly higher in absolute value than Pearson's r, its use for verifying the existence of a relationship is significant. Also, based on the significance level $\alpha = 0.000$, we reject the hypothesis H0 and accept the hypothesis H1, which means that there is a statistically significant linear relationship between the variables.

The value of the coefficient of determination R2 = 0.1492 of the indicated indicators indicates that the mentioned relationship of the development of research and development expenditures explains 15% variability of the development of the total number of long-term unemployed people in the Slovak Republic measured by Labor Office. The remaining 85% of the variability must be attributed to the action of other factors.

Fisher's criterion F-test (critical value of significance level alpha = 0.05)

H0: $\rho = 0$ The regression model is not statistically significant

H1: $\rho \neq 0$ The regression model is statistically significant The level of significance F= 0.000026 < 0.05 we reject the null hypothesis H0 and we consider the model to be statistically highly significant because the level of significance F is smaller than our chosen level of significance alpha.

Regression form of the equation:

*Number of long-term unemployed = 23.4002 −0.0645834 *R&D expenses*

It means that if research and development expenses were to increase by one point (€1 million), the number of long-term unemployed people would decrease by 64 points (people).

Significance of coefficients P – Value = 0.000026 < 0.05, this parameter is statistically significant, evident.

Bootstrap 95% two-sided confidence interval for β0 and β1. Confidence interval β1: P (-0.0880458 < β1 < -0.0504016) with 95% confidence, an increase in research and development expenditures in Slovakian autonomies by one unit (€1 million) will cause a decrease in long-term unemployed people by 50-88 people on average.

With the selected indicators, we found the existence of a moderately strong indirect linear dependence between the volume of research and development expenditures and the number of long-term unemployed people, which could subsequently be expressed by the linear regression function y = 23.4002 – 0.0645834x and the correlation coefficient -0.38620640. They rejected the hypothesis H0 and accepted the alternative hypothesis H1: We assume that there is a linear relationship between the development of research and development expenditures and the development of the number of long-term unemployed registered people in the regions of the Slovak Republic, and showed its dependence in Figure 6. The constant b0 determines the position of the regression line and the constant b1 states that if there is an increase in research and development expenses in self-governing regions of the Slovak Republic by one unit (€1 million), it will cause a decrease in the number of long-term unemployed people by an average of 86-118 people.

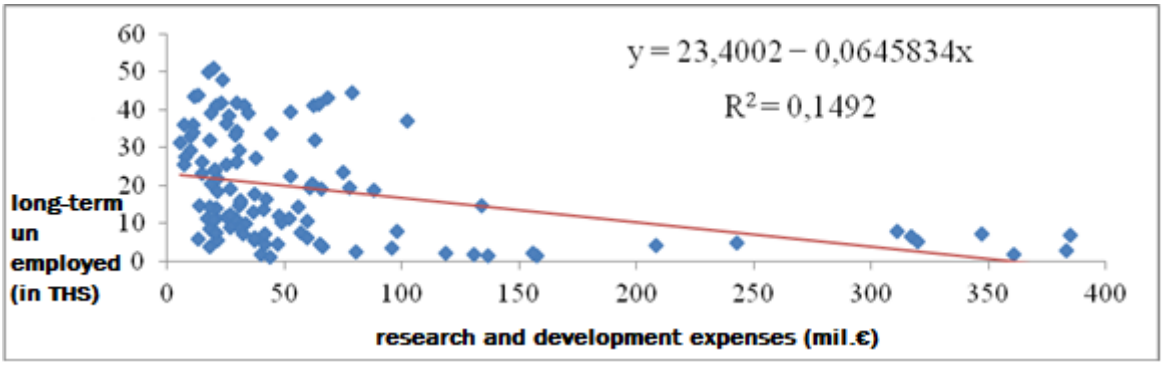

Figure 6. R&D expenses dependence on development and number of long-term unemployed

Source: own processing

4. DISCUSSION

Based on selected indicators, it was possible to observe a significant level of regional disparities in many directions, where, despite positive developments, there is a tendency to centralize attention and opportunities in the territory of western Slovakia. It is reflected in the number of unemployed people and the quality of life of the population, also represented by the increase in the number of people at risk of poverty, in the last year-on-year calculated change in the areas of central and eastern Slovakia. At the current time of historically minimal unemployment in the country, there are still regions and districts that need to be given special attention, as well as the most threatened groups of their population. In the levels of the achieved indicators in the regions, during the analysis, signs of connections between the prosperity of the regions and the development of the volume of local investments for research and development were observed, therefore these became part of the interest of further research.

In that case, the regression analysis indicated the existence of a relatively significant relationship between these variables, which could also mean the potential of influencing the level of unemployment. Therefore, we checked the existence of a relationship between the development of the volume of investments directed to research and development. In this case, the regression analysis also indicated a

moderately strong, non-directly proportional linear relationship and a possible connection in the development of these indicators.

Based on the results of the analysis of previous sessions, we decided to focus further research on selected, currently numerous, vulnerable categories of the population of the Slovak labor market, which were the unemployed with a low level of education, employed residents over the age of 55 and the long-term unemployed part of the population. By regression analysis of these variables, also in connection with the development of research and development investments, we found the existence of a linear relationship in all cases. The unemployment indicator shows a moderately strong, decreasing tendency in the examined period, and on the contrary, the employment indicator increases together with the volume of investments of the given direction (Valletta and Kuang, 2010). The findings therefore show that research and development expenditures can have the effect of creating jobs on the Slovak labor market across regions, and therefore, despite concerns about technical unemployment, this predictor of product innovations can move the self-governing regions of the Slovak Republic in a positive direction.

For effective targeting of the direction of this type of investment, further investigation of the issue appears to be necessary. It is mainly a search for correlation in the context of individual types of industry sectors, while the optics of the detected relationships should be focused separately on each problematic territorial unit within the economic case-management of unemployment, due to the considerably diverse conditions.

From the point of view of the favorably developing investigated element of unemployment in Slovakia, we can say that the situation has moved to a historically new level, but it did not mean an equally beneficial difference for all threatened groups of the population. A significant problem is the territorial-geographical discrepancy in the concentration of job opportunities and labor force. Mobility in the search for employment on the labor market may not always be a solution due to social conditions, traditions, family ties, or other reasons, especially in eastern Slovakia. On its territory, the creation of prosperous units of cities is also valid, mainly in the seat of districts and regions, with different developing local components.

The research results of this work could also indicate the way to possible topics for solving the given situation, which also outlined the idea of achieving an internally uniform way of development of autonomies, showing larger volumes of investments directed to research and development. It is connected with GDP development, as well as possibilities of the financial support of the region development from the side of the state and private investors that could contribute to the solving of the unemployment (Ciftcioglu and Bein, 2017; Bota-Avram, et al., 2021). Since the possible existence of a relationship between unemployment, employment and a given type of expenditure has been demonstrated, it is possible to work with and further develop these findings. In the defined relationships, it does not have to be only about the direct creation of places by these investments, but also about secondary employment, caused by the needs of the employees of the primarily created job positions. This can also be indicated by the proven potential relationship in the analysis of long-term unemployed people and people with a low level of education achieved against the given expenses, when, despite their unsatisfactory position on the labor market, they are also under the influence of the detected non-direct relationship.

The situation with negative trend of unemployment can be solved also through so-called self-employment (Markus et al., 2019). However, as for the relation to GDP, Ben-Salha and Mrabet (2019) point out the economic growth does not mean the country will have no unemployment.

An important factor in creating effective analyzes and finding solutions is the availability of correct and simultaneously valid statistical data (Simionescu and Zimmermann, 2017). When designing the paper, we also noticed a delay in their publication in the key indicators, already when calculating them at the level of the country as a whole. This applied even more seriously to the basic minimum of data available within the analysis focused on the territory of individual self-governing regions. We can also say that even less calculated data was available from the territory of the districts. Therefore, we consider it necessary to improve the availability and actuality of this information, to enable a more detailed examination of the economic context in the country. Findings resulting from the analysis can be subject of the research only in larger units or at the level of the country, but precisely within small parts. Mainly where they are really primarily manifested in the daily pulsation of the residents' lives, and where they are actually lacking, even

if they carry a considerable analytical and informative meaning for more effective targeting of possible solutions.

CONCLUSION

The phenomenon of unemployment is a complex element of the economic system; it connects with many factors at the same time and characterized by the ambiguity of its origin, links, or possible solutions, due to the inability to influence the occurrence of potential exogenous causalities. By its nature, it reflects the health of the state's economy, the development of society and it is related to *quality of life* factors at the individual level as well. The psychological and social costs of unemployment can often represent a higher price than the material losses caused by it. In order to minimize the risk of large-scale unemployment outbreaks in the future and eliminate the need for artificial reduction, it might be appropriate to focus on creating forces capable of sustainably creating job opportunities along the developing and changing labor market.

The contribution was focused on the analysis of unemployment of individual self-governing regions in the Slovak Republic. The main goal was to carry out an analysis of this phenomenon in the context of the economic indicators of the given regions and to identify its social aspect with an impact on the quality of life of the inhabitants of the regions for the selected time. The statistical part of the research subsequently examined the development of regional unemployment and, using regression analysis, we determined the existence of a relationship between this phenomenon and the volume of investments spent on research and development. The analysis demonstrated in this work the existence of a relationship between investments in research and development and unemployment, with the potential to influence the given phenomenon in different intensity, depending on the examined structures of participants in the labor market offer.

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For citation:

Nguyen, T.A.N., Nguyen, K.M., Nguyen, D.V., Luong, T.T.H. (2024), "The Determinants of Financial Literacy in the Southeast of Vietnam", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 107-116.

The Determinants of Financial Literacy in the Southeast of Vietnam

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ARTICLE INFO

Received January 29, 2023
Revised from February 30, 2023
Accepted March 30, 2023
Available online April 15, 2024

JEL classification: D14; D19; D10

DOI: 10.14254/1800-5845/2024.20-2.9

Keywords:

Financial literacy;
financial knowledge;
financial behavior;
financial attitude;
demographic and socioeconomic characteristics.

ABSTRACT

This study explores how demographic and socioeconomic characteristics are linked with the financial literacy of individuals in the southeast of Vietnam. In this study, financial literacy is estimated by assessing financial knowledge, financial behavior, and financial attitude. The utilized method involves a sample comprising 527 individuals. The ordinary least squares (OLS) and the generalized structural equation model in logit (GSEM) regressions were applied to analyze the data and provide an explanation of the relationship among demographics, socioeconomic characteristics, and three facets of financial literacy. The results show that education levels and the formal sector have a positive relationship with both financial knowledge and financial attitude. Specifically, the findings indicate that males have a higher level of financial knowledge than females, whereas females have better financial behavior and attitude. Age has a positive and statistically significant relationship with financial attitude but no statistically significant relationship with financial behavior. Also, we cannot detect any correlation between young and old people with financial knowledge. Individuals in midlife have greater financial knowledge than younger generations. Accordingly, it is highly recommended that women, the young, and the elderly all are singled out because of their demographics may benefit most from increased financial literacy. In addition, governments should focus on strengthening and educating people about financial literacy, especially those who are thought to be less financially literate.

INTRODUCTION

Literacy in financial matters is now widely acknowledged as an essential ability for people to possess in order to thrive in today's ever-more-complicated economic environment. Despite its importance, several studies from around the globe show that a sizable portion of the population still lacks financial literacy and that urgent action is required to address the issue (Lusardi and Mitchell, 2011a; Brown and Graf, 2013).

The increasing complexity of financial markets may cause consumers to make bad decisions if they are not well informed. The lack of awareness of the importance of financial literacy among consumers and their propensity to make poor financial decisions prove the pressing need for them to acquire financial literacy (OECD, 2019). People's ability to make economically and financially sustainable decisions may be supported by financial literacy, which in turn improves people's future well-being.

Financial literacy term is extensively utilized in the literature review, but the current article is approached by using a definition where financial literacy encompasses three aspects financial attitude, financial knowledge, and financial behavior (Huston, 2010). Individuals with a high level of financial literacy can use their knowledge of economic concepts and principles to make educated choices in areas such as retirement planning, asset accumulation, cost-cutting measures, and debt management (Lusardi and Mitchell, 2014). According to the OECD's definition, financial literacy encompasses a wide range of competencies necessary for an individual to make informed decisions about their own finances and attain a condition of financial security. Experts and researchers agree that financial knowledge, behavior, and attitude are three parts of financial literacy that should be considered (Atkinson & Messy, 2012; Santini et al., 2019). Placing an emphasis not only on financial knowledge but also on financial behavior and financial attitude that the OECD considers important aspects of one's overall financial well-being, the approach to financial literacy advocated by the OECD is ideally suited to be implemented in this context.

Numerous research articles have explored how characteristics like demographic and socioeconomic factors impact financial literacy (Kadoya and Khan, 2020). Previous research demonstrate that gender has an impact on financial literacy (Bawre and Kar, 2019; Kadoya and Khan, 2020). Women have been shown to have a poorer level of financial literacy than men in more recent research conducted by Kadoya and Khan (2020); and Rink et al. (2021). On the other hand, Kim and Mountain (2019) contends that sexual orientation has no impact on financial literacy. They demonstrate that there is no difference in financial awareness based on gender since people of both sexes have an identical level of the grasp of the financial awareness idea. However, age shows a significant difference between developing and developed economies when it comes to financial literacy. Bawre & Kar (2019) found that young and old people lack financial knowledge compared with other age groups. Earlier researchers also explore whether individuals' income has any effect on their financial literacy. In addition, Bawre and Kar (2019) also propose that income levels significantly impact on financial literacy. However, this finding is not supported by Kim and Mountain (2019) who prove that there is no relationship between income and financial knowledge.

Since the introduction of the economic reform agenda in 1986, Vietnam has achieved remarkable progress in spurring the economy from a poverty country to a developing and emerging economy. Contributing to this achievement, the financial industry plays an essential role. The financial sector in Vietnam has continuously grown in order to provide a variety of financial products and services that increase convenience. As a pivotal component, Vietnam's stock market began its establishment and operation in the 2000s, and its rapid development has been documented. In a report from the Ministry of Finance, the volume of market capitalization accumulated to the first quarter of 2022 is 93.8% of GDP. In order to adapt and respond to the significant improvement of the financial sector, individuals' financial literacy should be enhanced. Indeed, the importance of financial literacy has been stated in a range of studies. Lusardi et al. (2017) proved that financial security is critical for the secure future of individuals. Poor financial decisions can result from a lack of financial knowledge, and this prevents individuals from attaining financial goals (Ergün, 2018). However, contrasting sharply with the abundant literature on financial literacy in other countries, research in Vietnam is limited. Therefore, the determinant of financial literacy is pioneer research which would initiate further research to increase financial literacy in Vietnam.

According to studies by Askar et al. (2020) and OECD (2015), having a deep understanding of finances plays a significant part in the fight against poverty. However, there is not much research on this issue in countries with low income. In addition, the problems related to measuring the level of financial literacy and exploring key factors determining individuals' financial literacy or access to formal financial products, inclusion, and well-being perspective are left open. Accordingly, the purpose of this study is to explore which demographic and socioeconomic characteristics affect financial literacy to make recommendations for an appropriate strategy to improve financial literacy among the general population, particularly in the southeast of Vietnam. In prior research, demographic and socioeconomic factors were presented by basic indicators such as gender, age, education, and income. However, in this study, we use a different approach by

adding two more indicators comprising training courses and access to financial information variables to get a great insight into respondents' characteristics. Moreover, following OECD (2016), financial literacy in this research is also examined by measuring three facets to deeply understand the financial knowledge, financial behavior, and financial attitude of respondents.

The paper consists of five sections. The literature review is presented in the next part, followed by data and methodology section. Section 4 shows the results and discussions of the research. The last part presents conclusions.

1. LITERATURE REVIEW

Attempts have been made to develop and research the measurements of financial literacy through surveys that can be empirically tested. The first one was the project of Jump$tart Coalition at high schools and colleges in the United States in 1997. Lusardi and Mitchell (2007) included a set of financial literacy questions in the research on Health and Retirement Study in 2004, which was used as a model for subsequent surveys. Later polls, such as the OECD/INFE poll, were built on this basis by asking questions about financial knowledge, behavior, and attitude. According to the OECD, financial literacy is demonstrated in this study through three primary aspects, including financial knowledge, financial behavior, and financial attitude (OECD 2016). The financial knowledge component consists of questions on basic concepts related to finance, economics, and numeracy ability. It is an essential part of financial literacy because it allows customers to compare and make sound financial decisions. Financial behavior examines people's activities such as financial product choices, planning, and saving and spending patterns that influence their financial well-being in the short and long terms. The third aspect of financial literacy is financial attitude which is intended to assess respondents' attitudes, an important part to make effective financial decisions and future financial planning.

Several studies conducted throughout the world used demographic and socioeconomic variables of financial literacy to assess people's comprehension of financial literacy. According to Lusardi et al. (2017), there is a gender gap in financial literacy ratings. Women, in particular, have lesser financial literacy than men in most studies (Kadoya and Khan, 2019; Yoshino et al., 2017), and the reasons for this are still being contested. In addition, women are more likely than men to say they do not know the answers to the questions in the survey. Financial literacy follows a hump-shaped pattern with age, growing first and then dropping in old life (Kadoya and Khan, 2020). According to Lusardi and Mitchell (2007), there are variations in the behavior and consequences of planning and spending between youthful and middle-aged persons. However, this finding is different from the result found by Scheresberg (2013) indicating that there is no difference in financial literacy ratings of age.

A critical topic is whether education programs related to finance can promote financial literacy. A substantial number of studies on this topic have been undertaken, but the results are equivocal and are influenced by numerous specific elements of the programs such as syllabus, instructor, or target groups, etc. Fernandes et al. (2014) conducted a meta-analysis research including 188 studies and discovered that there is a significant positive relationship between financial education and economic behavior but very little influence. Also, through a meta-analysis of 126 researches, Kaiser and Menkhoff (2017) discovered that financial education has a considerable influence on financial behavior and it seems to be less on financial literacy. However, the findings imply that it is difficult to improve low-income individuals' financial behavior with financial education. Furthermore, in a research aiming to examine the impact of education programs at primary and secondary schools, Amagir et al. (2018) found that financial education programs have significant positive effects on students' financial knowledge but no significance on their financial behavior.

Previous research has also emphasized the importance of other factors, such as workforce status, income, and marital status which have also been proven to influence financial literacy. A study has revealed that the self-employed, particularly company owners, have better levels of financial literacy than the jobless (Lusardi and Tufano, 2009). Chen and Volpe (1998) discovered that persons with more work experience can get a chance to gain more knowledge, facilitate the interpretation of more complicated information, and provide a foundation for decision-making.

In terms of income, Calamato (2010) proposed that a steady source of income may also impact financial attitude and habits since it is easier for persons with a consistent income to manage their financial lives. Additionally, Atkinson and Messy (2012) discovered that financial literacy has a positive connection with income and wealth. Interestingly, Johnson and Sherraden (2007) provided evidence that the income levels of parents have a significant positive relationship with their children's financial knowledge. Further, those with lower incomes have a higher dropout rate, which has an indirect impact on their long-term financial literacy (Calamato, 2010). In this scenario, it is proposed that there is a possibility of reverse causation: persons with high financial literacy levels gain greater income levels while better financial decisions also bring higher incomes. Accordingly, it is also possible that those with greater levels of financial literacy have higher incomes because they can make more informed decisions about their financial issues.

Finally, there is also a correlation between the level of financial knowledge and marital status. Brown and Graf (2013) found that compared to married people, singles tend to have lower levels of financial literacy.

2. DATA AND METHODOLOGY

2.1 Data

A questionnaire survey is used to collect information on individuals' financial literacy and demographic characteristics. Particularly, financial literacy is measured in three aspects, including financial knowledge, financial behavior, and financial attitude. The data was gathered at the beginning of January 2022 by delivering the paper survey to respondents who consented to participate in the study and then collecting it shortly after they finished it. The full sample consists of 527 individuals between 18 and 60 years old and covers five cities representing five provinces in the southeast of Vietnam: Ho Chi Minh city, Bien Hoa city, Vung Tau city, Thu Dau Mot city, and Dong Xoai city. The questionnaire survey was a combination of financial knowledge, financial behavior, and financial attitude which represent three aspects of financial literacy and was designed in accordance with OECD (OECD, 2015). In addition, individuals' information related to gender, age, education level, training courses in business or finance, working status, marital status, access to financial information, and income level was also collected.

2.2 Measurement of variables

Dependent variables

We examined financial knowledge, financial behavior, and financial attitude in this study to better understand various facets of financial literacy. These three aspects of financial literacy are the study's dependent variables. Given the difficulties in effectively evaluating financial literacy by using standard questions about financial literacy, we followed the OECD technique of measuring financial literacy from a broader viewpoint (OECD, 2015). Table 1 summarizes the statistics for the variables considered in this investigation. The average financial knowledge, behavior, and attitude scores of respondents are 0.522 (standard deviation (SD) = 0.25), 0.517 (SD = 0.30), and 0.536 (SD = 0.41), respectively.

Table 1. Descriptive statistics

Variables	*Obs*	*Mean (SD)*	*Min*	*Max*
Financial knowledge (FK)	527	0.522 (0.25)	0	1
Financial behavior (FB)	527	0.517 (0.30)	0	1
Financial attitude (FA)	527	0.536 (0.41)	0	1

Source: Authors calculated from research data

Independent variables

We incorporate various factors relating to respondents' demographic and socioeconomic characteristics to explain financial knowledge, behavior, and attitude in Vietnam. As well-studied topics in financial literacy literature, gender, age, and education are also included since they appear to be key factors in financial literacy. Furthermore, respondents' employment status, such as working in the formal or informal sector, income level, and access to financial information is also considered to predict financial literacy.

In addition to these conventional demographic and socioeconomic factors, we added two additional variables that previous research did not consider analyzing their connection with financial literacy. First, it is assumed that training courses or major studies related to economics or finance in the recent past are connected with financial literacy. Another additional variable is access to financial information through readiness to acquire financial knowledge, perceive behavior, or perceive attitude via newspapers, magazines, television, and the internet.

Table 2 summarizes the information provided by respondents. 51.23% of the 527 people valid for analysis are female, while 48.77% are male. In terms of age, the majority of respondents are between the ages of 25 and 34, and 35 and 49, with about 43.3% and 29.4%, respectively. Regarding education, almost 60% of respondents have a diploma or a bachelor's degree. The percentages of respondents who complete secondary and high school are nearly 15.8% and 15.4%, respectively. Only approximately 9% of people have a postgraduate degree. In terms of income, approximately 56% of people earn less than VND 9 million each month (they are not obliged to pay personal income tax at this earning level). Additionally, 43.26% of respondents work in the informal sector, while the remaining respondents work in the official sector. Furthermore, just over 18% of respondents routinely access and obtain finance-related information, and around 30% engage in finance/business/economic courses through training courses or their major, which they learn from their university.

Table 2. Summary of demographic characteristics of respondents

	Frequency	*%*
Gender		
- Female	270	51.23
- Male	257	48.77
Respondents' age		
- Under 25	104	19.73
- 25-34	228	43.26
- 35-49	155	29.42
- 50-60	40	7.59
Respondents' education		
- Secondary school	83	15.75
- High school	81	15.37
- Diploma/Bachelor	316	59.96
- Postgraduate	47	8.92
Marital status		
- Single	162	30.74
- Married	365	69.26
Labor force		
- Informal sector	228	43.26
- Formal sector	299	56.74
Income level		
- Under 5 million VND	141	26.76
- 5 – under 9 million VND	155	29.41
- 9 – 15 million VND	145	27.51
- Over 15 -30 million VND	52	9.87
- Over 30 million VND	34	6.45
Training courses		
- Yes	161	30.55
	366	69.45

- No		
Access to financial information	95	18.03
- Regularly	432	81.97
- Rarely		
Observations	527	100%

Source: Authors calculated from research data

2.3 Methodology

To explain how demographic and socioeconomic characteristics are linked to financial knowledge, financial behavior, and financial attitude, The linear regression is applied by the ordinary least squares (OLS) regression model. For the three aspects of financial literacy, we employed three models. Financial knowledge, financial behavior, and financial attitude are used as dependent variables. Gender, age groups, education levels, labor force, income levels, marital status, training courses, and access to financial information are all independent factors. The linear regression model is as follows:

$$FK \text{ or } FB \text{ or } FA = \alpha + \beta_1 \text{gender} + \beta_2 age + \beta_3 education + \beta_4 \text{labor force} + \beta_5 \text{marital status} + \beta_6 \text{income} + \beta_7 \text{training course} + \beta_8 \text{AFI} + \beta_9 \text{ area} + \varepsilon_i$$

We also employed a generalized structural equation model in logit (GSEM in logit) to test the robustness of the results. A score of more than 0.5 indicates greater financial knowledge, behavior, and attitude, and a lower score indicates the opposite. The dependent variable is coded 1 for more financially educated respondents, those who have greater financial knowledge, better financial behavior, and better financial attitude, and 0 for those with a score of less than 0.5 for financial knowledge, financial behavior, and financial attitude. The independent variables were left unchanged from the linear regression model. Previous research has claimed that endogeneity is a significant concern in the study of financial literacy, which can lead to biased results (Lusardi & Mitchell, 2011a). According to Bartus (2017), the GSEM in the logit model compensated for any endogeneity bias in the coefficients. Hence, we utilized the GSEM in the logit model, similar to the linear regression model, to control possible endogenous issues.

3. RESULTS AND DISCUSSIONS

The OLS regression results of the demographic and socioeconomic components affecting financial knowledge, behavior, and attitude are shown in Table 3. The regression coefficients of financial knowledge, financial behavior, and financial attitude are presented in Models 1, 2, and 3, respectively. Model 1's coefficients indicate a positive link between financial knowledge and male gender, education level, income, training course, and formal sector. We discovered no association between respondents' access to financial information and financial knowledge. The ages 25-34 and above 50 also do not corroborate the relationship. Interestingly, we discovered a distinct association between several demographic characteristics and both financial behavior and financial attitude when we compared the link with financial knowledge. In contrast to model 1, the coefficients of model 2 demonstrate that gender and age have no link with financial behavior, as training courses and marital status do. However, diploma or graduate level of education and income levels over VND9 million are strongly connected with financial behavior. Model 3 coefficients demonstrate that dissimilar to financial knowledge, men are adversely linked with financial attitude, whereas age groups are favorably related to financial attitude. Only the highest income level of more than VND30 million has a close link with financial attitude. Overall, the data suggest that while men have greater financial knowledge than women, women have better financial behavior and attitude than men. Regarding two additional variables connected to training courses and access to financial information, demographic and socioeconomic aspects were introduced. Training courses influence people's financial knowledge but have no impact on their financial behavior or attitude. However, individuals who have access to financial information have an impact on their financial attitude.

Table 3. Ordinary least squares (OLS) regression coefficients.

	Financial knowledge (model 1)	*Financial behavior (model 2)*	*Financial attitude (model 3)*
Male	0.046 (0.02) **	-0.036 (0.03)	-0.034 (0.02) *
Age group (ref. under 25) - 25-34 - 35-49 - 50-60	 0.020 (0.03) 0.077 (0.03) ** 0.022 (0.04)	 -0.010 (0.03) 0.011 (0.04) 0.021 (0.05)	 0.092 (0.02) *** 0.111 (0.03) *** 0.106 (0.05) **
Education level (ref. under high school) - High school - Diploma/Graduate degree - Postgraduate degree	 0.149 (0.04) *** 0.192 (0.03) *** 0.156 (0.05) ***	 0.028 (0.04) 0.117 (0.04) *** 0.050 (0.05)	 0.052 (0.04) 0.048 (0.03) 0.086 (0.04) *
Formal sector	0.076 (0.02) ***	0.075 (0.03) ***	-0.020 (0.02)
Married status	0.04 (0.13)	0.103 (0.12)	-0.072 (0.06)
Income level (ref. under VND 5 million) - VND 5 – 9 million - VND 9 – 15 million - VND Over 15 – 30 million - Over VND 30 million	 0.05 (0.03) * 0.11 (0.03) *** 0.170 (0.04) *** 0.159 (0.05) ***	 0.039 (0.03) 0.75 (0.03) ** 0.079 (0.04) ** 0.112 (0.05) **	 0.001 (0.03) 0.025 (0.03) 0.027 (0.04) 0.097 (0.04) **
Training course	0.06 (0.02) ***	0.033 (0.02)	0.007 (0.02)
Access to financial information	0.273 (0.03)	0.146 (0.04)	0.197 (0.05) **
Area	yes	yes	yes
F	9.99 ***	5.69 ***	1.79 **
Adjusted R^2	0.283	0.177	0.059
Observations	527		

Notes: t values in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Furthermore, the data is analyzed by using the generalized structural equation model in logit (GSEM in logit) to assess the robustness of the results and ensure the reliability of the findings. Table 4 displays the coefficients of the GSEM in the logit model to investigate what factors increase the chance of having good financial knowledge, behavior, and attitude. Similarly, regarding the OLS estimation, three models are estimated for the three facets of financial literacy. The coefficients of model 1 reveal that male gender, education level, training course, formal sector, and high-income level (over VND30 million) tend to increase financial knowledge, whereas younger people and those with incomes equal to or less than VND30 million per month are not found to have any relationship. After the robustness is controlled, the finding indicated that there are significant discrepancies between ~~in~~ respondents' knowledge and their gender. Males tend to have higher levels of financial knowledge than females. This result has supported previous studies (Lusardi & Mitchell, 2014). Furthermore, Lusardi et al. (2017) also found that the more educated persons are, the better financial literacy scores they achieve. The results of model 2 suggest that people who work in the formal sector and have a married status have better financial behavior, but gender, age, education, training course, access to financial information, and an income level of VND30 million or less are unrelated to financial behavior. In model 3, the coefficients demonstrate that age, education, and employment in the formal sector tend to enhance financial attitude, but the male gender tends to deteriorate it. In summary, the results reveal that the connection of age, education, and the formal sector is essentially comparable to three components of financial literacy after correcting any endogeneity by using GSEM in the logit technique. However, there are variations in all aspects of financial literacy for men. Particularly, in contrast to financial knowledge, males are adversely related to financial behavior and financial attitude but just statistically significant with financial attitude. Furthermore, the overall results of the GSEM in logit and OLS models are quite comparable, showing that our results are robust.

Table 4. Generalized structural equation model (GSEM) in logit regression coefficients.

	Financial knowledge (model 1)	*Financial behavior (model 2)*	*Financial attitude (model 3)*
Male	0.087 (0.04) **	-0.046 (0.04)	-0.080 (0.04) *
Age group (ref. under 25) - 25-34 - 35-49 - 50-60	 0.071 (0.06) 0.198 (0.07) *** 0.095 (0.09)	 -0.067 (0.06) -0.026 (0.07) 0.086 (0.09)	 0.118 (0.07) * 0.238 (0.07) *** 0.170 (0.09) *
Education level (ref. under high school) - High school - Graduate degree - Postgraduate degree	 0. 245 (0.07) *** 0.305 (0.06) *** 0.244 (0.09) ***	 0.122 (0.08) 0.096 (0.07) 0.132 (0.10)	 0.138 (0.08) * 0.169 (0.07) ** 0.167 (0.10) *
Formal sector	0.141 (0.04) ***	0.123 (0.05) **	0.178 (0.05) ***
Married status	0.1168 (0.21)	0.523 (0.22) **	0.265 (0.21)
Income level (ref. under VND 5 million/per month) - VND 5 – 9 million - VND 9 – 15 million - VND Over 15 – 30 million - Over VND 30 million	 -0.033 (0.06) 0.080 (0.06) 0.112 (0.08) 0.264 (0.09) ***	 -0.03 (0.06) 0.052 (0.07) 0.09 (0.09) 0.217 (0.10) **	 0.036 (0.06) 0.075 (0.07) 0.170 (0.09) * 0.122 (0.10)
Training course	0.095 (0.05) **	-0.028 (0.05)	- 0.010 (0.05)
Access to financial information	0.031 (0.04)	0.088 (0.06)	0.062 (0.06)
Area	yes		
Observations Log likelihood	527 -324.997	527 -358.537	527 -353.293

Notes: t values in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

CONCLUSION

The purpose of this research is to look at the aspects that contribute to Vietnamese individuals' financial literacy. To determine whether demographics and socioeconomic characteristics influence financial literacy, multivariate regression analysis was used. The survey revealed significant gaps in financial literacy among individuals in the southeast of Vietnam. Specifically, our study findings revealed that females, people working in the informal sector, and those who have not received financial knowledge from any training course have less financial knowledge than males, those working in the formal sector, and those participating in financial training programs. Furthermore, persons with higher incomes were more financially literate than those with lower incomes. However, the findings indicate that there is no evidence of the link between the majority of demographic and socioeconomic characteristics and individual financial behavior. The findings contributed to the existing knowledge of the influence of various demographics and socioeconomic parameters by investigating the diversity of financial knowledge and financial attitude.

The findings of this study also revealed several potential consequences. First, the Vietnamese government must implement educational initiatives to promote people's financial literacy, particularly women, those working in the informal sector, and those proven to be less financially literate. Second, our empirical findings indicate that high-income levels have a considerable effect on the three facets of financial literacy. Hence national financial education approach should prioritize low-income individuals.

ACKNOWLEDGEMENT

Funding: This research is funded by Vietnam Ministry of Education and Training under grant number B2022-MBS-04.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Gláserová, J., Otavová, M., Blazkova, A. (2024), "Non-Financial Reporting by Banks in the Context of Current Development",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 117-130.

Non-Financial Reporting by Banks in the Context of Current Development

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ARTICLE INFO

Received February 04, 2023
Revised from March 03, 2023
Accepted April 03, 2023
Available online April 15, 2024

JEL classification: M 40, M48, Q 56, G 21

DOI: 10.14254/1800-5845/2024.20-2.10

Keywords:

Non-financial information,
non-financial reporting,
Directive 2014/95/EU (NFRD),
banking institution,
social responsibility,
anti-corruption policy.

ABSTRACT

The paper investigates the impact of the implementation of Directive 2014/95/EU nonfinancial reporting into Czech accounting regulations by evaluating the level and quality of non-financial reporting by banking institutions, including their foreign branches based in the Czech Republic. Information from the area Environment, Social and Governance are considered globally topical and relevant. They contribute to increasing competitiveness and responsible building of the future. The verification of level and quality of non-financial reporting was based on the comparison of the years 2016 and 2021, i.e., periods before and after the implementation of the directive. For the purpose of comparison, banking institutions were divided into three groups: banks with an obligation to report non-financial information, banks that are large accounting entities, and other banks. Key indicators of five basic areas of non-financial reporting were identified and the level of their reporting by banks was subsequently examined. The quality of the reported information was assessed using a point scale. The level of non-financial reporting in the sector of financial institutions in the Czech Republic was compared with the level of reporting in the Visegrad countries, Germany and France. By means of correlation and regression analysis, factors that influence the quality and level of non-financial reporting were identified, the most significant being net assets, gross loans to customers and Tier 1. It was also found that non-financial reporting is unsystematic due to the absence of a comprehensive methodology, mainly in the group of banks II and III. At the same time, the V4 countries report less non-financial information compared to Germany and France. A positive finding is the fact that there has been an increasing tendency in non-financial reporting in all monitored countries.

INTRODUCTION

Nowadays, in addition to financial reporting, non-financial reporting is also becoming more and more important. Information about the undertaking and its future development may be equally as important as, for example, information about the profitability and capital appreciation of the undertaking. Therefore, the basic mission of every undertaking is to create harmony between the economic role of business and the

responsibility for its impact on the whole society. Non-financial reporting can be defined as the disclosure of information about the undertaking provided to the general public that does not only relate to financial performance. Non-financial information includes a wide range of aspects and its impact can therefore be very broad. The fact that there is no uniform definition of the content of non-financial information leads to differences in non-financial reporting by undertakings. Information published as part of non-financial reporting is abbreviated to ESG (environmental, social, governance).

In recent years, progress has been made in non-financial reporting. Non-financial reporting is necessary for communication between the undertaking and interested groups (employees, business partners, investors, customers, media and the public). Regular reporting of non-financial information should mainly help large undertakings identify sustainability risks and bring increased confidence in them among investors and consumers. This is now an important management tool. Non-financial reporting thus provides another business dimension.

Non-financial reporting can be viewed as an increase in credibility and transparency of undertakings, which leads to establishing a strong position in the market. The reporting itself varies from undertaking to undertaking because there is no binding standard of reporting for undertakings. The willingness to disclose financial information is significantly affected by the size of the undertaking. Large undertakings are more willing to disclose non-financial information because they often realize that by doing so, they give users a more favourable view on corporate behaviour and stability, which leads to the increased undertaking's performance.

On 22 October 2014, Directive 2014/95/EU (NFRD) was adopted by the European Parliament and the Council. Its content is non-financial reporting by large undertakings. NFRD stands for Non-Financial Reporting Directive and hereinafter it will be referred to as "the NFRD". The member states of the European Union had an obligation to implement this directive into their national regulations so that non-financial information for 2017 was reported in accordance with the directive. For the first time, the NFRD imposes an obligation on defined large undertakings to report non-financial information. Before the NFRD entered into force, opinion on non-financial reporting was divided in the European Union. Generally speaking, the West of Europe was more advanced in non-financial reporting.

By publishing the NFRD the European Commission seeks to increase the transparency, consistency and comparability of non-financial information of European undertakings. According to lawmakers, non-financial reporting is a crucial step in managing the change leading to a sustainable global economy that combines long-term profitability with social justice and environmental protection (Consolandi, 2020).

The NFRD is the first instrument to set rules and requirements for non-financial reporting so that reporting within the EU is more uniform and systematic. Therefore, the large undertakings concerned are required to report on an annual basis non-financial information, in particular on the environment, social and employment matters, human rights and anti-corruption or bribery matters. It should also be added that currently, in accordance with the NFRD, non-financial reporting is mandatory for approximately 6,000 undertakings in the European Union.

In connection with non-financial reporting in the Czech Republic, it must be noted that it is not as popular as in other developed European countries, especially in Western Europe. Currently, the obligation to report non-financial information concerns a relatively small number of entities in the Czech Republic. When reporting non-financial information, there is an obvious fragmentation and unsystematic approach, which in most cases only results from general legal requirements imposed on non-financial reporting in the Czech Republic. Also, external verification only focuses on the existence of a non-financial report, not on its content.

With the introduction of the NFRD, non-financial reporting has become an integral part of reporting also by financial institutions that meet the criteria contained in the NFRD. Therefore, this paper focuses on verifying the level of quality and quantity of non-financial reporting by banking institutions based in the Czech Republic and also foreign branches operating in the Czech Republic.

1. LITERATURE SEARCH

In 2014, Directive 2014/95/EU on disclosure of non-financial and diversity information by certain large undertakings and groups, amending Directive 2013/34/EU on the annual financial statements, consolidated financial statements and related reports of certain types of undertakings, was adopted. Directive 2014/95/EU is also called the Non-Financial Reporting Directive (hereinafter referred to as "the NFRD"). Until 2016, undertakings published non-financial information on a voluntary basis. The obligation to disclose non-financial information for the 2017 accounting period arises from the NFRD adopted and mandatorily implemented by all EU member states. Under the NFRD, only large undertakings are obligated to publish non-financial information if they are also public-interest entities with more than 500 employees. Public-interest entities include financial institutions, e.g., banks. The NFRD aims to get undertakings to integrate sustainability using their own goals. The European Union then only monitors their behaviour (Di Vaio et al., 2020). De Groen (2020) however, add that these goals are often general and, in their opinion, the NFRD will not bring the desired results. They also add that the NFRD places an additional administrative burden on undertakings.

The financial sector plays a key role in the area of non-financial reporting and sustainable development. The main reason for such a large involvement of the financial sector is primarily an increase in competitiveness and also corporate value placed on this area. In comparison with business entities, the vast majority of financial institutions have a strategy with specific goals. According to financial institutions, a motivating factor for the expansion of ESG reporting among other companies could be the inclusion of ESG risks in investment decision making and other financing. (Brázda and Brodani, 2022)

The basic legislative framework of this area also includes the Taxonomy Regulation and non-binding guidelines for non-financial reporting issued by the European Commission. Non-financial reporting is further regulated by the regulation on the disclosure of information related to sustainability "SFRD – sustainable finance disclosure regulation" (Gregor, 2021). With effect from 1 January 2022, there is a new classification system with new requirements for publishing information on green investment products, which is crucial for the banking institutions themselves (Walker et al., 2018). As we can see, green investing has become a key factor in the field of energy in recent years. Eyraud et al. (2011) state that the policies of individual states should support more private investment that would initiate the potential of green investment. At the same time this is an opportunity for financial institutions to cover these investments. The European Union, in cooperation with central banks, has developed a standard for green bonds (EU-GBS), which is intended to help create transparent, standardized and comparable information about green bonds and above all reduce the risk of greenwashing (De Ruiter, 2020; Jakubík and Uguz, 2021). It is also important that financial institutions convey the importance of this topic to their clients and assess the impact of investments with respect to sustainability. (Gangi et al., 2018).

Elliott (2022) adds that thanks to the introduction of EU-GBS and green bonds, the green investment market is still expanding. The reason is mainly ever-increasing new environmental legislation, the public's growing demand and above all the situation where investors and large companies have committed themselves to environmental protection and social responsibility. The green bond market has expanded in recent years. Now, there are a large number of other categories such as "social bonds" and "sustainability bonds" and investors such as banks, insurance companies, governments and private investors (Dropulic, 2021). However, Korca and Costa (2021) observe that in the area of green investing and non-financial reporting there is a lack of clearly defined key performance indicators (KPI) that would facilitate reporting and ensure international comparison and greater willingness of undertakings to report this information. Lin and Hong (2022) see disadvantages mainly in the restriction of retail investments which are not well integrated into regular funds and also in the estimate of the impact of green investments and the evaluation of their benefits. Another disadvantage mentioned is that investments in green projects do not guarantee an increase in rating and that they are not cheaper than classic bonds. Lyeonov et al. (2019) state that most financial institutions do not place much emphasis on green investing and do not include this data in their reports. However, this does not apply to Western and Northern European countries such as Germany, France, Sweden and others.

To assess the quality and level of reporting, the so-called ESG rating is used. It is based on environmental, social and transparency factors. Its advantage is that it is always prepared for a certain sector of

the economy (Abhayawansa and Tyagi, 2021). ESG ratings are crucial primarily for investors but also for the banks themselves. They can use ratings to assess risks and other partial factors that can help to get the picture of the company. An international survey carried out by KPMG (2020) "KPMG Survey of Sustainability Reporting" compares the level and quality of non-financial reporting by undertakings in more than 52 countries around the world. Despite possible negatives (e.g., non-uniform methodology) of non-financial reporting, there has been an increase in non-financial reporting by undertakings in recent years. (Venturelli et al., 2020). At the same time, research by Schönborn (2019) indicates that financially successful undertakings disclose non-financial information more. The above is also confirmed by the study conducted by Malik (2015). Casey and Grenier (2014) add that the reason is the fact that the market perceives such companies as less risky.

In Italy, research confirmed the active role of large banks in disclosing their non-financial information. The eight out of ten companies perceive the contribution of ESG positively (Brázda and Brodani, 2022).

Most financial institutions view non-financial reporting as a competitive advantage they can offer the customer. Some countries such as France, the UK, Sweden, Denmark, Spain and Finland already had similar regulations in place at the national level (Caputo et al., 2019). It is worth mentioning that the Polish government was against the introduction of the NFRD and wanted non-financial reporting to be prepared on a voluntary basis (Krasodomska and Godawska, 2020). In general, it can be said that Western European countries are more advanced in non-financial reporting than other European countries (Dumitru et al., 2017). Belal et al., (2013) add that the reasons why the Eastern countries are falling behind may be due to the low enforceability of reporting and mainly due to the historical economic arrangement. In recent years, however, awareness of sustainability has increased greatly, within all European states (Schönborn et al., 2019).

In November 2022, a new Corporate Sustainability Reporting Directive (CSRD), directive was approved. According to this directive, the obligation to report non-financial information should also apply to another group of undertakings. These will be all large undertakings meeting at least one of the following conditions: more than 250 employees, annual turnover higher than 50 million euros, balance sheet total higher than 43 million euros or being a publicly traded company.

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2. METHODOLOGY

The impacts and evaluation of the implementation of the NFRD into Czech accounting legislation are examined on the basis of analysis of annual reports and separate non-financial reports prepared by banking institutions and branches of foreign banks based in the Czech Republic, which are on the list of regulated and registered entities of the financial market administered by the Czech National Bank. The analysis of annual reports helps to evaluate the impact of the implementation of the NFRD into Czech legislation by comparing the years 2016 and 2021. The period before the implementation of the NFRD is the year 2016, which is compared with the most current data, i.e., the year 2021. Five basic areas of non-financial reporting were identified, i.e., environmental matters, social matters, treatment of employees, respect for human rights and anti-corruption and bribery policy. In each area sub-criteria were determined and analysed in the documents. A total of 48 banking institutions were analysed. For more effective comparison they were divided into three basic groups. These are banks with an obligation to disclose non-financial information (Group I), banking institutions defined as large entities according to the Accounting Act (Group II) and other banking institutions (Group III).

The quality of published non-financial information was assessed using a point scale, where each criterion can have up to three values, i.e., 0-2 (0 points if the criterion is not disclosed, 1 point if the criterion is reported in general, and 2 points for detailed information). Each of the banks could be assigned a maximum of 34 points for all areas studied. The choice of these criteria was based on the Guidelines for Non-Financial Reporting proposed by the European Commission and guided interviews with experts from

audit firms and businesses engaged in this area. The specific criteria within individual areas are shown in Table 1.

Table 1. Non-financial reporting criteria

Area	*Criteria assessed*
Environmental matters	Reduction of negative impacts on the environment
	Limitation on coal funding
	Acceptance of commitments under the Paris Climate Agreement
	Motivation of employees to protect nature
Social matters	Education courses and awareness raising
	Charity activities
	Investment in innovation
	Employee motivation to engage in charity and voluntary work
Employees	Staff training
	Employee discounts on insurance products
	Employee benefits
Respect for human rights	Code of ethics
	Zero tolerance for discrimination
	Support for programmes for inclusion of disadvantaged individuals
Anti-corruption and bribery policy	Code of ethics
	Staff training
	Implementation of the EP regulation

To broaden the view on non-financial reporting, the level of reporting in the Czech Republic was compared with the reporting in the countries of the Visegrad Group (hereinafter referred to as "V4"), Germany and France. The data for the comparative analysis was obtained from the EUKI database, specifically for the sector of financial institutions. The V4 countries were chosen because of their similar historical and political development. Germany was chosen as a country that is an important export partner of the V4 countries. France was chosen as one of the first countries to introduce mandatory non-financial reporting at the national level.

The quality and quantity of disclosed non-financial information was studied using correlation and regression analysis. The objective of this statistical modelling is to determine the factors that influence the quality and extent of non-financial reporting and also determine the dependence of the variables on the overall score, when the individual correlation coefficients are tested using the 5% significance level. Regression analysis tries to confirm the results obtained in correlation analysis. The dependent variable is the score which will be explained using the following explanatory variables: gross loans to customers; customer deposits; number of employees; ROAE; ROAA; capital adequacy; Tier 1; regulatory capital; net assets. The regression model developed on the basis of the data obtained will determine the variables which explain best the score achieved.

3. RESULTS

The following chapter presents the results of the research into the quality and quantity of non-financial reporting. The first part of the results shows the evaluation of the impact of the implementation of the NFRD into Czech accounting legislation and the comparison with the situation in selected European countries. The second part shows the scoring and the development of reporting in the period before and after the implementation of the NFRD. The last part presents the results from statistical modelling using correlation analysis where the dependence of variables on the level of disclosure of non-financial information is examined.

The impact of the implementation of the NFRD on non-financial reporting by banking institutions

Under the NFRD, banking institutions are obligated to include non-financial information in their financial statements. The non-financial information must primarily cover the areas of the environment, employee care, human rights, anti-corruption policy and social issues. The table below shows the percentages of non-financial reporting within the individual groups of banking institutions. The changes between 2016 and 2021 represent the impact of the implementation of the NFRD on non-financial reporting into Czech national legislation.

Table 2. Level of non-financial reporting by groups of banks (in %)

Factors	*Group I*		*Group II*		*Group III*	
	2016	*2021*	*2016*	*2021*	*2016*	*2021*
Environmental matters	35.71	51.79	11.36	38.64	6.25	10.00
Social matters	44.64	57.14	22.73	31.82	10.00	10.00
Employees	52.38	66.67	24.24	33.33	15.00	20.00
Respect for human rights	40.48	54.76	3.03	9.09	6.67	8.33
Anti-corruption, anti- bribery and anti-money laundering policy	42.86	67.86	4.55	15.91	5.00	6.25

Source: Authors' own calculations

The results of Table 2 show that in all groups of banks under study there was in increase in reported information in 2021 compared to 2016. A more significant increase of approximately 15 p.p. can be observed in the areas of the environment, respect for human rights, and anti-corruption, anti-bribery and anti-money laundering policies. In other areas, there was also an increase in reporting (about 10 p.p.). The only exception is the area of social issues in Group III, where there was no increase.

In Group I, the most reported area in 2021 was the area of anti-corruption and bribery and anti-money laundering policy. This finding is positive because this area is very sensitive in the banking sector. In Group II, the most frequently reported area was the environment and in Group III, it was the area of employees. Non-financial reporting by banking institutions is supplemented by Table 3, which compares the situation in the Czech Republic with the situation in the V4 countries, as their political and economic developments are similar. Germany and France were also included as they represent the developed countries of Western Europe. Germany is an important export partner of the Czech Republic and France is the country in which the obligation to report non-financial information at the national level was introduced first.

Table 3. Comparison of non-financial reporting in selected European countries (%)

		Czech Republic	*Hungary*	*Poland*	*Slovakia*	*AW V4*	*Germany*	*France*
Environment	A	*14.3*	*0*	*26.7*	*40*	*26.7*	*27.8*	*37.8*
	B	*28.6*	*66.7*	*62.2*	*46.7*	*51.1*	*63.8*	*88.9*
Employees	A	*13.3*	*11.1*	*16.6*	*1607*	*14.4*	*30.6*	*37.8*
	B	*66.7*	*55.3*	*50*	*50*	*48.6*	*77.8*	*91.1*
Human rights	A	*6.7*	*3.7*	*0*	*0*	*2.6*	*11.1*	*13.3*
	B	*26.7*	*22.2*	*16.7*	*16.7*	*20.6*	*61.1*	*51.1*
Anti-corruption policy	A	*6.7*	*11.1*	*33.3*	*33.3*	*12.8*	*22.2*	*11.1*
	B	*60*	*59.3*	*50*	*50*	*56.6*	*57.6*	*68.9*

Source: EUKI 2020 and 2019

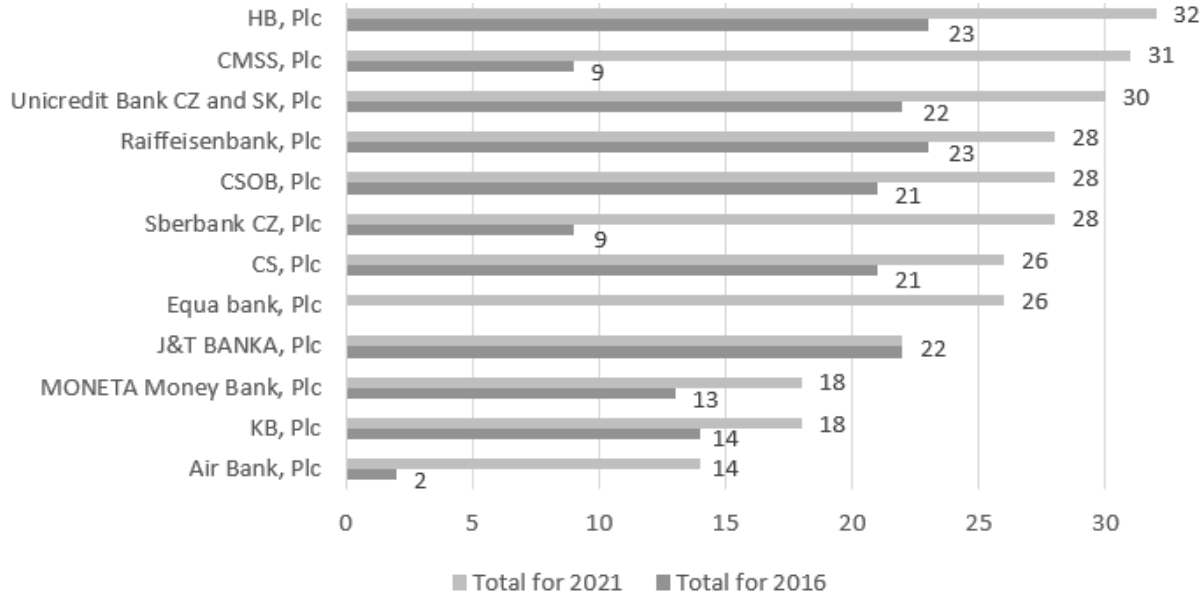
The results in Table 3 are divided according to the quantity of reported non-financial information, where row "A" represents the percentage of high-quality information reported by banking institutions. On the contrary, row "B" is represented by banks that fulfil this obligation only formally, they do not provide much information and usually they only mention the given area. The table brings results that evaluate not only the non-financial reporting itself but also the quality of the information. As can be seen from Table 3, the only area in which the Czech Republic completely falls behind the V4 average is the area of the environment. In other areas, the financial institutions of the Czech Republic exceed the average of the V4 countries. When we look closely at row A (showing high-quality information) we can notice that the Czech Republic is around the average of the V4 countries.

Non-financial reporting by financial institutions in Germany and France reaches higher values in comparison with the average of the V4 countries and is also of higher quality. The international comparison shows that France has the best results. The only area in which it slightly falls behind the V4 countries is the reporting of high-quality information in the area of anti-corruption policy (row A). In all the other areas, however, it far exceeds the average of the V4 countries. Such a good result can be attributed primarily to a long-term obligation to report non-financial information in French national legislation. What is worth noticing is that the other V4 countries, except the Czech Republic, do not report any high-quality information in at least one mandatory area.

Evaluation of non-financial reporting by banking institutions in the Czech Republic

A qualitative view on published non-financial information by individual groups of banking institutions is added. The score evaluation results are represented by separate graphs for specified groups of banking institutions according to the procedure specified in the section Methodology. Banking institutions can gain a maximum of 34 points, whereas the graphs include only those banking institutions that earned a minimum of 3 points for the year 2021.

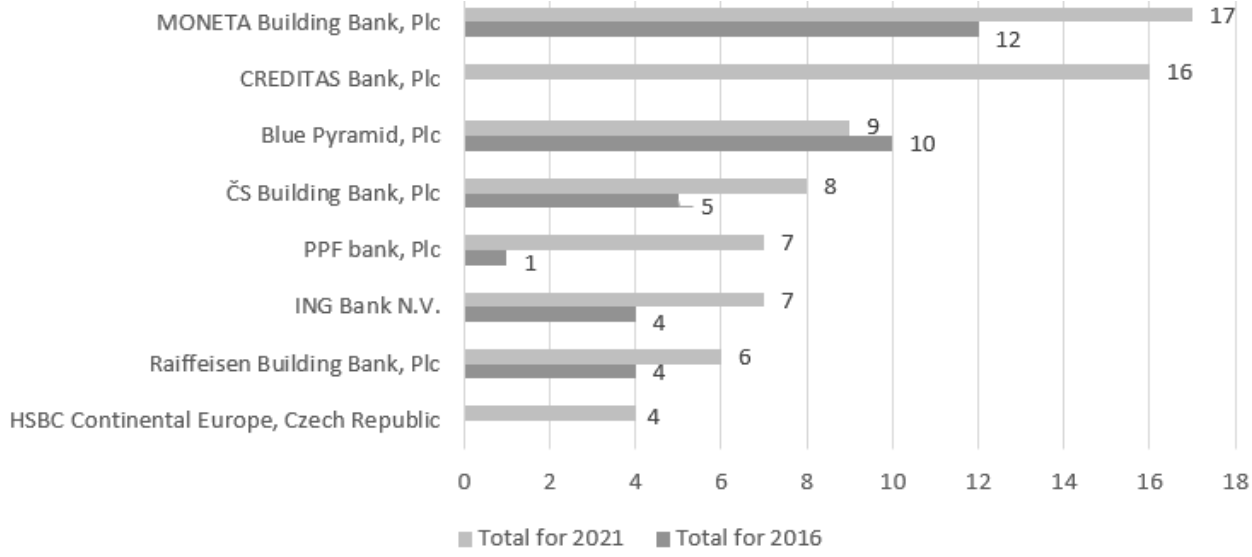
Graph 1. Group of banks I, comparison of the years 2016 and 2021



Source: Authors' own work based on annual reports

Group I is represented by a total of 14 entities, of which two entities did not earn the minimum of 3 points for 2021, therefore they are not shown in the graph. The highest score was achieved by HB, Plc. Graph 1 also shows the increasing level of non-financial reporting after the introduction of the NFRD, when entities scored, on average, eight more points

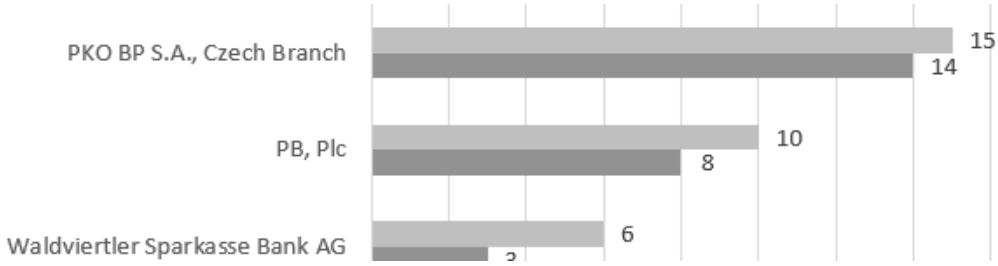
Graph 2. Group of banks II, comparison of the years 2016 and 2021



Source: Authors' own work based on annual reports

Group II is represented by 11 entities. Three banks, however, do not publish mandatory information. The best bank in this group was MONETA Building Bank, Plc. Second place was taken by Creditas bank and third place by Blue Pyramide Building Bank, Plc. In comparison with Group I, there were lower values of the maximum score and on average there was a lower increase in points between 2021 and 2016.

Graph 3. Group of banks III, comparison of the years 2016 and 2021

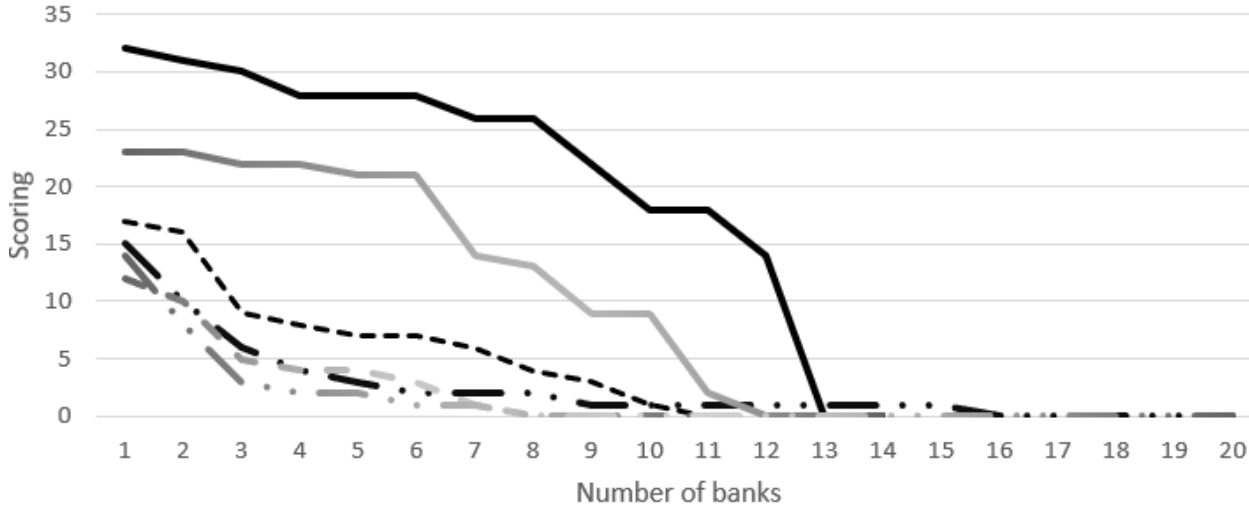


Source: Authors' own work based on annual reports

Group III is the largest group of banks in terms of the total number of entities. In total, there are 20 banking institutions. However, only 25% of them publish non-financial information. The other entities either do not publish at all or did not reach the minimum threshold of 3 points for the year 2021. The highest score in this group was earned by the foreign branch of the PKO BP S.A Bank. It can be noted that mainly foreign bank branches report in this group. Among the most important areas reported by the banks surveyed are "Environment" and "Employees".

The graphic representation of all groups of banking institutions illustrates the trend and development of the achieved point evaluation for the period before and after the implementation of the NFRD into Czech accounting legislation

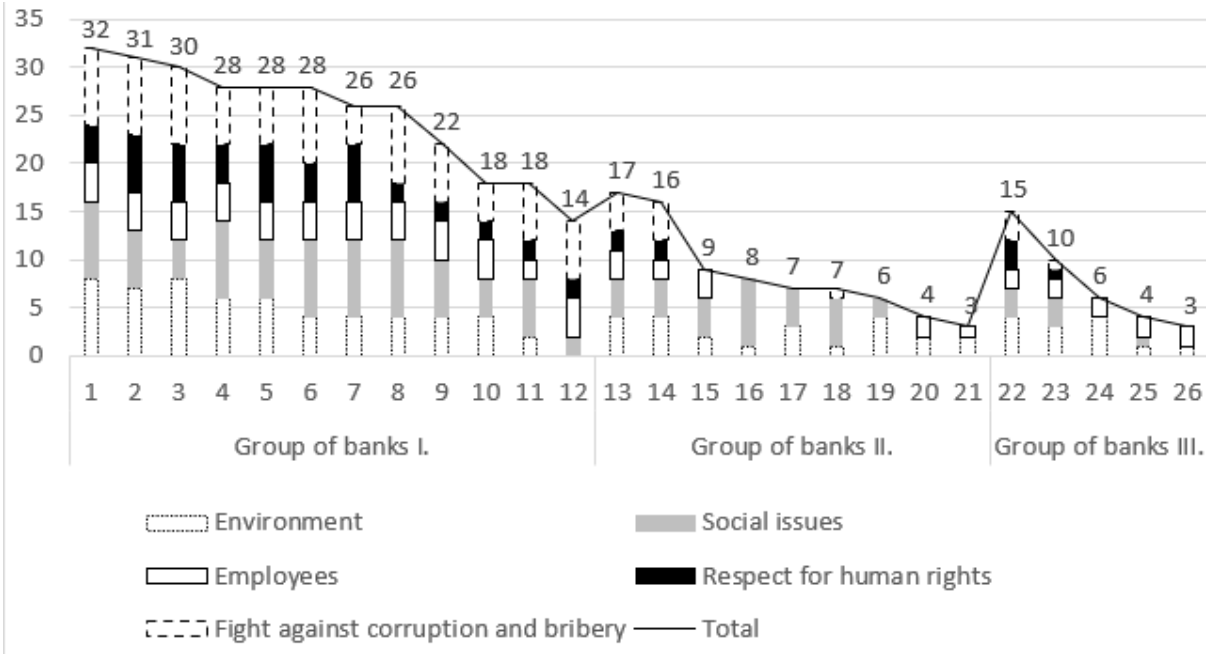
Graph 4. Comparison of the groups of banks in the period 2016-2021 before and after the implementation of the NFRD



Source: Authors' own work based on annual reports

A positive increase in point evaluation and in overall reporting of non-financial information can be seen in all groups of banking institutions. There is a significant difference in the points between Group I and the other groups. The difference became even greater in 2021. As Graph 4 shows, the implementation of the NFRD helped improve non-financial reporting. The results are illustrated by Graph 5, which shows the point distribution of individual groups of banks within the monitored areas

Graph 5. Comparison of the groups of banks (2021) in the period before and after the implementation of the NFRD



Source: Authors' own work based on annual reports

Statistical modelling of dependency

The following chapter focuses on indicators that may influence the level of reported information in non-financial statements of banking institutions. The relationship between the point evaluation and the other variables is studied using Spearman's correlation coefficient and regression analysis. Both statistical methods take into account point evaluation in relation to the variables typical for banking institutions, such as gross loans to customers, customer deposits, converted number of employees, ROAE, ROAA, net assets and Tier 1.

Spearman's correlation coefficient

Using this coefficient, we try to find out which of the variables mentioned are related to the point evaluation. The direction and intensity of this relationship are particularly important. However, before the interpretation of the correlation coefficients it is necessary to verify their significance using the p-value.

Most of the calculated coefficients show positive values, which means that the larger this quantity is, the more banking institutions report non-financial information. But this is not true the other way round. The highest intensity of dependence is shown by the quantity "gross loans to customers". Together with the quantities "Tier 1" and "net assets" it ranks among the quantities with a significant impact on the total score. In addition, P-values of these variables are significant at the 5% level. The only coefficient with a negative value is the "ROAA". Banks with a low return on assets are likely to focus more on non-financial reporting, by which they may try to highlight another advantage of their business. The paper did not deal more with this causality.

Spearman's correlation coefficient using observations 1–33

Score	Variable	p-value
-0.247	ROAA	0.155
0.105	ROAE	0.583
0.367	Customer deposits	0.053
0.441	**Number of employees**	**0.018**
0.501	**Net assets**	**0.005**
0.516	**Tier 1**	**0.003**
0.607	**Gross loans to customers**	**0.000**
1.000	**Point evaluation**	

Regression analysis

The regression model supports the results of the correlation analysis, which shows the strongest correlation between the point evaluation and gross loans to customers. In the regression model, the point evaluation was used as a variable explained, the remaining variables (ROAA, ROAE, deposits and gross loans to customers, number of employees, Tier 1 and net assets were used as explanatory variables. However, after building the regression model, only one variable appears to be significant, i.e., gross loans to customers. The positive signs of the coefficients mean that the bank's score increases with the increase in the volume of loans provided. As in the case of correlation analysis, the inverse relationship is not true The individual correlation coefficients are tested at the 5% significance level. Table 4 shows individual coefficients. The regression model complements the information derived from the correlation analysis.

Table 4. Results of the regression model

N=33	b*	Std.Err. of b*	b	Std.Err. of b	p-value
Gross loans to customers	1.164211	0.541313	5.4410	2.52985	0.041

DISCUSSION AND CONCLUSION

The aim of this paper was to evaluate the impact of the implementation of the Non-Financial Reporting Directive (NFRD) into Czech accounting legislation. The focus was on the level of reporting non-financial information before and after the implementation of the NFRD. For comparison purposes, banking institutions were divided into three groups: banks with an obligation to report non-financial information, banks that are large accounting entities, and other banks.

An analysis of the annual reports prepared by individual banking institutions revealed an increase in the volume of reported information in all groups of banks. This suggests that non-financial information is also more reported by entities with no obligation to report this information. At the same time, it can be stated that their number is still increasing. A graphical analysis of non-financial reporting was used to reveal information about the quantity of this reporting. The analysis is supplemented with a point scale evaluating the quality of non-financial information.

In most banking institutions, reporting the traditional areas such as the environment prevails. It is often supplemented with the area of anti-corruption and bribery policy. This area is by its nature very important for banking institutions.

Within Groups II and III, reporting is highly unsystematic and it is impossible to identify the most frequently reported areas. There has been a noticeable absence of a comprehensive methodology applicable to the banking institutions included in these groups. The conclusions are supported by statistical research, especially Spearman's correlation coefficient. It shows that the indicators "net assets", "gross loans to customers" and "Tier 1", showing the total size of banking institutions and the significance of their position

on the financial market, have the greatest impact on the score of non-financial reporting. These variables are also significant at the 5% level, which confirms the above conclusions. If the above-mentioned variables grow year on year, it is assumed that the score will go up. This is mainly due to the high values of the correlation coefficients of these variables. The least influence on the score is related to the "ROAA", which results from the correlation coefficients. It is possible to state that the larger the entity is and the higher its credit activity is, the more willing it is to report high-quality non-financial information.

As there is no uniform methodology for non-financial reporting, a marked difference in the quantity and quality of published non-financial information was found in the research.

Therefore, an amendment to the NFRD seems logical. The amendment may bring unification of requirements for non-financial reporting. It can be assumed that this will simplify comparison in the area of non-financial reporting. For the purpose of transparency and clarity of information, it would be appropriate to ensure that the new amendment to the NFRD will integrate non-financial information into annual reports of companies, which would put non-financial information on the same level as financial information. Emphasis should also be placed on diversity and a bigger representation of green investments. This is closely related to social responsibility and reporting non-financial information.

As EU legislation is very vague and does not closely specify how detailed and extensive non-financial information should be reported, the biggest problem can be seen in the imaginary rating scale. Despite the obligation to report non-financial information, the form of reporting is not specified anywhere. It was found that every entity reports non-financial information in a different way, i.e., with different quantity and quality. The result is that non-financial reporting is done "in a pleasing way". Annual reports and especially separate reports on non-financial information are used by companies as a tool for presenting their achievements. It is likely that if no unified structure is introduced and reports are not subsequently checked, the comparability and transparency of non-financial information will be difficult even in the years to come. The goal of the new regulation should be to achieve a higher level of transparency of non-financial information reported by companies in all sectors.

From the year 2023 a uniform reporting methodology will be in force together with individual indicators that should support the NFR standards. A more comprehensive and detailed view on the area of non-financial reporting should also be provided by the Corporate Sustainability Reporting Directive (CSRD). It introduces an obligation that the information be reported in a comprehensive form. According to this directive, the obligation to report non-financial information should be extended to another group of companies. These will be all large undertakings meeting at least one of the following conditions: more than 250 employees, an annual turnover of more than 50 million euros, a balance sheet total of more than 43 million euros, or being a publicly traded company. The directive also envisages that if any of these conditions is also met by medium-sized or small enterprises, they will also have an obligation to report non-financial information, with a three-year deferral of the effective date. Thus, the reporting of non-financial information would be mandatory for approximately 38,000 undertakings in the European Union. It is also mentioned that the verification of annual and consolidated sustainability reports will be subject to a mandatory audit. In order to be able to carry out the audit entities will have to pass an examination of professional competence. The published sustainability reports will have five areas which will include information about the business model and the strategy of the enterprise, business policies and their results, risks and their management and key performance indicators that relate to the relevant business activity. These regulations should be used for the accounting period starting on 1 January 2023. This seems unlikely, taking into account the current situation. It can be assumed that they will become effective later. In this context, it is necessary to mention that in November 2021 the International Sustainability Standards Board (ISSB) was established. It is a new standard-setting board within the IFRS Foundation. The mandate of the ISSB Board is to issue standards that provide a comprehensive global basis for disclosing information about sustainability for capital markets. The In March 2022 the ISSB Board issued the first two exposure drafts of IFRS standards for disclosure of sustainability data: IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Data and IFRS S2 Climate-related Disclosures.

It can therefore be assumed that in the following years the level of quality and quantity of non-financial reporting will continue to increase. This is also due to the fact that many undertakings and clients are increasingly making decisions on the basis of non-financial reporting and there is no doubt that their

numbers will continues to grow in the future. This fact is due not only to legislation but also to greater levels of social responsibility. The European Commission's Taxonomy Regulation, the main theme of which is meeting environmental targets, is another aspect that may affect the level of reporting. For these reasons, we expect in the coming years that there will be a significant increase in non-financial reporting not only by financial institutions, especially in the area of environmental data (e.g., carbon footprints), which together with other areas will be classified as mandatory in accordance with the CSRD. We can therefore expect an increased interest in non-financial reporting not only from banking institutions.

ACKNOWLEDGEMENT

This work was supported by Mendel University (grant project IGA-PEF-TP-23-009).

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Bocková, N., Hornungová. J., Dohnal, M. (2024), "Non-numerical Bankruptcy Forecasting Based on Three Trends Values – Increasing, Constant, Decreasing", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 131-144.

Non-numerical Bankruptcy Forecasting Based on Three Trends Values – Increasing, Constant, Decreasing

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ARTICLE INFO

Received February 19, 2023
Revised from March 20, 2023
Accepted April 20, 2023
Available online April 15, 2024

JEL classification: G33, G17

DOI: 10.14254/1800-5845/2024.20-2.11

Keywords:

Forecast,
Insolvency;
Trend;
Qualitative;
Bankruptcy;
Transition.

ABSTRACT

There is a broad spectrum of different BM (Bankruptcy Models). However, complex bankruptcies are unique, vaguely known, interdisciplinary and multidimensional. These are the key reasons why sufficiently large sets of examples are not available It is therefore often prohibitively difficult to make forecasts using numerical quantifiers and traditional statistical methods. BMs development suffer from IS (Information Shortage). IS eliminates straightforward application of traditional statistical methods based on information rich environment; that is on the law of large numbers. Artificial Intelligence has developed different tools to minimise IS related problems. Trend reasoning is one of them. It is based on the least information intensive quantifiers There are four different trends i.e. qualitative values and their derivatives: plus/increasing; zero/constant; negative/decreasing; any value / any trend. *The paper studies BMs represented by models based on EHE (Equationless Heuristics). An bankruptcy example of EHE is* – If Selling of Assets is increasing then Satisfaction of Creditors is increasing. *Such verbal knowledge items cannot be incorporated into a traditional numerical model. No quantitative quantifiers, e.g. numbers, are used in this paper. The solution of a trend model M(X) is a set S of scenarios where X is the set of n variables quantified by the trends. All possible transitions among the scenarios S are generated. An oriented transitional graph G has as nodes the set of scenarios S and as arcs the transitions T. An oriented G path describes any possible future and past time behaviour of the bankruptcy system under study. The G graph represents the complete list of forecasts based on trends. An eight-dimensional model serves as a case study. Difficult to measure variables are used, e.g.* Level of Greed, Political Influence. *There are 65 scenarios S and 706 transitions T among them. A priory knowledge of trend reasoning is not required.*

INTRODUCTION

Bankruptcies related forecasts represent a broad spectrum of complex tasks difficult to observe (Thomas, 2004). They are often unique and of interdisciplinary nature (e.g. a specific integration of macroeconomics, law, engineering). Bankruptcy related task can be analysed for different aspects (Goodell et al., 2021), see e.g. political situation (Li and Faff, 2019) or Sentiment (Zhao et al., 2022). In other words there is a broad spectrum of different model. Different tools are used to analyse them – statistical analysis, fuzzy or rough sets, genetic algorithms and some other methods of artificial intelligence, see e.g. (Yoon and Hwang, 1995). Soft sciences are often used to develop bankruptcy forecasting models. However, highly nonlinear, vague, partially inconsistent and multidimensional systems are prohibitively difficult to study at the quantitative level. Several types of quantitative simplifications are therefore used, e.g. linearization. The resulting models are oversimplified and therefore inapplicable results are often obtained (Dohnal and Doubravský, 2015).

Formal used tools are : neural networks, genetic algorithms, vague reasoning (fuzzy, qualitative, semi-qualitative, rough, and probabilistic), see e.g. (Punzo, 2003). Numbers and numerical mathematics (e.g. sets of differential equations) are frequently used as well; see e.g. (Acharjya and Rathi, 2021). Some variables are extremally vague and difficult to quantify, e.g. Greed, Sentiment (Zhao et al., 2022). Moreover such problems as rumour spreading, see e.g. (Zhao et al., 2021) put pressure on development, modification and applications of updated algorithms of artificial intelligence.

This paper deals with bankruptcies forecasting under conditions of severe information shortages. Information shrotages are likely generators of problems if traditional statistical methods are used. Moreover, the global financial crisis in 2007–2009 is an important reason to take into consideration aging of data records. This makes information / knowledge shrotages more serious. Such bankruptcies are often described by non-numerical quantifiers, e.g. words – low, medium, high. However, the transfer of such verbal values into fuzzy sets is very subjective, see e.g. (Chaudhuri and Kajal 2011). Complexities of real-life bankruptcy tasks make any formal description difficult (Wright and Goodwin, 2009). Sets of input information / knowledge items are extremely heterogeneous, see e.g. (Wright and Goodwin, 2009). The following list gives typical items:

- Dominantly Subjective Information
  - Experience
  - Analogy
- Partially subjective information
  - Own observations / measurements
  - Observations which are available on commercial basis
  - Literature sources
  - Verbal descriptions
- Dominantly objective information
  - Mathematical models, e.g. sets of differential equations
    - Without numerical values of parameters
    - With values of constants and parameters
  - Statistical models, e.g. a polynomial function based on the least squares algorithm
    - Original data sets are available
    - No original data sets are available
    - With partial data set availability

Predicting the possibility of bankruptcy is considered as one of the key issues of current economic and financial research. The growing importance of corporate bankruptcy prediction as a research subject has been confirmed in recent years by the appearance of various thorough reviews in the literature with the goal of summarizing the important findings of previously published studies (Matenda et al., 2021). The prediction models can be divided into three main categories:

- Statistical models, see e.g. (Mai et al, 2019)
- Artificial Intelligence, see e.g. (Jardin et al., 2021).
- Combination of statistical, and artificial intelligence techniques see e.g. (Kim et al., 2021).

However, methods of traditional statistical have many restrictive hypotheses, such as linear, normality, and independence hypotheses (Freund et al., 2010). In practice, these hypotheses are difficult to satisfy simultaneously. Hence, the effectiveness and applicability of these models are often very limited (Mai et al., 2019). Recently, methods of artificial intelligence technology have received widespread attention (Mai et al., 2019). Compared with traditional statistical methods, methods of artificial intelligence technology do not have strict restrictive assumptions on the distribution of data; they can also handle large scale data sets and express nonparametric and nonlinear relationships (Wang et al., 2018). Artificial intelligence applications have become an integral part of the financial services industry (Shamima et al., 2022). Common sense is needed to increase the reasoning power to minimise problems related to shortages of observations. In short, computers lack common sense.

1. INFORMATION SHORTAGES

Forecasting and Decision-making related to bankruptcy proceedings are often based on models of unique systems. It means that conventional statistical methods, which are, directly or indirectly, related to the basic law of large numbers, are difficult or impossible to apply. It means that knowledge items of different levels of subjectivity must be taken into consideration to develop the best possible model of a unique task under study. Therefore, many bankruptcy observations are required. However, they are not available.

This is the reason why information non-intensive formal tools are used more and more frequently, see e.g. fuzzy and / or rough sets (Pavláková Docekalová and Kocmanová, 2016; Bocková et al., 2012). Common sense is needed to increase the reasoning power to minimise problems realted to shrotages of observations. In short, computers lack common sense. Common sense formalization has attracted attention long time ago; see e.g, (Bredeweg and Salles, 2009). Common sense algorithms based just on four values - *positive, zero, negative, anything* – are studied in this paper. Many bankruptcies related knowledge items are available just as verbal descriptions based on trends: *plus/increasing; zero/constant; negative/decreasing*. For example:

If Corporate Indebtedness is increasing then Long Run Average Revenue is decreasing more and more rapidly (1)

All pairwise relations X and Y given in Fig. 1 are trend relations. It means that nothing is quantitatively known. Six examples of quantifier-less pairwise trend relations are given in Fig. 1.

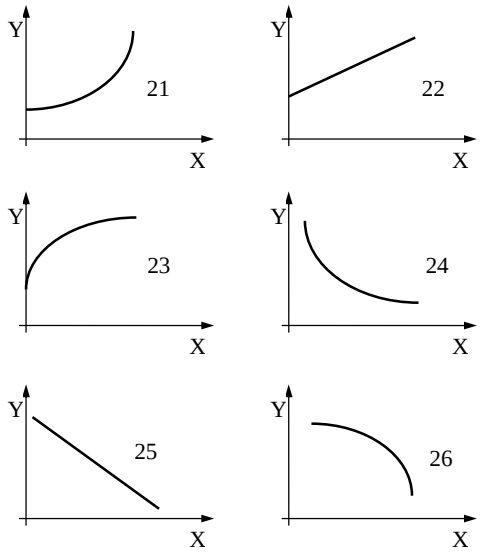

Figure 1. Examples of trend pair-wise relations

Source: own

For example, the relation 22 indicates that:

- The relation Y = f(X) is increasing
- There is a linear relationship between Y and X (2)
- If X = 0 then Y is positive.

The heuristic (1) is represented by the shape No. 21, see Fig. 1.

Moreover the following two types of pairwise proportionalities / relations between variables X and Y are considered in this paper:

Support	X	Y
Reduce	X	Y

(3)

Support An increase in (X) has a supporting effect on (Y)
Reduce An increase in (X) has a reducing effect on (Y).

An example of complexities and vagueness of subproblems related to bankruptcies studies is the following relationship f between MC (macroeconomic conditions), CD (corporate default) and K (set of all numerical constants used in MC and CD), see e.g. (Xing et al., 2023).

$f(MC, CD, K) = 0$

The majority of the constants K are positive and multiplicative. The trivial relation demonstrate a simple way how to eliminate the numerical constants, X is a variable K .

$X = (+) . X = X$

Therefore trend analysis does not require knowledge numerical constants. It means that their time consuming identification is not required

The relations (3) are based just on the first derivatives dY/dX. The relations given Fig. 1 require trend quantification of the second derivative d^2Y/dX^2. It means that the relations (3) are the most vague trend relations.

2. TREND MODELS

There are many different interpretations of trend concepts. The trend concepts as it is used in this paper is based on four values: see e.g. (Bredeweg, 2009), (Vicha, Dohnal, 2008):

Positive	Zero	Negative	Any Value
+	0	-	*

(4)

An equationless trend model M is a set of *w* pair-wise relations

$M = P_s (X_i, X_j)$ (5)
$s = 1, 2, ...w$

Examples / shapes of the relations P (5) are given in Fig. 1.

An algorithm, which can be used to solve the model (5), is based on pruning of a specially generated tree of combinations. It is not the goal of this paper to describe such algorithm, as it is a purely mathematical combinatorial task, see e.g. (Vicha, Dohnal, 2008).

The model (5) is solved and the set of *n* dimensional scenarios is obtained **S**(n, m). There are *m* scenarios:

$$\mathbf{S}(n, m) = (X_1, DX_1, DDX_1), (X_2, DX_2, DDX_2),..., (X_n, DX_n, DDX_n)_j, \quad (6)$$
$$j = 1, 2,..., m$$

where, D*X* is the first and DD*X* is the second time trend derivatives. For example, the following three dimensional scenario, n = 3 (6)

X_1 X_2 X_3 (7)
(+ + +) (+ - 0) (+ - -)

indicates that X_1 is increasing more and more rapidly, X_2 decreases linearly, X_3 is decreasing more and more rapidly. All variables are positive – see the first symbol of all three triplets (7).

It is possible to take into consideration higher trend derivative, e.g. the third one DDDX. However, studied tasks are ill known and the third trend derivatives DDDX are not available. Another simplification is that the second derivatives are ignored if the studied information items are so poorly known that the second derivatives DDX cannot be evaluated. If the second derivatives are ignored or unknown then the model (5) cannot be described by the shapes given in Figure 1.

Trend proportionalities are therefore introduced, see (3). DTP is a *direct trend proportionality* and ITP is an *indirect trend proportionality*:

DTP If *X* is increasing then Y is increasing
If *X* is decreasing then Y is decreasing DX = DY (8)

ITP If *X* is increasing then Y is decreasing
If *X* is decreasing then Y is increasing DX = - DY

DTP represents the following three shapes, see Fig. 1: 21, 22, and 23. ITP represents 24, 25, and 26.

3. TRANSITIONAL GRAPHS

The set of scenarios **S** (3) is not the only result of a trend modelling. It is possible to generate transitions among the set of scenarios.

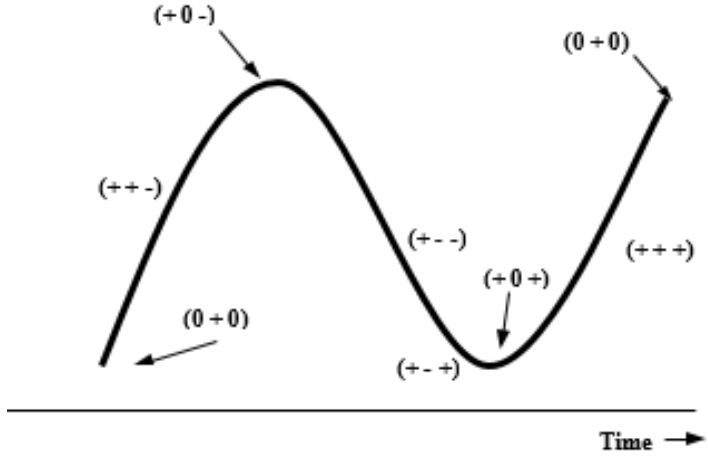

Figure 2. A trend description of a quantitative oscillation

Source: own

The triplets given in Fig. 2 describe a broad spectrum of different oscillations, e.g. dumped oscillation or irregular oscillations with randomly or deterministically changing frequencies and / or amplitudes.

A complete set of all possible one-dimensional transitions is given in the following table:

Table 1. A list of some one-dimensional transitions

	From		To	Or	Or	Or	Or	Or	Or
1	+ + +	→	+ + 0						
2	+ + 0	→	+ + +	+ + -					
3	+ + -	→	+ + 0	+ 0 -	+ 0 0				
4	+ 0 +	→	+ + +						
5	+ 0 0	→	+ + +	+ - -					
6	+ 0 -	→	+ - -						
7	+ - +	→	+ - 0	+ 0 +	+ 0 0	0 - +	0 0 +	0 0 0	0 - 0
8	+ - 0	→	+ - +	+ - -	0 – 0				
9	+ - -	→	+ - 0	0 - -	0 – 0				

Source: own

For example, the third line of Tab. 1 indicates that it is possible to transfer the triplet (+ + –) into the triplet (+ 0 –). This transition is not the only possible. There are two more possible transitions. Fig. 3 gives a trend description of an oscillation using the one dimensional triplets.

Any quantitative one-dimensional oscillation, see e.g. Fig. 1 and Fig. 2, can be represented by a simple oriented graph, see Fig. 3. There are 8 one-dimensional scenarios, m = 8, n= 1 (6). Any forecasting related to the oscillation Fig. 1 is trivial. For example the scenario (+ + -) is transferred into the scenario (+ 0 -), see Fig. 3.

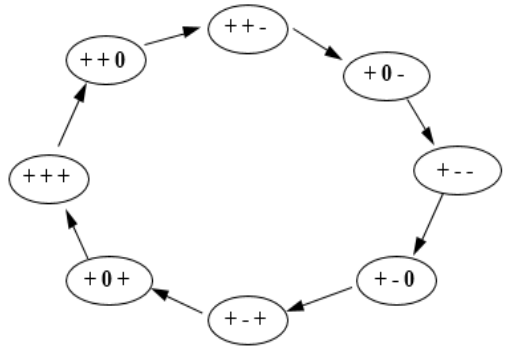

Figure 3. Transitional one dimensional graph of an oscillation, see Tab. 1

Source: own

An example of a more complex transitional graph is given in Fig. 4. There are 5 scenarios, m = 5 (6). The transitional graph in Fig. 4 is an example of an unsteady state behaviour of a more complex model (5). If a forecaster accepts the model (5), then the corresponding transitional graph represents all possible trend forecasts and all possible trend histories to choose from; no feasible forecast can be overlooked / ignored. It means that the transitional graph is a generator of trend-based forecasts.

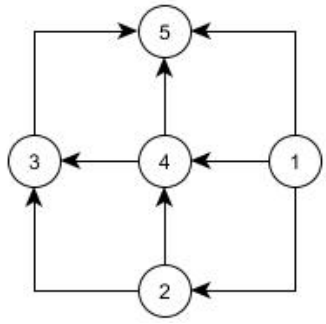

Figure 4. Transitional graph based on the set of 5 scenarios

Source: own

Let us suppose that the scenario No. 4 is under study as a current forecasting root. The following paths are two-steps forecasts:

$S_4 \rightarrow S_3 \rightarrow S_5$

$S_4 \rightarrow S_2 \rightarrow S_3$ (9)

No other two steps behaviours / forecasts are possible.

The complete description of all past two steps histories is given in (10), if the current root is again the scenario No. 4, see Fig. 4.

$S_1 \rightarrow S_2 \rightarrow S_4$ (10)

The set **X** of variables

$\boldsymbol{X} = X_1, X_2, \ldots, X_n = (\mathbf{V} \cup \mathbf{G} \cup \mathbf{O})$ (11)

$\mathbf{V} \cap \mathbf{O} = \emptyset$
$\mathbf{V} \cap \mathbf{G} = \emptyset$
$\mathbf{O} \cap \mathbf{G} = \emptyset$

$\mathbf{V} = (V_1, \ldots, V_v) = (X_1, \ldots, X_v)$
$\mathbf{G} = (G_1, \ldots, G_t) = (X_{v+1}, \ldots, X_t)$
$\mathbf{O} = (O_1, \ldots, O_w) = (X_{t+1}, \ldots, X_n)$

$n = v + w + t,$

is chosen as relevant. Any forecasting / decision-making will be based on a *n*-dimensional model M(**X**). A set **X** of *n* variables is a union of Decision variables **V**, Goals variables **G** and Off-control variables **O** (11).

The set **O** of variables is not under control of a forecaster / decision maker. If a forecaster is a company's manager or a government then the set **O** is different. This is the reason why future unsteady state behaviours depend heavily on interpretations of the set of variables **X** (11).

An example of variables X presented from the point of view of a company management is:

Investments V
Profit G
Tax O

The variable O is controlled by a government and not by a company management.

4. CONFRONTATIONS OF MODELS

It is a well-known fact that bankruptcy models' accuracies are often very low. It is therefore highly desirable to confront results of several models developed by several forecasters / decision makers.

A team of *r* forecasters is involved

$$F_1, F_2, \ldots F_r \tag{12}$$

It is usually not possible to achieve a consensus among a team of *r* forecasters. This is the reason why each forecaster has his/her n-dimensional model:

$$M(n)_1, M(n)_2, \ldots M(n)_r \tag{13}$$

The models (13) are solved and sets of trend n-dimensional scenarios **S** are obtained:

$$S(n)_1, S(n)_2, \ldots S(n)_r \tag{14}$$

The Core and Envelope sets of scenarios (14) are, see e.g. (Dohnal and Doubravský, 2015):

$$S_{COR}(n) = S(n)_1 \cap S(n)_2, \ldots \cap S(n)_r$$
$$S_{ENV}(n) = S(n)_1 \cup S(n)_2, \ldots \cup S(n)_r \tag{15}$$

The set S_{COR} eliminates all atypical scenarios and S_{ENV} covers all possible scenarios generated by all decision makers. It is obvious that $S_{ENV}(n)$ is a superset of $S_{COR}(n)$:

$$S_{ENV}(n) \supseteq S_{COR}(n) \tag{16}$$

5. CASE STUDY

Any trend analysis is a combinatorial problem. A tutorial example of a trend model of a bankruptcy is given in (Doubravsky, Dohnal, 2018). There is a strong correlation between the number of scenarios and the number of variables. If a number of scenarios is more than 50 then the corresponding transitional graph is very complex. Several hundreds scenarios is not an exception. This is the reason why just nine variables are used (17). Moreover, there is no need to define the variables precisely. One has to keep in mind that just trend quantifications are required. E.g. if GRD (Greed) variable is increasing then it is irrelevant that a description of specific set of activities is not given. Variables that have a significant impact on the bankruptcy forecasting have been carefully selected to reflect heterogenous nature of the tasks under study. A discussions with a small team of experts and PhD students was organised.

SEL Selling of Assets
ENJ Ensure Justice
GRD Level of Greed
TAX Tax Burden
SAT Satisfaction of Creditors
SOL Solution of Debtors Assets
POL Political Influence
BUL Bullying of Creditors
INF Inflation (17)

The very nature of the variables (17) indicates that they are difficult to quantify, see e.g. *Level of Greed*.

Let us suppose that there are two experts / forecasters, r = 2 (12):
E_1 and E_2 , (18)
The first expert E_1 developed the following model:

1	DTPSEL ENJ	see (8)
2	25 SEL GRD	see Fig. 1
3	21 SEL SAT	
4	24 SEL SOL	
5	23 ENJ TAX	(19)
6	24 ENJ BUL	
7	DTPTAX POL	
8	24 SAT BUL	
9	DTPPOLINF	

There are 65 scenarios; m = 65 (6, 19),

#	SEL V	ENJ V	GRD V	V	TAX G	SAT G	SOL O	POL O	BUL O	INF see (11)	see (17)	(20)
1	+++		+++		+--	+++		+++	+-+	+++	+-+ +++	
2	+++		+++		+--	+++		+++	+-+	+++	+-0 +++	
3	+++		+++		+--	+++		+++	+-+	+++	+-- +++	
...	...	...	...	...	...	...	...	...	...			
32	+0+		+0+		+0-	+0+		+0+	+0-	+0+	+0- +0+	
33	+00		+00		+00		+00		+00	+00	+00 +00 +00	
34	+0-	+0-	+0+		+0-	+0-	+0+		+0-	+0+	+0-	
35	+-+	+-+	++-	+-+	+-+	+++		+-+	+++	+-+		
...	...	...	...	...	...	...	...	...	...			
38	+-+	+-+	++-	+-+	+-+	++0		+-+	+++	+-+		
64	+--	+--	+++		+--	+-0	+++		+--	+++	+--	
65	+--	+--	+++		+--	+--	+++		+--	+++	+--	

There are 706 possible transitions among 65 scenarios (20). The transitional graph is very complex, see Figure. 5.

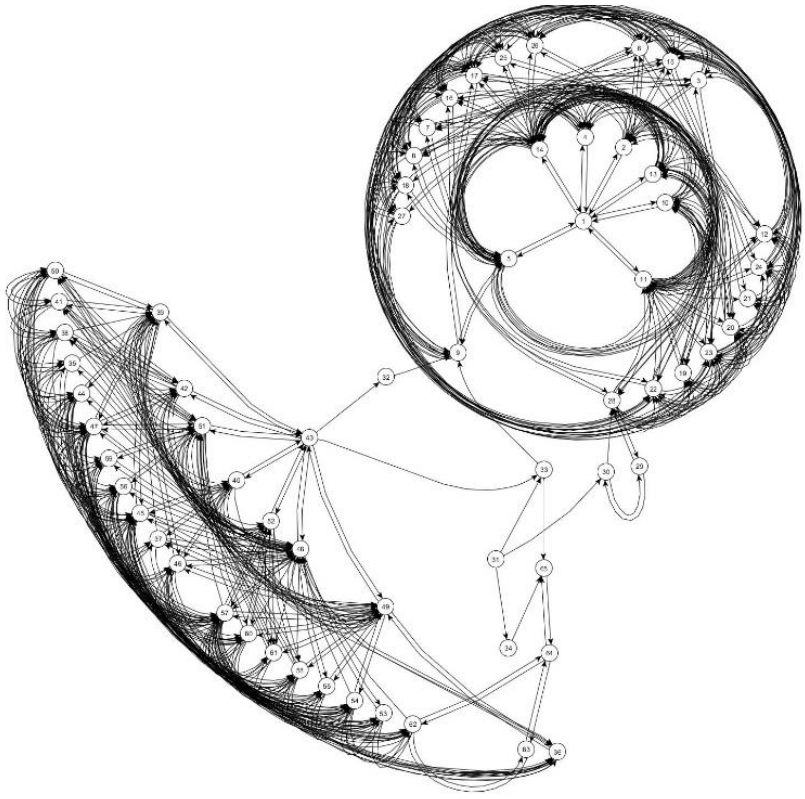

Figure 5. Transitional graph based on the set of 65 scenarios (19)

Source: own

The second expert E_2 (18) modified the model of the first expert. The following relation:

6 25 ENJ BUL

was used.

Therefore the model of the second expert is:

1 DTPSEL ENJ
2 25 SEL GRD
3 21 SEL SAT
4 24 SEL SOL
5 23 ENJ TAX (21)
6 25 ENJ BUL
7 DTPTAX POL
8 24 SAT BUL
9 DTPPOL INF

There are 29 scenarios (21).

No.	SEL	ENJ	GRD		TAX	SAT	SOL	POL	BUL		INF								
	V	V	V	V	G	G	O	O	O										
1	+++		+++		+--	+++		+++		+-+	+++		+--	+++					
2	+++		+++		+--	+++		+++		+-0	+++		+--	+++					
3	+++		+++		+--	+++		+++		+--	+++		+--	+++					
...	...		...	...	...	...	...	...	...	...									
13	++-	++-	+-+	++-	++-	+-+	++-	+-+	++-										
14	+0+		+0+		+0-	+0+		+0+		+0-	+0+		+0-	+0+					
15	+00		+00		+00		+00		+00		+00		+00		+00		+00		(22)
16	+0-	+0-	+0+		+0-	+0-	+0+		+0-	+0+		+0-							
...	...	...	...	...	...	...	...	...	...										
27	+--	+--	+++		+--	+-+	+++		+--	+++		+--							
28	+--	+--	+++		+--	+-0	+++		+--	+++		+--							
29	+--	+--	+++		+--	+--	+++		+--	+++		+--							

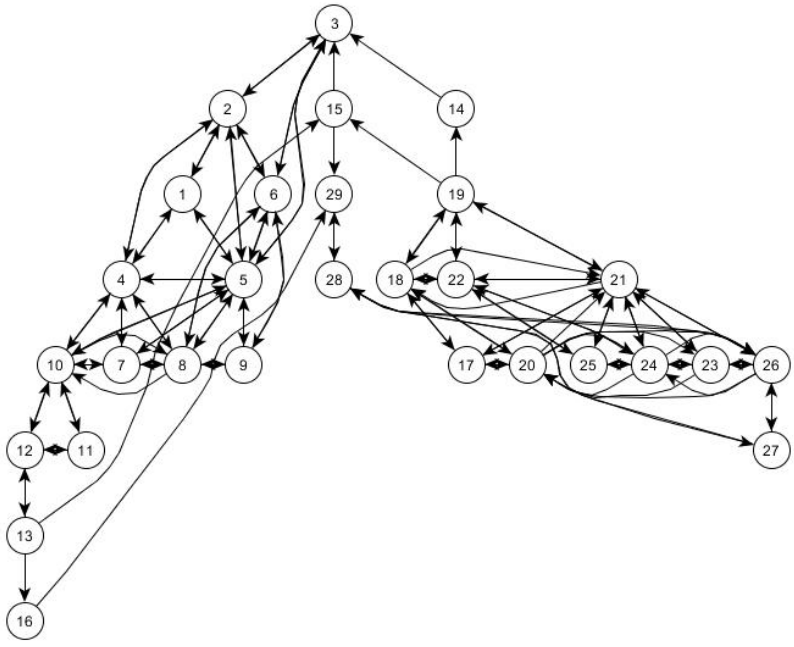

Figure 6. Transitional graph based on the set of 29 scenarios (22)

Source: own

Both models (19, 21) are heavily subjective. An elimination of atypical scenarios is therefore desirable. An intersection (see the Core (15)) of the sets of scenarios (20, 22) removes such potentially atypical scenarios. The intersection has 27 scenarios, see (23). It means that just two scenarios removed from the set (22).

No.	SEL V	ENJ V	GRD V	V	TAX G	SAT G	SOL O	POL O	BUL O		INF				
1	+++		+++		+--	+++		+++		+-+	+++		+--	+++	
2	+++		+++		+--	+++		+++		+-0	+++		+--	+++	
3	+++		+++		+--	+++		+++		+--	+++		+--	+++	
4	+++		+++		+--	++0		+++		+-+	++0		+--	++0	
5	+++		+++		+--	++0		+++		+-0	++0		+--	++0	
6	+++		+++		+--	++0		+++		+--	++0		+--	++0	
7	+++		+++		+--	++-	+++		+-+	++-	+--	++-			
8	+++		+++		+--	++-	+++		+-0	++-	+--	++-			
9	+++		+++		+--	++-	+++		+--	++-	+--	++-			
10	++-	++-	+-+	++-	+++		+-+	++-	+-+	++-					
11	++-	++-	+-+	++-	++0		+-+	++-	+-+	++-					
12	++-	++-	+-+	++-	++-	+-+	++-	+-+	++-						(23)
13	+0+		+0+		+0-	+0+		+0+		+0-	+0+		+0-	+0+	
14	+00		+00		+00		+00		+00		+00		+00	+00	+00
15	+0-	+0-	+0+		+0-	+0-	+0+		+0-	+0+		+0-			
16	+-+	+-+	++-	+-+	+-+	+++		+-+	++-	+-+					
17	+-+	+-+	++-	+-+	+-+	++0		+-+	++-	+-+					
18	+-+	+-+	++-	+-+	+-+	++-	+-+	++-	+-+						
19	+-+	+-+	++-	+-0	+-+	+++		+-0	++-	+-0					
20	+-+	+-+	++-	+-0	+-+	++0		+-0	++-	+-0					
21	+-+	+-+	++-	+-0	+-+	++-	+-0	++-	+-0						
22	+-+	+-+	++-	+--	+-+	+++		+--	++-	+--					
23	+-+	+-+	++-	+--	+-+	++0		+--	++-	+--					
24	+-+	+-+	++-	+--	+-+	++-	+--	++-	+--						
25	+--	+--	+++		+--	+-+	+++		+--	+++		+--			
26	+--	+--	+++		+--	+-0	+++		+--	+++		+--			
27	+--	+--	+++		+--	+--	+++		+--	+++		+--			

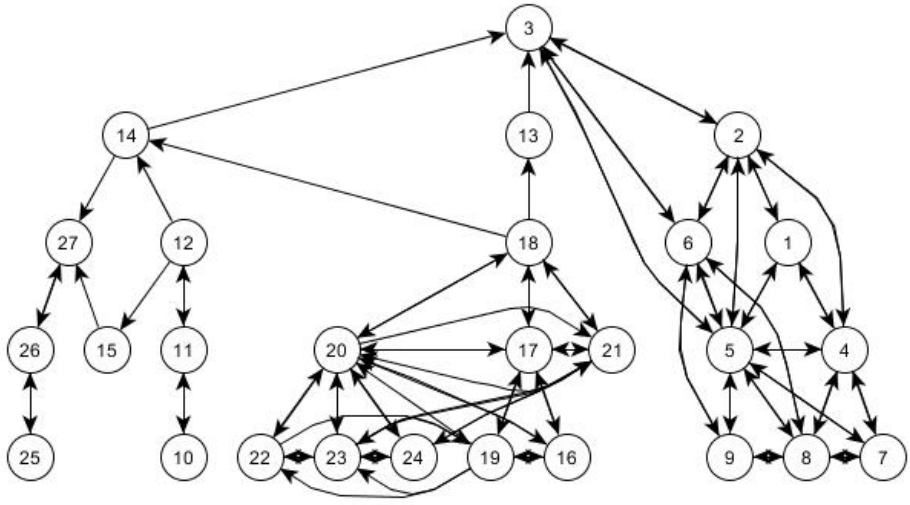

Figure 7. Transitional graph based on the set of 29 scenarios (23)

Source: own

Any forecasting is heavily predetermined by interpretations of variables (11). The choice of the sets **V**, **O**, **G**, is of crucial importance and is based on the current point of view.

Let us suppose that the following interpretations of variables are done from the point of view of a government:

SELV Selling of Assets
ENJV Ensure Justice
GRD V Level of Greed
TAXO Tax
SATG Satisfaction of the Creditors (24)
SOL G Solution of Debtor´s Assets
POL O Political Influence
BUL V Bullying of Creditors
INF O Inflation

It means that, see (11):

O = [POL, INF, TAX]
G = [SAT, SOL]
V = [SEL, ENJ, GRD, BUL]

A simple common sense analysis indicates that there are two different points of views and forecasts:

- Debtor's
- Creditor's

G variables are objective functions, using the terminology of multi objective optimisation. However, we are not looking for a compromise. Therefore, two opposing views are studied; see Fig. 8 and Fig. 9.

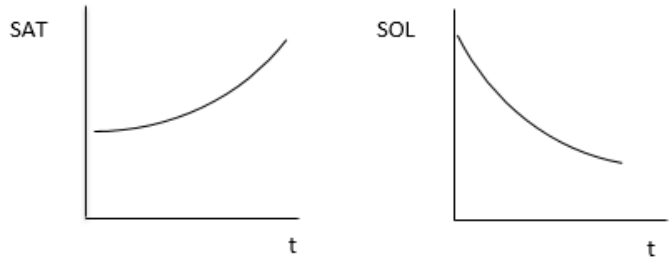

Figure 8. Debtor´s view – where *t* represents a variable time

Source: own

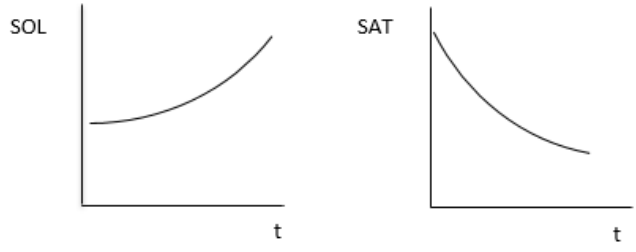

Figure 9. Creditor´s view - where *t* represents a variable time

Source: own

The worst trend description of the Debtor´s view is:

SAT Increase more and more rapidly DSAT = + DDSAT = + (25)
SOL Decreasing more and more slowly DSOL = - DDSOL = +

The worst trend description of the Creditor´s view:

SAT Decreasing more and more slowly DSAT = - DDSAT = + (26)
SOL Increase more and more rapidly DSOL = + DDSOL = +

CONCLUSION

A broad spectrum of research activities in artificial intelligence has generated many different methods, algorithms and methodologies, which can be potentially used for forecasting and related areas.

A forecast user requires transparent and easy to understand explanations why and how different algorithms generate some forecasts. If formal tools are mathematically too demanding then it is very difficult to introduce them into the broad forecasting community. The trend transitional graphs can be explained using just elementary concepts of derivatives.

There are three main advantages of the trend based forecasting:

- No numerical values of constants and parameters are needed
- It is possible to develop multidimensional models based on verbal knowledge items, e.g. heuristics
- The set of trend scenarios is a superset of all meaningful scenarios, i.e. forecasts.

No reasonable forecast can be missed if the analysis is based on a good trend model.

The aim of this paper is to ensure a certain procedure for relief from debts so that both parties are satisfied. The paper explores a set of trend heuristics, i.e. a trend model.

Developments of the trend models do not require knowledge of complicated theories of artificial intelligence. These methods are used as black boxes. An important advantage of the trend forecasts is that anybody can develop a model based on elementary knowledge of mathematics. The authors are ready to make the relevant calculations of a model is delivered.

It is very probable that developments of relevant formal tools of artificial intelligence will have important consequences. Naïve physics and consequently algorithms based on common sense reasoning will be used in Bankruptcy models and related tasks more and more extensively.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Kazinczy, E. (2024), "Aspects of Fragility in Bosnia and Herzegovina", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 145-154.

Aspects of Fragility in Bosnia and Herzegovina

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ARTICLE INFO

Received February 27, 2023
Revised from March 6, 2023
Accepted April 26, 2023
Available online April 15, 2024

JEL classification: O52, D74

DOI: 10.14254/1800-5845/2024.20-2.12

Keywords:

Bosnia and Herzegovina,
Dayton Peace Agreement,
Fragile State.

ABSTRACT

Bosnia and Herzegovina remains a country with a number of deeply rooted structural challenges, which are linked to the political and the broader social sphere. The current paper provides an overview on a range of key factors that have led to the country's fragility. During the analysis we start with the concerns related to multi-ethnic democracies, and specifically to Bosnia and Herzegovina's unique state structure. The latter was founded in 1995, in line with the so-called Dayton Peace Agreement. We also touch upon variables that are connected to the economic and social fields, by discussing indicators that are related to labor market distortions or the level of corruption. The study provides an overview on Bosnia and Herzegovina's position referring to international fragility indexes. Based on the analysis, we find various aspects that raise concerns regarding Bosnia and Herzegovina's fragility.

INTRODUCTION

Ethnic tension has a long history in the region of Bosnia and Herzegovina (B&H), which culminated in the war of the 1990s. In 1995, The General Framework Agreement for Peace in Bosnia and Herzegovina (1995, Dayton Peace Agreement henceforth) brought peace to a war ravaged territory. Thus, on the one hand, it became a success story for international peace-keeping. On the other hand, shortly after signing the Dayton Peace Agreement, it became clear that the applied institutional structure was too complex and cumbersome to function efficiently. Furthermore, internal divisions were constantly present in B&H, including occasional secessionist intentions. The tension within society and the condition of the economy reflect the continuous debate on how the institutional framework should be restructured (see e.g., Kartsonaki, 2016; Søberg, 2008). Based on this, one might consider the state-building procedure an ongoing process. Although within this paper we provide an overview of the key challenges, we do not include the various reform proposals for a new institutional structure.

In the context of B&H, the term ethnic conflict is often referred to. According to S. Burg and P. Shoup (1999), ethnic conflict is a power struggle between mobilized identity groups that can aim at equality in an existing country, or even the establishment of an independent country. This approach to an ethnic conflict describes the insult against other religious or ethnic groups, following the dissolution of the former

Yugoslavia. Since the Dayton Peace Agreement, ethnic tension has been preserved by the current electoral system (see Sahadzic, 2009) and culminates during election campaigns. 'Insults against other ethnic and religious groups, political rivals, International Community representatives and even individual citizens have become a constant part of political behavior and method. Because they have no real progress to show, certain BiH politicians design conspiracy theories, to replace serious discussions on real problems that affect the well-being of their citizens' (OHR, 2018). From a certain aspect, this statement covers the topic of the current study.

This paper intends to provide an overview on fundamental challenges regarding the country's current institutional system and the key factors that lead to state fragility. The group of shortcomings are interconnected. The institutional framework is capable of creating instability; likewise other systemic phenomena, such as labor market distortions or corruption. Indeed, the economic development and the welfare of the society can stabilize a political system, whereas unemployment, for instance, is considered a major risk factor for social unrest (ILO, 2011). Nevertheless, it is the decision-making sphere which has the potential to provide tools to curb fragility. The primary aim of this paper is to highlight various symptoms of Bosnia and Herzegovina's fragility. As a further intention, this study would like to add to the literature on the politics and state structure of the country, while including social and economic aspects as well.

The paper is structured as follows: The next chapter provides a methodological overview. The first subsection of the following chapter highlights the general challenges of multi-ethnic democratic systems based on the respective literature. The second subsection focuses on Bosnia and Herzegovina's prototype, founded by the Dayton Peace Agreement. The following chapter focuses on quantitative variables. Its first subsection demonstrates a range of indicators that underline structural challenges calling for fundamental changes. The next subsection demonstrates the country's position within fragility rankings. The final chapter concludes.

1. METHODOLOGY AND KEY TERMS

Within the respective literature, a specific country group is labelled as 'vulnerable', 'fragile', 'instable' or 'failed'. Due to its complexity, there is a broad range of the relevant measuring sticks and definitions for a state's fragility. W. Naudé & M. McGillivray (2011) specify the following interrelated traits to determine fragility: conflict, the low development status, vulnerability and the lack of a developmental state. Goldstone et al. (2010) analyze the background of political instability. While analyzing a wide range of factors, they find that political institutions or the regime type predict the onset of political instability. Indicators, such as economic conditions or demography, do not function as significant predictive tools for instability onsets. In our study, we refer to the OECD's definition, which characterizes 'fragility as the combination of exposure to risk and insufficient coping capacity of the state, system and/or communities to manage, absorb or mitigate those risks. Fragility can lead to negative outcomes including violence, poverty, inequality, displacement, and environmental and political degradation' (OECD 2020, p. 15). (To read further definitions and the relevant literature, see Naudé & McGillivray (2011) or A. Kartsonaki (2016)).

Based on the above definition, within this paper we consider the coping capacity of the states as a baseline. Via a range of authors, including D. Horowitz (2014), D. Kapidzic (2014), A. Lijphart (2004) or A. Mujkic (2015), the paper describes general and country-level challenges for multi-ethnic societies, as we consider this factor as a starting point. In this study, we define ethnic groups as people with common religion, language and common culture. In BiH, there are three constituent ethnic groups: Bosniaks, Croats and Serbs. As a next step, in a separate subchapter, the qualitative overview on the Dayton Peace Agreement and its aftermath are included for outlining the unique case of BiH. Both the general discussion of the multi-ethnic democracy and the prototype of Bosnia and Herzegovina are based on the relevant literature.

Following the discussion of the political background, our analysis highlights social and economic symptoms that can also be linked to the quantitative approach of state fragility. Here we include various aspects, such as labor market discrepancies, poverty or corruption. These mentioned phenomena are in line with the OECD's quoted definition, where the potential outcomes of fragility are mentioned. Some of these factors are underpinned by the respective data. These socioeconomic variables are generally included in the

fragility indexes, but they require more insight. The connection between these indicators and fragility are bidirectional, as these indicators can be viewed not only as outcomes, but also as reasons of fragility.

As for the quantitative approach, all data are collected primarily from the databases of international institutions. The time series are not included, as the paper focuses on the period between 2019 and 2021. During the quantitative approach, the regional countries are occasionally added in the analysis for the purpose of comparison. When referring to the region of BiH, we touch on South-Eastern Europe, including the group of the following countries: Albania, Bosnia and Herzegovina, Croatia, Kosovo (without prejudice to positions on status), Montenegro, North Macedonia and Serbia. These countries cover a wide spectrum in respect of their development level or their political challenges. While taking into consideration the background information, the comparison of the countries' respective statistics carries relevant messages. During the analysis, the exact data should be treated with caution, but they are still able to outline specific features. Finally, the fragility related indicators are able to reflect the need for changes. As a final section, we include the results of specific fragility indexes. In case of the Fragile States Index we collect the values for the various sub-indicators, while in case of the OECD's and Marshall et al.'s dataset we interpret the results.

2. DISCUSSION

2.1 Aspects of fragility: Multi-ethnic democracy

General challenges from the respective literature

Building a well-functioning democracy in B&H can be considered as a challenge. Horowitz (2014) generally states that ethnic divisions create difficulties for building democracy, as they generate ethnic parties with ethnic voting. He claims that a consociational institutional structure is built in countries where the society is severely divided and there is a long-lasting interethnic antipathy. This institutional structure includes proportional group participation with minority vetoes. Given this structure, it is difficult to establish a durable power-sharing institutional system for three main reasons. Firstly, the preferences of the majority and the minority ethnic groups are asymmetric. Secondly, a general risk aversion is present. Thirdly, the negotiators have biases, which rule in or rule out certain models. Despite the difficulties, there is still a need to adjust these political systems in order to keep them efficient and flexible. However, Horowitz (2014) claims that consociational institutions are generally sticky. Namely, while there is an intention to restructure them, the form has not been specified. This latter thought underpins the fact that although there have been a number of reform proposals over the years in BiH, still, none of them have been acceptable for all decision-making groups.

Generally speaking, there is a clear debate on whether a multi or a monoethnic society can build a democratic system more successfully. On the one hand, the literature claims that in a monoethnic society it is not likely that deep-rooted inter-group conflicts and secessionist attempts will occur (see Dahl (1971) or A. Karatnycky (2002)). Thus, there is a greater chance of reaching a consensus on reform processes. On the other hand, other authors, e.g., M. Firsh & R. Brooks (2004), argue that diversity does not influence democratic development. D. Kapidzic (2014) points out that the perception which assumes that building democracy is more difficult in multi-ethnic societies is wrong. He claims that it is rather the bipolar ethnic arrangements which destabilize democratic systems. Indeed, there is mixed evidence regarding this aspect.

As a general theoretical proposal, A. Lijphart (2004) elaborates on nine areas related to the constitutional choice for countries with deep divides. He provides a set of recommendations within these nine areas, which serves power sharing and group autonomy as well. However, in BiH's particular case, Bieber (2001) states that a multi-national democracy needs an institutional structure which omits the hope of 'solving' nationalism, and avoids fueling ethnic tensions.

Referring to political conflicts, A. Mujkic (2015) claims that instead of the rift among the constituent ethnic groups, the dominant division is rather between the 'the class of agents of ethno-political

entrepreneurship and the class of objects of these entrepreneurs' appropriation' (Mujkic, 2015, p. 623). Based on the literature of this subchapter, one can highlight general challenges of multi-ethnic institutional state structures.

The Dayton prototype of multi-ethnic democracy

By 1995, the Bosniaks preferred a centralized state, the Croats their own third entity, while the Serbs an independent country. Due to the fact that the leaders of the three nationalist parties were not able to agree even on basic questions, a radically decentralized federation with rigid power-sharing was created (Keil, 2013). In accordance with the Dayton Peace Agreement, an extensive and complex institutional framework was established, based on an ethnic based electoral system, offering veto power for the constituent ethnic groups in cases of fundamental decisions. Based on the applied state structure, two entities and a special district (Brcko District) were formed. The entity dominated by Bosniaks and Croats, the Federation of Bosnia and Herzegovina (FBiH), consists of ten cantons, divided into 79 municipalities. The Serb-dominated entity, Republika Srpska (RS), misses the cantonal level, but has 62 municipalities (BHAS, 2017; European Commission, 2019). Both entities and the Brčko District have ethnically mixed populations, including groups that do not belong to any of the three constituent nations (see Figure 1).

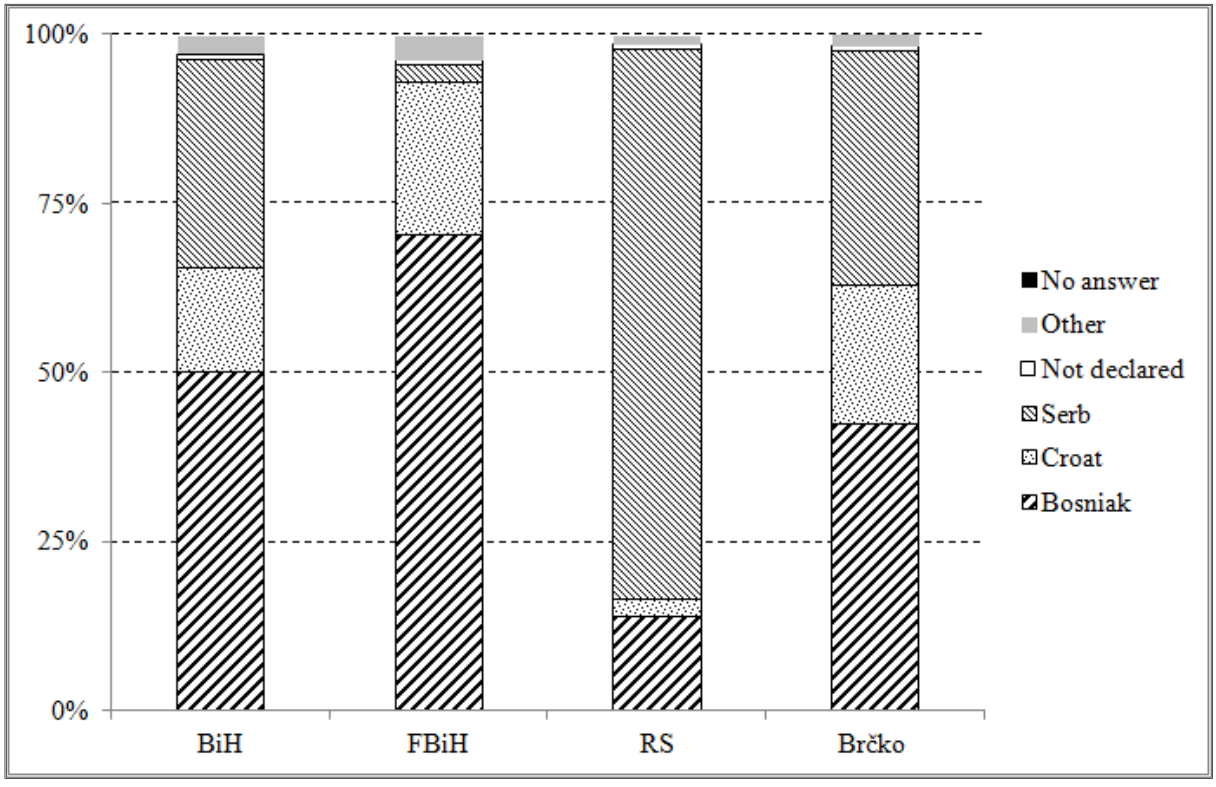

Figure 1: Population by ethnic or national affiliation

Note: The category of 'No answer' is not visible, as it is below 0.2 percent in all cases.

Source: BHAS (2017, p. 54)

As a result of the Dayton Peace Agreement, Bosniaks gained their primary war aim, namely a united BiH. However, Bosniaks generally argue that the Serb Entity is a result of genocide. From the Serbs' point of view, Republika Srpska can be considered as a tool of protection against Bosniak and Croat domination. Therefore, leading Serb politicians insisted on an autonomous entity with strong power-sharing at the central level including veto rights. In addition, secessionist intentions occasionally arise. As for the Croats, numerically the smallest among the constituent ethnic groups, they failed to create their own entity.

However, they have three cantons with a Croat majority, which offers them a certain level of autonomy. The picture becomes even more complicated when minorities which do not belong to the constituent ethnic groups are taken into account. They are excluded from political positions and occasionally even face discrimination (Keil, 2013).

Besides the domestic political elite that serves the above described state structure, there is also a significant international presence. The so-called High Representative's primary task is to safeguard the implementation of the Dayton Peace Agreement, though the exact tasks have shifted somewhat over the years. The High Representative is supposed to form a link between the local and the international actors, by representing a coordinating body of the international community. Nevertheless, it is noteworthy that this community is not a coherent group either, thus creating a source of criticism (Donais, 2005). As for the European Union (EU), B&H has a potential candidate status. It tries to implement a dual strategy of European integration and state building. However, the EU's conditionality has not brought success as a state building tool. This is partly based on the political elite's mixed commitment to the EU accession process (Bieber, 2011).

Aspects of fragility: Specific indicators

Indicators of fragility

On the one hand, B&H's economy can be considered stable. Following the turbulence of the global financial crisis, from 2013, its real GDP growth rate remained low but positive, while the current account deficit per GDP ratio decreased from its critical values. The budget deficit and government debt were under control. Based on the currency board regime, the exchange rate of the convertible mark is fixed to the euro, which creates an anchor for the economy. Inflation is generally moderate, whereas the occasional deflation is partly based on external factors (CBBH, 2019). As on a global level, COVID-19 generated short-term shock waves to B&H's economy from a macroeconomic perspective, but the negative effects were expected to be temporary (CBBH, 2021).

On the other hand, there is a number of factors that indicate deep structural distortions. Based on the ILO's (2011) empirical analysis, unemployment has the strongest connections with the estimated risk of social unrest. This result is particularly relevant in relation with BiH's striking unemployment rates. Based on the applied methodologies, there are various statistics related to unemployment, i.e., the exact numbers published by different institutions might differ. Still, when considering the unemployment rates between 2018 and 2020, the labor survey based rate was between 15 and 20 percent, while the administrative unemployment rate was around 35 percent over the same period (CBBH, 2019, p. 25). Disregarding the differences of the applied methodologies, youth unemployment is around double the total figure. Partly as a result of these facts, the net migration rate is well over the values of other regional countries, although data for Kosovo is not available (UNDP: HDI).

As a further category that relates to unemployment, the poverty level in B&H can be underlined. The share of population at risk of poverty amounted to 26.5% in 2011, which was among the highest in Europe (World Bank Group, 2015, p. 9). Based on the methodology of BHAS's (2021) time series, the percentage of impoverished individuals did not decrease significantly over the years, as it amounted to 18% in 2004, while it was 17% in 2015. A further analysis found that also the in-work poverty rate was higher in B&H compared to any of the EU-member countries, as it reached 24.5% in 2015 based on the estimations (ESPN, 2019, p. 4). This was attributed to low wages, labor segmentation, low work intensity, or even to not receiving wages when employed. The report also mentioned that the secure public employment was heavily controlled by the politicians' networks (ESPN, 2019).

In connection with poverty, Figure 2 represents the GDP per capita and the level of youth unemployment in the region. While emphasizing the effects of methodological differences on the exact numbers, the ranking of the economies on the GDP per capita basis is still relevant. It is noteworthy that this ranking has not shifted substantially for over several decades in the region (Plestina, 1992), questioning the existence of a catching-up process from an economic aspect.

As a further indicator of potential tension, the dimension of social inequality is generally included in fragility indexes. Based on the respective data, one can conclude that following the transition period, inequality sharply increased until the early 2000s (WID: Data), but its value remains in line with the regional average (World Bank Group, Gini). Still, it is a relevant concern in the light of unemployment and poverty.

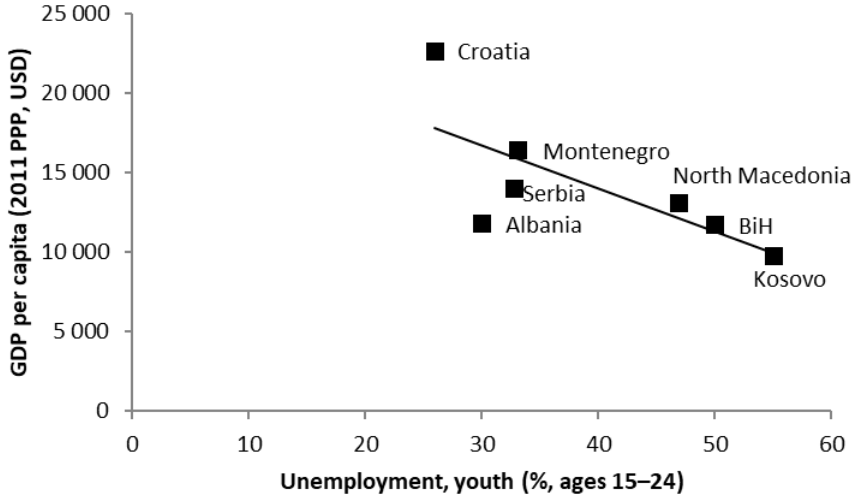

Figure 2: GDP per capita and youth unemployment (2017)

Note: PPP is the abbreviation for 'purchasing power parity'.

Source: UNDP (HDI), Arandarenko and Brodmann (2019), World Bank Group: Data, own compilation

Like the labor market conditions, the level of corruption is also an indicator that is generally being added to fragility indexes, as it hinders efficient distribution and development. It stabilizes the position of the ruling political powers, and preserves political and social inequality. Furthermore, Neudorfer and Theuerkauf (2014) even find a positive link between corruption and the risk of ethnic civil war. Thus, it is particularly relevant that in B&H corruption is considered to be widespread. All of the bureaucratic layers experience certain political capture, primarily in the fields of healthcare, education, the labor market or public procurement (European Commission, 2019). The Corruption Perceptions Index of Transparency International (2021) uses a scale from 0 (highly corrupt) to 100 (very clean). Table 1 demonstrates this index for the regional countries, but it also includes two corruption-related indicators from the World Bank Group. Generally speaking, these indicators underpin the statements which label widespread corruption among the key challenges in B&H, even in terms of the regional scope.

Table 1. Corruption indicators (2021)

	Corruption Perceptions Index	Bribery incidence (percentage of firms experiencing at least one bribe payment request)	Percentage of firms identifying corruption as a major constraint
Albania	35	36.1	43.4
Bosnia and Herzegovina	35	16.0	29.5
Croatia	47	10.1	12.1
Kosovo	39	3.2	56.1
Montenegro	46	21.4	4.7
North Macedonia	39	7.4	18.3
Serbia	38	6.9	14.6

Source: Transparency International (2021), World Bank Group (Enterprise Surveys), own compilation

Fragility indexes

There are aspirations to quantify the level of a country's fragility. One of the datasets is the Fragile States Index. In 2021, it ranked 179 states. For each country a total value is given, by adding up their scores from one (least fragile) to ten (most fragile) in twelve categories (see Table 2). These scores are a result of the analysis of over 100 sub-indicators, which can be grouped by political, social and economic dimensions. The countries are ranked on the basis of the total values. A larger total score, and, parallel with this, a higher rank, represents a greater degree of fragility (FFP, 2021).

As the Fragile States Index is not available for Kosovo, it is B&H which is considered the most fragile compared to any other regional countries. From a global viewpoint, B&H is around the middle of the rank. It is worth highlighting certain specific scores. The highest score within Table 2 relates to BiH's 'factionalized elites', which reflects the high level of political fragmentation in the country. The cohesion-related indicators are generally high for B&H. The scores reflect that B&H's economy is vulnerable, while the level of brain drain and 'human flight' is high. Furthermore, the state legitimacy raises questions, and the issue of refugees is still on the table. In line with the discussion of the previous sections on the role of the international actors, the ranking underpins the high degree of external intervention. These conclusions persist during the analysis of the respective time series.

Table 2: Fragile States Index (2021)

			Cohesion Indicators			Economic Indicators			Political Indicators			Social and Cross-Cutting Indicators		
Country	Rank	Total	Security Apparatus	Factionalized Elites	Group Grievance	Economy	Economic Inequality	Human Flight and Brain Drain	State Legitimacy	Public Services	Human Rights	Demographic Pressures	Refugees and IDPs	External Intervention
Bosnia and Herzegovina	77th	72.9	5.0	8.7	6.6	6.4	4.1	6.5	6.2	4.8	4.9	5.1	7.0	7.6
Serbia	101st	67.4	4.5	8.3	7.1	6.1	4.3	5.9	5.5	3.9	3.5	3.9	7.4	7.0
North Macedonia	108th	64.5	4.7	7.3	6.0	6.5	4.5	6.0	5.1	4.8	3.0	4.2	6.9	5.5
Albania	119th	59.0	4.8	6.2	4.1	6.4	2.9	8.3	5.5	4.4	3.6	4.1	2.6	6.1
Montenegro	120th	58.5	4.6	6.5	9.1	6.0	2.0	4.7	3.6	4.4	3.4	3.9	3.4	6.9
Croatia	138th	49.8	2.6	4.4	4.9	5.7	2.8	5.7	2.3	3.1	2.6	4.6	6.6	4.5

Note: Data for Kosovo are not available. IDP is the abbreviation for 'internally displaced person'. The order of the countries reflects their rankings.

Source: FFP (2021)

The OECD (2020) also stresses the need for a multidimensional approach on fragility, thus they analyze five dimensions: political, societal, economic, environmental and security, via 44 indicators. As an outcome of the applied quantitative and qualitative analysis, they rank official development assistance-eligible (ODA-eligible) states from one (severe fragility) to six (not fragile). Five ODA-eligible regional countries were included in the database of the 2018 edition: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia and Serbia. Generally speaking, the listed countries were attributed with low or minor fragility without major differentiation among them (OECD, 2018). Indeed, from a world-wide perspective, these regional states can be considered well-performing and rather stable among the ODA-eligible countries.

Marshall et al. (2018b) code the characteristics of authorities in various countries over the world, thus their dataset relates to fragility indexes as well. They categorize B&H as seriously fragmented in political terms, meaning that dominantly and effectively the country is ruled by the local authorities. They even state that RS is de facto separate. Furthermore (likewise among the main categories of the Fragile States Index), here as well the dataset categorizes Bosnia and Herzegovina's political system as having major foreign interruption (Marshall et al., 2018a).

CONCLUSION AND RECOMMENDATION

The current paper provided an overview on Bosnia and Herzegovina's fragility, with a special focus on its state structure and the matter of multi-ethnic democracies. Based on the general top-down approach, it is the political institutions that are in the position of decision-making. Thus, these actors are capable of promoting fundamental reforms and development. However, in BiH, the current cumbersome institutional framework itself has various underlying shortcomings. The discussed aspects can be considered interconnected factors that induce fragility.

The Dayton Peace Agreement artificially built a multinational federal state structure almost from scratch. As its most important achievement, it ended a bloody war, but it could not bridge ethnic divisions. Bosnia and Herzegovina is still divided by its internal ethno-political groups, as the support of inter-ethnic political parties or civil associations remains limited. The inter-ethnic cooperation is supposed to be supported by the presence and influence of the international community, which raises concerns regarding the efficiency of the institutional system and the democratic state of the political structure.

Besides the interethnic tension and the cumbersome political structure of the country, there are a number of further challenges. Among them, the current paper has highlighted the key labor market concerns, the level of poverty and the problem of widespread corruption, which are considered as key drivers of collective frustration. The discussed cognate phenomena all point to B&H being a fragile country compared to other European states. This conclusion has also been demonstrated by fragility indexes within this paper.

Despite the above mentioned challenges that call for changes at the decision-making level, a fundamental reform process in the state structure and the political intuitions is not likely to occur for several reasons. Namely, such reform proposals that are acceptable for all three constituent nations have yet to be on the table. Generally, the aims of the involved ethnic groups greatly differ and the preferences remain asymmetric, so they support different institutional models. Furthermore, decision-makers are not willing to curb their rights or cede power due to reform processes. Finally, as the international community is not homogenous either, external actors are less efficient in supporting deep-rooted changes.

Based on these facts, the post-war ethno-political divide seems to be persistent. In case of any fundamental changes, at least one of the constituent ethnic groups would be dissatisfied. In such a case, if a group experiences the exclusion from power or opportunity, it can create grievances transforming into violence (World Bank Group, 2018). This conclusion is in line with the path-dependence theory, which claims that certain historical events determine future development (Pierson, 2000). The signing of the Dayton Peace Agreement has put Bosnia and Herzegovina on a path which it is difficult to change. Indeed, it was the most critical juncture in the country's history. Currently, it is uncertain what internal or external force or shock would be capable of reshaping BiH's institution system and decreasing vulnerability.

The current research can be continued in multiple forms, but here we would like to demonstrate three potential possibilities. One option would be the analysis and comparison of various constitutional reform proposals. A further possibility would be the in-depth analysis of any of the here discussed variables. As a third option, a comparative analysis could be carried out with a low number of regional countries in order to specify domestic differentiating factors.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Iershova, N.Y., Portna, O.V., Davydov, D., Krivokapic, R., Delibasic, M. (2024), "Financial Stability of Small and Medium-Sized Businesses in a Crisis Economy: The Determinants of Management", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 155-168.

Financial Stability of Small and Medium-Sized Businesses in a Crisis Economy: The Determinants of Management

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ARTICLE INFO

Received March 09, 2023
Revised from April 08, 2023
Accepted May 08, 2023
Available online April 15, 2024

JEL classification: D83, F41, M10

DOI: 10.14254/1800-5845/2024.20-2.13

Keywords:

Financial stability,
small and medium-sized business,
management,
determinants of management,
risk of financial stability loss,
analytical tools,
Ukraine,
Montenegro.

ABSTRACT

The article provides a solution to the problem of the financial stability for small and medium-sized businesses in a crisis economy. To ensure the idea of the company development, the authors of the present study relied on the situational approach which defines management as specific circumstance that requires adequate actions to solve it. The purpose of the research is focused on the practical aspects of making managerial decisions in the conditions of a crisis economy to ensure the financial stability of medium and small enterprises (SMEs). For this, the methods of analysis and syn-thesis, expert evaluation, fuzzy logic, and the situational approach were used. This article focuses on the three main reasons, including: i) increase in the risk of financial stability losses by small and medium-sized companies, ii) insufficient use of analytical and information technologies, iii) the complexity of decision-making in conditions of crisis and uncertainty. The research was carried out in the following areas: 1) analysis of risks to the financial stability of companies associated with crisis phenomena in the economy, 2) assessment of the risk of financial stability loss based on the method of fuzzy logic, 3) formation of the configuration of management decisions to ensure the financial stability of the company in the conditions of a crisis economy based on the situational approach. The results revealed the relevance of the research and the reliability and sustainability of the research tools. Based on the results, the most important problems of the companies were identified, an approach to assessing the risk of losing financial stability by the company was proposed based on the method of fuzzy logic, and practical recommendations were given on how to determine the configuration of managerial

decision-making based on the management determinants. Empirically, this paper uses two test samples: companies in Ukraine and those in Montenegro.

INTRODUCTION

Against the background of changes in the competitive business environment caused by the crisis economic situation, an important condition for the development of companies is financial stability. In practical terms, financially stable companies have the following advantages: greater attractiveness for investors and creditors as well as higher variability in the selection of suppliers and personnel. In addition, financial stability is one of the main goals of business management. Management competencies provide the possibility of maneuverability through the configuration of own and borrowed funds to improve the trajectory of the company development. Small and medium-sized businesses need special attention to ensure financial stability. This is important because the entrepreneurial activity of SMEs forms the hidden core of the economies of many countries in the world. On the eve of the pandemic caused by COVID-19 in Great Britain, medium-sized ebusinesses employed 7.6 million people while small enterprises encompassed 1.6 million people (International Trade Center (ITC) publication, 2020). According to a study by Naoyuki Yoshino et al., (2016), SMEs account for more than 98% of all Asian enterprises, providing two out of the three private sector jobs in the Asian region.

The focus of attention of the scientific community and practitioners is placed on the analysis and assessment of factors that determine the financial stability of the company, justification of methods for assessing its level, development of measures to manage the business financial stability. But managerial approaches to ensuring the financial stability of small and medium-sized companies in the crisis economy require further development. We theoretically form research through the prism of the situational approach since the financial stability is unique to each company and it is determined by a specific situation. These circumstances, combined with the urgency of ensuring the financial stability for small and medium-sized businesses in Ukraine and Montenegro, determined the choice of the research topic and the formulation of its purpose, tasks and novelty.

1. LITERATURE REVIEW

In the conditions of the economic crisis, the number of studies on various aspects of the financial stability of companies is gaining momentum. In particular, there are scientific papers that discuss the nature of financial stability (Naranchimeg et al., 2020; Tvaronaviciene, 2018), the levers to ensure it (Bondar et al., 2021, Krivokapic, 2017), criteria and indicators to determine the assessment of its level (Laitinen, 2018; Sainjargal et al., 2020), and management technologies to maintain its importance at the appropriate level (Stein et al., 2019). Many scientists agree that financial sustainability is the ability of an organization to achieve a state of financial equilibrium and ensure its development in the process of interaction with the external environment of business communication. In their study Naranchimeg and Enkhamgalan (2020) consider financial stability as a company competency that helps to increase revenues and expand the market potential of the organization. An emphasis is placed on the importance of assessing financial stability for the development of management decisions to reduce the risks of business activities. This is substantiated by many scientific papers that discuss the importance of measuring financial stability for risk management (Lenssen et al., 2014; Martin et al. 2018). In addition, the measurement is relevant to assess the factors that affect the business financial stability and its level. In their research of factors affecting the financial stability of SMEs, Nonhlanhla and Musawenkosi (2017) determine the lack of financial skills. This leads to falsification of financial information, and further analysis is based on inaccurate financial statements. In his own study, Laitine (2018) emphasizes that the lack of understanding of financial statements by managers or business owners negatively affects the financial stability of a business.

Ensuring financial stability is the focus of practical activities of managers in large companies and SME managers. Based on the results of the Financial Functions Report: Seizing the Opportunity (ACCA, 2021),

we investigated the main SMEs in Ukraine and Montenegro. A survey showed that the total number of companies in Ukraine is 50 and in Montenegro — 50 (Figure 1). The results of the survey show that the most important problems of companies are the decrease in labor productivity and provision for financial stability as well as the lack of information for making management decisions. The economic downturn caused by COVID-19 has a negative impact on the development of SMEs (Marjański and Sułkowski, 2021). For example, Shen et al., 2020; Sun et al., 2021 note the Chinese economy is determined by a decrease in the investment activity of SMEs by 13-24% and an increase in unemployment by 6.2%. Romania also saw a 37% decrease in the net profit value in large and small companies (Achim et al., 2022). Important results obtained in a study by Achim et al. (2022) shed light on the fact that proper management of financial stability and liquidity consolidates the company's economic indicators to maintain and increase the return on equity and assets. Susana C. Santos et al. (2023) investigate how digitalization affects the sustainability of SMEs based on monitoring data obtained from 388 micro, small, and medium-sized beekeeping enterprises in Indonesia. The results of scientists confirm the conclusions that new digital technologies are the key to identifying, evaluating and using opportunities, strengthening the business competitiveness, increasing the efficiency of operations, especially in conditions of uncertainty and risks (Rymarczyk, 2020).

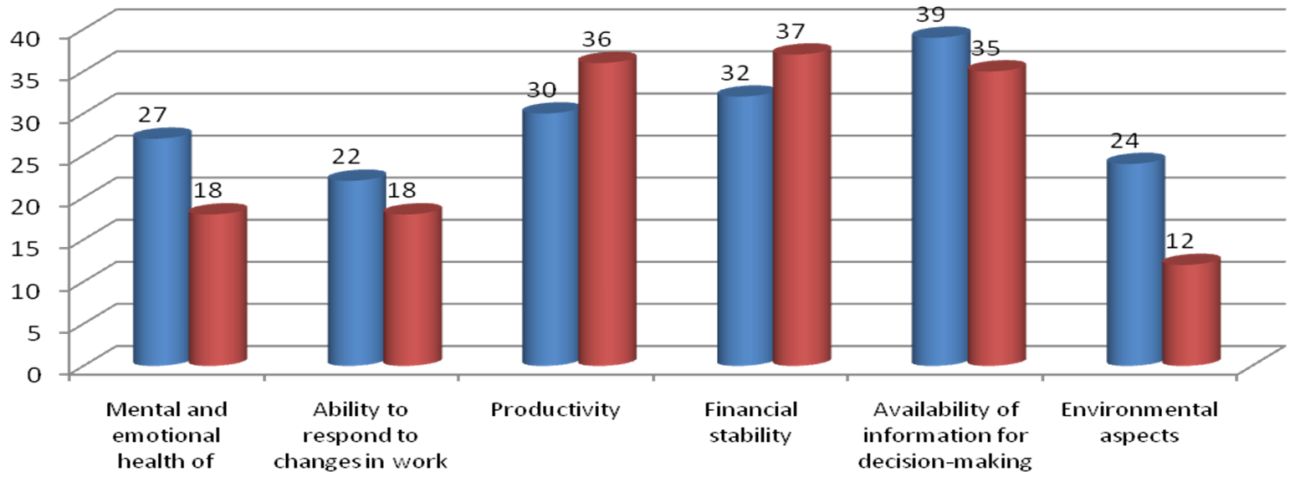


Figure 1. The most important problems of SME in Ukraine and Montenegro determined by their owners and managers

Source: Compiled by the authors based on the approach of the Association of Chartered Certified Accountants September (2021)

Against the background of the new economic period, it is necessary to establish innovative approaches to managing the financial stability of companies. Kusa et al. (2022) substantiated that financial stability is accompanied by flexibility in SMEs in the hotel industry in Poland. Flexibility is manifested in a combination of entrepreneurial behavior that can contribute to increased business efficiency. In the direction of flexible management technology, Indu Khurana et al. (2022) and Tiutiunyk et al. (2021) propose a multi-level model of sustainability: at the micro level (entrepreneur), meso (organization) and macro level (entrepreneurial ecosystem). S. Kot et al. (2019) presented multinational approach on effect of strategic supply chain management on sustainability of SME. The focus of Ullah et al. (2022) is in the field of regulatory management, which has a positive effect on increasing the business financial stability. In addition, we agree with Portna et al. (2020b) and Olah at al. (2021) that the relationship between the financial stability and innovative development of the company has a twofold nature: these categories are the purpose of the business activity and a means of achieving it.

In order to make balanced business decisions, to be financially prepared for inevitable economic crises that are beyond the control of the company, business owners need to analyze the most important financial indicators. Rjoub & Samer (2021) developed a financial stability index which is based on combining blocks of stability indicators: (a) capital adequacy; (b) profit and profitability and (c) liquidity. In a study by Iershova et al. (2021), it is substantiated that innovative financial and accounting technologies are

relevant for forecasting the sources and causes of financial stress in the company as an open system. In the world of big business, financial stability is calculated using complex graphs and formulas (from mathematical to logical). For medium-sized companies, it is recommended to calculate a number of absolute and relative ratios based on Balance Sheet data (Portna et al., 2020a). Business balance sheets are reliable, but in conditions of uncertainty and risk, the importance of using innovative approaches increases. The theory of fuzzy sets is an apparatus for formalizing one of the types of uncertainty that arises when modeling real objects (Zadeh, 1994). The unclear methodology of assessing the financial stability of the company confirms the relevance of this approach compared to the standard methodology (Díaz Córdova et al., 2017). To confirm the effectiveness of the fuzzy logic method, Lukic et al. (2022) proved its significance in determining the severity of risk of contract extension with policyholders to ensure business development and its long-term sustainability (Delibasic, 2022). According to the latest studies, probabilistic models prevail in the quantitative assessment of risks and they are a fundamental basis for making informed decisions in a crisis economy.

2. DATA AND METHODOLOGY

The authors of the article applied a rigorous approach to scientific research in the field of managing the financial stability of companies. The methods of analysis and synthesis are used to study the factors that have the greatest influence on the financial stability of companies. This facilitated building the focus of management taking into account modern trends and challenges of company development. To identify factors, we used the questionnaire research instrument (total number of respondents from Ukrainian enterprises, n = 125 people, Montenegrin companies = 94 people). Company managers and business owners were selected as respondents. The identified factors were subsequently used in assessing the risk of losing the financial stability by a company. Empirically, this paper uses two test samples: companies in Ukraine and those in Montenegro. The next step of the research was the application of fuzzy logic methodology to assess the risk of losing the financial stability by a company. The assessment structure consisted of the following stages:

- Stage 1 is preparatory (selection of an expert group, ranking of factors that affect the financial stability, etc.);
- Stage 2 is analytical (performance of analytical procedures in order to assess the risk of losing financial stability by a company);
- Stage 3 is productive (interpretation of the assessment results).

The method of expert evaluation and ratio analysis of financial indicators of activity was used to obtain the results of assessing risks of the financial stability loss. The agreement of experts' opinions is determined based on the concordance coefficient (W). The statistical significance of the concordance coefficient (W) was checked using the Pearson's χ^2 test. The experts' selection of indicators for the analysis and assessment of the company's financial stability comply with the rule of ‘necessity and sufficiency’.

The next step of the research was to develop an innovative technology of making management decisions to ensure the financial stability for the company in conditions of risk and uncertainty. To achieve this goal, we used a situational approach. The application of graphical and tabular methods is aimed at visualizing the research results. The development of the research structure and the formulation of conclusions were carried out using the scientific methods of structural logic and generalization.

3. RESULTS AND DISCUSSION

3.1 Financial stability in the managerial focus of small and medium-sized enterprises

Businesses operate in a dynamic, therefore, risky environment. In terms of complex networks of interdependence, this provides companies with additional opportunities to implement their own interests but creates potential threats due to risks and uncertainties. In this study, we assumed that financial stability is an object of management and a goal of business management. Such a provision allows it to be defined as a determinant of development, which ensures the well-being in the future and prospects for the further development of the company. The expediency of the situational approach when making management decisions to ensure the financial stability of the company is explained by the fact that management is a specific situation determined by the circumstances and it requires appropriate and adequate actions (Figure 2).

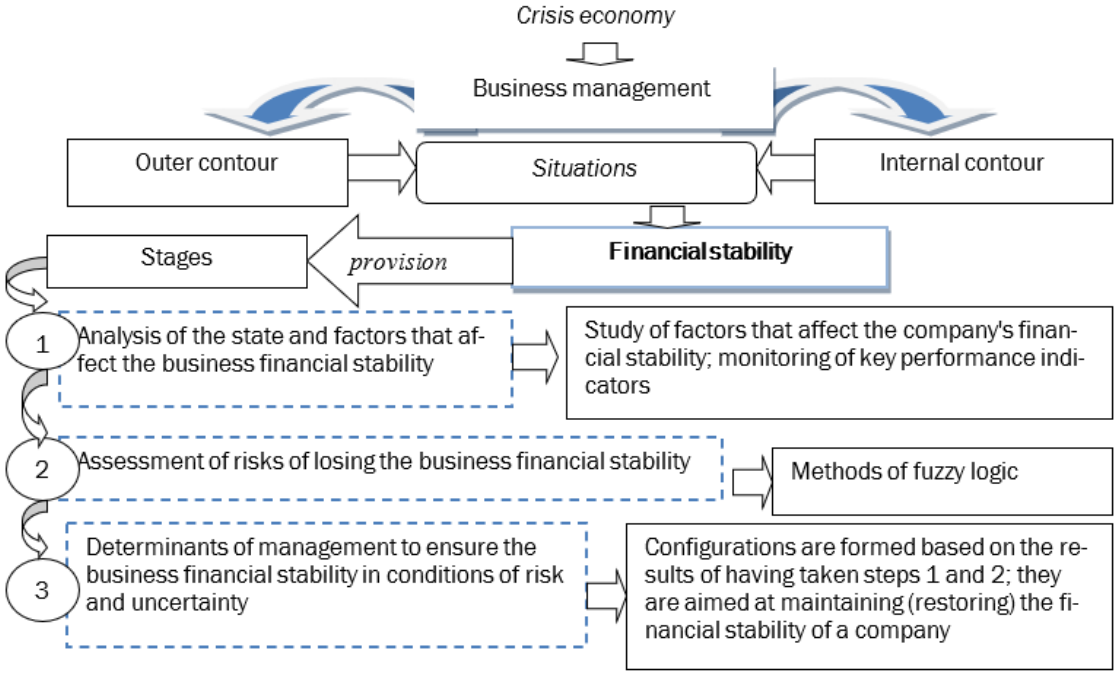
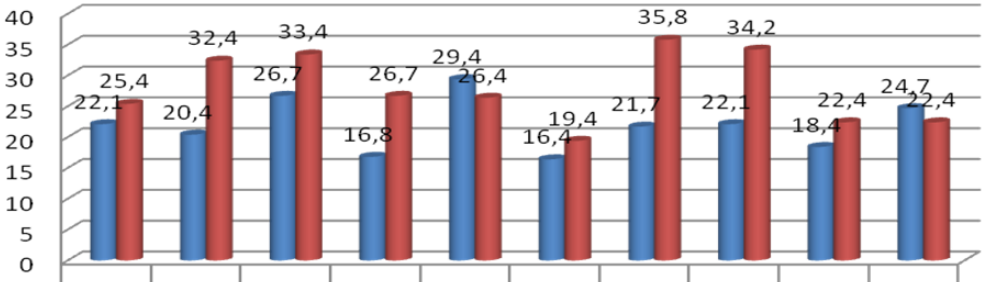


Figure 2. Contour map of ensuring the business financial stability in a crisis economy from the standpoint of a situational approach

Source: authors

The configuration of the SME financial stability is determined by many factors, which are mostly conditioned by the specifics of its activity and external operational circumstances (situations). The survey method made it possible to determine the factors that, according to the respondents, mostly condition the financial stability of the company they work for (Figure 3).

The external contour is formed by factors that do not depend on the company's activities (socio-economic, political stability at the macro level, tax, credit and investment policy of the state, the level of real income of the population, etc.) (Novoa-Hoyos et al., 2022). The internal counter is formed by the volume and structure of the company's assets, the cost and structure of their financing sources, the quality of management, and others. For Ukrainian companies, financial factors are the most influential on the business financial stability from the the respondents' point of view. They include an inefficient asset structure (35%), high cost of capital (28%), and growth of receivables (41%).



	Inefficient structure of current costs	Growth of receivables	Irrational capital structure	Decrease in economic potential	Inefficient asset structure	Insufficiently diversified range of products	High cost of capital	The instability of the tax system	Decreasing capacity of the domestic market	Increasing competition
Companies in Montenegro	22,1	20,4	26,7	16,8	29,4	16,4	21,7	22,1	18,4	24,7
Companies in Ukraine	25,4	32,4	33,4	26,7	26,4	19,4	35,8	34,2	22,4	22,4

Figure 3. Analytical classification of factors that affect the financial stability of companies in Montenegro and Ukraine

Source*:* Authors

For Serbian companies, operational factors are determined to be the most influential on financial stability. They encompass an inefficient structure of current costs (31%) and poorly diversified range of products (27.8%). At the same time, the respondents mention the problems related to an inefficient capital structure (15.9%) which causes risks to the business financial stability. Based on the analysis and systematization of the survey results, the respondents attributed the instability of the tax system (15.7%) and the growth of inflation (13.4%) to general economic factors. The market factors that mainly affect the financial stability of companies encompass a decreased capacity of the domestic market (13.4%), increased competition (16.8%) and monopoly in the market (15.2%). Awareness of the factors that affect the financial stability of a company can help leaders and managers perform monitoring and evaluate financial stability as a top priority when conducting business.

3.2 Assessing risks of losing the business financial stability

In the conditions of a crisis economy, a significant number of business failures are due to insufficient qualification or incompetence of managers who neglect potential risks. When making management decisions in a company, it is important to know whether the obtained values of financial indicators are acceptable and good and to what extent. In addition, the financial analyst or manager seeks to establish a logical connection between the quantitative values of indicators of the selected group and the risk of financial security (Dankiewicz et al., 2022). That is, a person who makes management decisions cannot be satisfied with a binary assessment of good vs bad. To understand the situation, the nuances of the situation and the economic interpretation of the values of these nuances are important. The application of fuzzy logic tools is conditioned by the need to consider a significant number of heterogeneous indicators, the existence of floating limits of the normative range, the increasing complexity of mathematical models, and the need to make correct decisions in terms of incomplete and unclear information. Based on the results of studies by Milanesi (2014), Korol (2018), and Chang et al., (2015), we implemented a fuzzy logic approach to assess risks of losing the financial stability by a company.

This methodology is applied on the example of the company activity for two periods (periods I and II). The group of experts was formed from the number of scientific and pedagogical workers and specialists of the companies selected for the study (number of risk factors, n = 6; number of experts, m = 5). The experts were asked to identify the main risks of losing the financial stability by the companies they work for. A set

of such risks was formed based on the results of a previous survey (Figure 3). The results of the experts' work are displayed in Table 1.

Table 1. Summary matrix of ranks

Risk factors	*Name of the factor*	*Experts*				
		1	*2*	*3*	*4*	*5*
x_1	Risk of an inefficient structure of current costs	6	5	6	6	5
x_2	Risk of increased receivables	5	6	5	5	6
x_3	Risk of an insufficiently diversified range of products	2	4	3	4	3
x_4	Risk of a decrease in economic potential	4	3	4	3	1
x_5	Risk of an inefficient asset structure	1	2	2	1	4
x_6	Risk of an irrational capital structure	3	1	1	2	2

Source*:* authors

Next, we built a matrix of ranks, where the risk factor has the greatest value in terms of sums of ranks x_1, and the least — x_6.(Table 2).

Table 2. The matrix of ranks

Risk factors	*Experts*					*Analytical results*		
	1	*2*	*3*	*4*	*5*	*Sum of ranks*	*d*	d^2
x_1	6	5	6	6	5	28	10.5	110.25
x_2	5	6	5	5	6	27	9.5	90.25
x_3	2	4	3	4	3	16	-1.5	2.25
x_4	4	3	4	3	1	15	-2.5	6.25
x_5	1	2	2	1	4	10	-7.5	56.25
x_6	3	1	1	2	2	9	-8.5	72.25
$\sum$	21	21	21	21	21	105		337.5

Source*:* authors

The average degree of agreement between experts' opinions was estimated using the concordance coefficient (Fishburn, 1990) calculated according to the formula:

$$W = \frac{12S}{m^2(n^3 - n)} \qquad (1)$$

Where S = 337.5, n = 6, m = 5.

$$W = \frac{12 \times 337.5}{5^2(6^3 - 6)} = 0.771$$

The value of the obtained coefficient indicates a high degree of consistency in experts' opinions. The assessment of the significance of the concordance coefficient is determined by the Pearson test: $\chi^2 = 5(6-1)` \times 0.771 = 19.29$. The calculated χ^2 is compared with the table value for the number of degrees of freedom K = 5 and the significance level $\alpha = 0.05$. Since the calculated $\chi^2 = 19.29$ is greater than the one provided in the Table (11.07050), then W = 0.771 is not a random value. Therefore, the obtained results of expert evaluation make sense and can be used in further calculations. Next, we calculated the weights of risk factors. For this, the survey matrix is reformatted into a matrix of transformed ranks according to the mathematical expression: $s_{ij} = x_{max} - x_{ij}$, where $x_{max} = 6$ (Table 3).

Table 3. Matrix of transformed ranks

Risk factors	*Experts*					Σ	*Weight, λ*
	1	*2*	*3*	*4*	*5*		
x_1	0	1	0	0	1	2	0.02667
x_2	1	0	1	1	0	3	0.04
x_3	4	2	3	2	3	14	0.1867
x_4	2	3	2	3	5	15	0.2
x_5	5	4	4	5	2	20	0.2667
x_6	3	5	5	4	4	21	0.28
Total						75	1

Source*:* authors

According to the results, the risk factors are defined by experts as unequal. Next, the significance coefficients were calculated according to the Fishburn formula (Fishburn, 1990):

$$r_j = 2(n - j+1) / n(n + 1) \quad (2),$$

where n is the number of indicators, n=6, j is the degree of the indicator significance.

The ranking results and factor importance coefficients are presented in Table 4.

Table 4. Ranking results and significance of each factor

Risk factors	*Weight, λ*	*Rank*	*Significance according to the Fishburn formula, r_j*
Risk of an inefficient structure of current costs (x_1)	0.02667	6	0.0476
Risk of increased receivables (x_2)	0.04	5	0.0952
Risk of an insufficiently diversified range of products (x_3)	0.1867	4	0.1429
Risk of a decrease in economic potential (x_4)	0.2	3	0.1905
Risk of an inefficient structure of assets (x_5)	0.2667	2	0.2381
Risk of an irrational structure of the capital (x_6)	0.28	1	0.2857

Source*:* Authors

According to the fuzzy logic methodology, the levels of membership μ_{jk} of fuzzy subsets were calculated from the term-set of values of the variable (X) (Zadeh, 1990). The membership functions $\mu_A(X)$ are constructed for each linguistic term-set. The parameters of the main functions are described by Milanesi (2014) and Zadeh (1990). We used the membership function μi(X), which corresponds to a fuzzy trapezoidal number (T-number):

$$\mu_{\mathrm{A}}(x) = \begin{cases} 1 - \dfrac{b-x}{b-a}, & a \le x \le b \\ 1, & b \le x \le c \\ 1 - \dfrac{x-c}{d-c}, & c \le x \le d \\ 0, \text{in other cases} \end{cases} \quad (3)$$

The vertices of the trapezoid are calculated as follows:

$$A = \min(a_j)$$
$$B = \min\{\max(a_j)\min(b_j)\}$$
$$C = \max\{\max(a_j)\min(b_j)\}$$
$$D = \max(b_j) \quad (4)$$

Table 5 shows the matrix of membership levels μ_{jk} for fuzzy subsets from the term set of variable values.

Table 5. Matrix of membership levels μ_{jk} to fuzzy subsets from the term set of variable values for two periods (I та II)

Indicator	*Period I*					*Period II*				
	μ_1	μ_2	μ_3	μ_4	μ_5	μ_1	μ_2	μ_3	μ_4	μ_5
x_1	0	0	1	0	0	0	1	0	0	0
x_2	0	1	0	0	0	0	1	0	0	0
x_3	1	0	0	0	0	1	0	0	0	0
x_4	1	0	0	0	0	0	0	1	0	0
x_5	0	1	0	0	0	1	0	0	0	0
x_6	0	1	0	0	0	0	1	0	0	0

Source*:* authors

The basis is a matrix with selected quality levels: very high, $\mu_5$high, $\mu_4$medium, $\mu_3$low, $\mu_2$very low, μ_1 are the columns of the matrix, the selected indicators are its terms, the cells of their intersection are membership levels for the qualitative levels. We set two time intervals (periods I, II), during which the risk of losing the financial stability by the company was assessed. At the same time, financial stability in each of the time intervals was characterized by a set of N financial indicators which were calculated based on the data of the company's financial statements for each of the periods. The selection of evaluation indicators was carried out by experts. When choosing evaluation indicators for business entities, we suggest starting from the following conditions: a) the system of indicators {X} is sufficient for a reliable analysis and assessment of the business financial stability, b) the indicators should not have redundant irrelevant information. We recommend considering configurations such as: a) industry affiliation of the company, b) accounting policy of the enterprise, and c) asymmetry of information for users. For each indicator, the linguistic variable B_i, "the value of X_i indicator", is provided for the following set of values: B_i1 — very low level; B_i2 — low level; B_i3 — medium level; B_i4 — high level; B_i5 — very high level. Calculations have been made. Next, we calculated the aggregate risk indicator of the financial stability loss for the enterprise, g(FS) according to the double convolution formula:

$$g(FS) = \sum_{i=1}^{6} r_i \sum_{j=1}^{5} b_j \mu_j \quad (5),$$

Where b_j — nodal points of the classifier (1.5), r_j — the degree of the indicator significance, μ_j — the value of the level of belonging to fuzzy subsets relative to the current value of the jth factor.

The results of calculating the aggregated indicator of the risk of financial stability loss suffered by the company in dynamics for two periods are presented in Table 6.

Table 6. The results of calculating the aggregated indicator of the risk of financial stability loss

Quantity levels, j	*Nodal points, g_i*	*Σ(μ) in period I*	*Σ(μ) in period II*	*Aggregate indicator of risks of financial stability loss, g(FS)*	
				period I	*period II*
1	0.1	2	2	0.243	0.262
2	0.2	3	4		
3	0.3	1	0		
4	0.7	0	0		
5	0.9	0	0		

Source*:* authors

That is, the term-set of the linguistic variable G, "the financial stability", consists of components. Each of the subsets G 1 to G 5 corresponds to its property functions $\mu_1(X)$ to $\mu_5(X)$, where g(FS) is a comprehensive indicator of the risk of financial stability loss, and the higher g(FS) is, the more prosperous the enterprise becomes. Linguistic recognition of assessing the level of financial stability loss for the company is presented in Table 7.

Table 7. The classifier of levels for the aggregated indicator of the risk of the financial stability loss

Interval of values	*The linguistic value of a variable*
[0; 0.2]	Risk borderline for financial stability loss
[0.2; 0.4]	High risk level of financial stability loss
[0.4; 0.6]	Sufficient risk level for financial stability loss
[0.6; 0.8]	Low risk level for financial stability loss
[0.8; 1.0]	Very low risk level for financial stability loss

Source*:* authors

According to the results of calculations during two periods, the company has a high risk level of financial stability loss. In practice, the financial stability of the enterprise can change in a positive or negative direction under the influence of business operations. Therefore, the task of the management to ensure the business financial stability is to find the optimum which makes it possible to form the flows of economic transactions that lead to improving the financial stability of the company.

3.3 Scenarios of management decisions to ensure financial stability based on management determinants

When companies face disruptive changes caused by crisis phenomena and processes in the economy, they resort to situational management. Configurations of management decisions to ensure financial stability in a crisis economy are conditioned by the determinants of SME management (Figure 4).

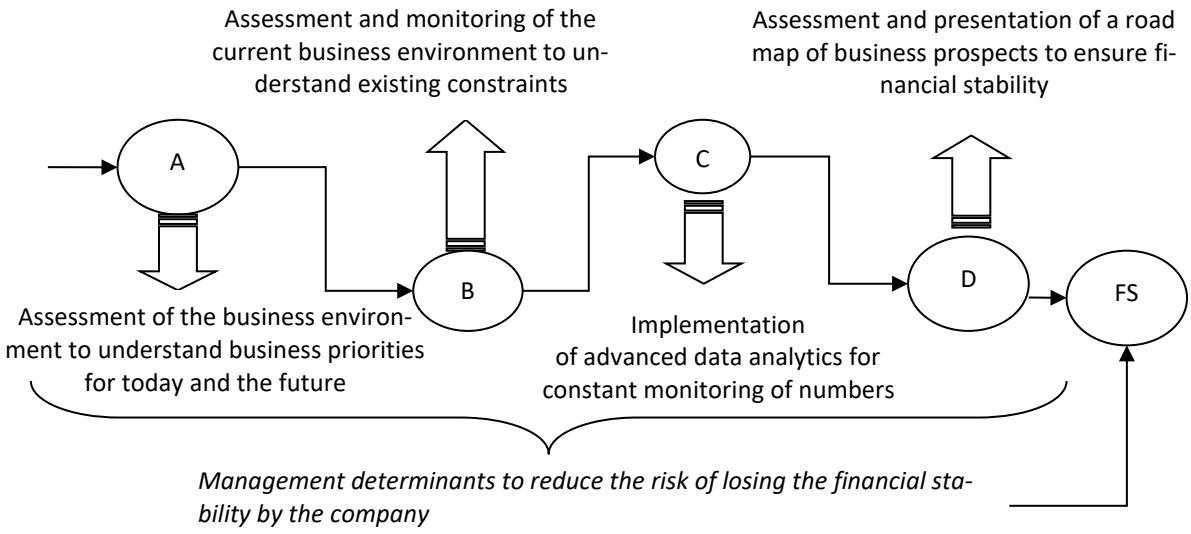


Figure 4. Configurations of management decision making based on management determinants

Source*:* authors

An important condition for the activity of small and medium-sized companies is their vulnerability to social changes. Managers and business owners should take this into account. The main determinants of management to ensure the financial stability of SMEs in a crisis economy are as follows: a) ensuring an effective structure of assets and capital, b) ensuring an image, c) ensuring stable and effective management, d) ensuring stable labor relations, e) ensuring stable relationships with suppliers. We present these determinants in more detail.

A) External determinant: the scenario is aimed at providing an image. In conditions of high competition and external risks, the company's reputation increases its brand value, which, in turn, increases the company's asset base and financial stability. Such a situation contributes to maneuverability with the company's own and borrowed money and it will be characterized by sufficient values of liquidity and solvency ratios.

B) External determinant: the scenario is aimed at ensuring stable relationships with suppliers. Building trust and positive relations with counterparties determines the acquisition of an interest-free loan, terms of payment with a delay.

C) Internal determinant: the scenario is aimed at ensuring stable and effective management. For this, the effectiveness of management accounting must be fortified. The problem is that data may often be hidden and isolated in data islands within a company. Numbers are evidence of the health and well-being of an enterprise. Therefore, in order to make considered business decisions, managers need to take control and manage their data by applying a sophisticated set of systems, tools and solutions. This will help to regularly monitor internal and external cash flows and focus attention on key financial performance indicators. Accounting professionals can potentially play a strategically important role both in formulating these numbers and in evaluating them appropriately for management needs.

D) Internal determinant: the scenario is aimed at ensuring stable labor relations. To do this, it is important to maintain your skills and get a higher return on your investment in staff training. Staff stability affects the company's image and indirectly affects the attitude of suppliers and counterparties to the company.

CONCLUSION

The authors supplemented the developments on the importance and ensuring the financial stability of small and medium-sized businesses in a crisis economy. Such a research proposal is motivated by the fact that, firstly, the financial stability of the company is related to its financial security and balance, and secondly, small and medium-sized businesses play a significant role in global supply chains. But many of them work on outdated systems and processes and face insufficient skills and technologies. Therefore, there are strong arguments for change, especially after the outbreak of the COVID-19 pandemic. For this, a change in the management configuration is needed to ensure and maintain the financial stability of a company. The authors of this study applied a scientific and practical toolkit in justifying changes in management determinants to ensure the financial stability of companies. The presented developments are relevant for entrepreneurship researchers and managers who seek to better understand how they can provide conditions for the growth of small and medium-sized businesses. They are also topical for the managers who work on ensuring the financial stability of their own business. Taking into account the fundamental importance, complexity and systematicity of this problem, the authors of the current study suggested management approaches aimed at reducing the risk of losing financial stability by companies that operate in a crisis economy. We understood that the total number of SMEs selected for the study was too small to be statistically significant. But we assumed that readers would find the story they tell useful. And this study will help to draw quantitative conclusions from such diverse material.

Risk and danger factors must be considered when developing specific solutions to ensure the financial stability of a business. We expanded the imagination of such factors for small and medium-sized companies of Ukraine and Montenegro in the post-quarantine economy, as they had to change their business models and operations during the COVID-19 pandemic. We argue that taking into account and evaluating these factors contributes to the formation of important information for management. We put forward a hypothesis and find that the problem of decision-making is determined by a weak assessment of risk factors and financial stability of companies. In addition, we found that the formation of the management focus of small and medium-sized business owners is determined by the speed of information technology development, world trends and challenges of the development of their companies. Therefore, it was important for us to establish the factors that influence the financial stability of the company. Overall, our findings show that governance deficiencies threaten the financial balance and safe operations of companies.

The presented approach to assessing the company's financial stability connects it with the effectiveness of risk management. Fuzzy logic is used to model the assessment of the cost of financial stability of companies. Subjective and objective indicators are comprehensively considered in the system of risk assessment indicators in a model that combines fuzzy theory with quantitative data analysis. The authors of the current study assumed that the fuzzy-multiple toolkit reduces the time spent on finding out the exact values of the variables and compiling the descriptive equation. This creates conditions for better risk management due to the requirements based on the rule of business evaluation. In addition, the use of fuzzy products gives advantages when solving complex or poorly formalized tasks, such as risk assessment. An expert analyst has the opportunity within this methodology to increase or decrease the number of linguistic variables, which does not affect the logic of the fuzzy model. The use of this innovative method provided an opportunity to apply the experience, insight and intuition of experts to form an informational and analytical basis for managing the company's activities from the point of view of a behavioral approach.

Our research makes important contributions. First, we show that effective management requires monitoring risk factors for loss of financial stability. We also believe that risk assessment allows an organization to build resilience as a dynamic capability. The detailing of the procedural aspect of the financial stability management methodology depends on the set goals, as well as various factors of informational, methodical, personnel and technical support in the company. Finally, our research finds evidence that the determinants of SME management play a crucial and unique role throughout the process of managing the financial stability of an entrepreneurial system.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Linhartova, V., Jan Pucek, M. (2024), "Corruption and Human Development: Panel Data Analysis in Transition Economies",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 169-182.

Corruption and Human Development: Panel Data Analysis in Transition Economies

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ARTICLE INFO

Received April 17, 2023
Revised from May 17, 2023
Accepted June 17, 2023
Available online April 15, 2024

JEL classification: C33, O47, H41, J24

DOI: 10.14254/1800-5845/2024.20-2.14

Keywords:

Corruption,
Human capital,
Human development,
transition economies,
panel data.

ABSTRACT

Human capital is currently referred to as the driving force of national economies. It includes all the knowledge, talents, skills, abilities, experience, intelligence, and training of the country's workforce. The governments of individual countries are fully aware of this and are trying to stimulate human capital and stimulate its development. Apart from the economic consequences of corruption, several social consequences of corruption have also been empirically proven. As a result of inefficient use of public budgets, resources are limited in healthcare, education, and culture, in short, areas proven to cultivate human capital. Despite that, many authors have studied the effect of corruption on various macroeconomic variables, but only a few studies have empirically investigated the relationship between corruption and human capital development. This article aims to analyze the effects of corruption on the development of human capital in transitional economies, which are often mentioned as problematic in the context of bureaucratic corruption. By analyzing panel data for the period 1996-2021, it was found that corruption affects the development of human capital in the transitive economies examined. Corruption also affects human development indirectly through the dimensions of "Knowledge" and "Standard of Living".

INTRODUCTION

Corruption is perceived as an obstacle to economic development. It undermines the credibility of the political system, which limits the delivery and quality of public services. Economic growth and investment are very costly because they increase the cost of public and private business activities. It clouds the business environment with uncertainty and disrupts the regulatory and legal framework that businesses must rely on.

Transition economies are very specific in human capital development. During the period of communism, the development of human capital was not supported, on the contrary, unification and mediocrity in all aspects of human life were explicitly favored and supported by the communist ideology.

Transitional economies are very often associated with so-called bureaucratic corruption, for which the transformation and privatization processes that the mentioned countries have gone through are an ideal breeding ground for the development of corrupt practices. Regarding the above, the question arises whether the obstacle to the development of human capital in the environment of transitive economies is not exactly bureaucratic corruption, which is often mentioned in connection with these countries.

The article aims to analyze the influence of corruption on human capital in nine transitional economies of Central and Eastern Europe (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia), which are often mentioned in connection with the so-called bureaucratic corruption. The issue of the influence of corruption on the development of human capital will be investigated in these countries using the analysis of panel data for the period 1996-2019. That is the longest time series for which the observed variables are currently available.

Three hypotheses are verified concerning the aim of the paper:

H1: There is a mutual relationship between corruption and human development.

H2: Corruption affects human development.

H3: Corruption affects human development through life expectancy/knowledge/standard of living dimension.

1. LITERATURE REVIEW

1.1 Corruption

Corruption is still a serious problem in the whole world and in many countries has reached a high level and is considered one of the main causes hindering the process of economic development. Corruption has adverse effects on the economic growth and development of any country by reducing income, hindering domestic and foreign investment, increasing inflation, promoting rent-seeking activities, misallocation of resources, reducing tax revenue, increasing income inequality and poverty, increasing child mortality and deteriorating the quality of education. (Iskandar and Saragih, 2018; Murshed and Mredula, 2018;)

If efforts are made to describe and analyze corruption more closely, the universality of this concept disappears, as it is assessed individually and is usually quite different. The best-known existing definition of corruption, given by Joseph S. Nye, defines this phenomenon as *"behavior that, due to the achievement of private (personal, family, narrow group) financial and/or status gains, deviates from the formal obligations arising from a public role or transgresses the norms against the performance a certain type of the private influence"* (Linhartová and Halásková, 2022). Transforming economies struggle with corruption more than other countries. According to Holmes (2013), *"corruption has replaced communism as the scourge of Eastern Europe"*. In 1990, the countries of Central and Eastern Europe began to transition from communism to free market capitalism. After more than thirty years of reforms, some countries in Central and Eastern Europe show different results in the level of corruption. (Linhartová and Halásková, 2022)

The institutional aspect was not given enough attention in the transformation process. The new formal rules were imperfect, suffered from many shortcomings, and were not even effectively enforced. They were opposed by informal rules in the form of customs, traditions, and established patterns of behavior that had evolved over decades of the socialist system, and were not compatible with the new formal rules, one could even say that they were in direct conflict with them. The result of neglecting the institutional level of transformation is the current state of transitive economies. Although in some countries the transformation has already officially ended, transitional economies show the same weaknesses in the institutional environment. These undoubtedly include corruption and rent-seeking in general. The natural outcome of such an approach is a significant scope of corrupt activities, common to all countries undergoing the process of transforming a centralized economy into a market one.

1.2 Human Development

Founder of the theory of human capital Gerry Becker defined human capital as abilities, skills, and the corresponding motivation to apply those abilities and skills. It also states that individuals decide to participate in human capital formation as investments based on a comparison of benefits and costs. In his view, the benefits are, for example, higher wages, and better employment, but also non-monetary benefits such as improved health, cultural education, and a shift in the social ladder. The cost is the value of time (the cost of lost opportunity) and the value of the expenses to manage these investments. Human capital is considered one of the key variables determining economic growth, and investment in it is considered one of the most important in terms of its importance and return (Becker, 2009).

The Human Development Index describes and evaluates how people can pursue their potential in a certain environment and how this environment determines them. It is more than just income, wealth, or commodity production and capital accumulation. Access to resources is undoubtedly an essential part of human development, but it is not the only goal of human development efforts. According to UNDP, *"The HDI was created to emphasize that people and their capabilities should be the ultimate criterion for evaluating a country's development, not just economic growth"* (UNDP, 2023). An important advantage of the index, which adds to its credibility, is the sources from which it draws data for its calculations. These are long-term monitored indicators and statistics covered by organizations that operate around the world and the areas are credible and generally respected (UNDP, 2023). Human Development Index dimensions are depicted in Figure 1.

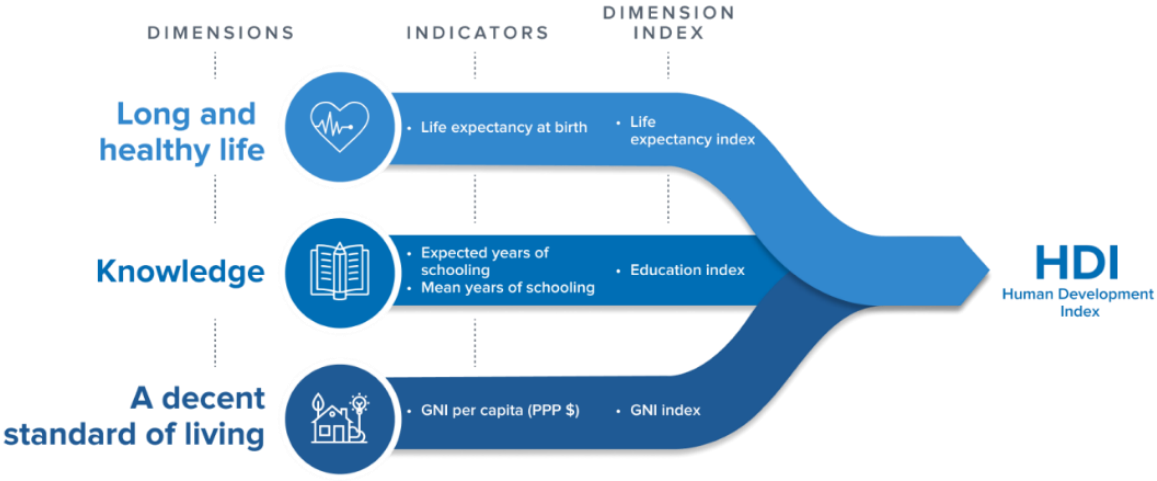

Figure 1. HDI dimensions and indicators

Source: UNDP (2023)

The Human Development Index (HDI) is an aggregate measure of the level of human capital in the key dimensions of human development: having a long and healthy life, being educated, and achieving a decent standard of living. HDI is the geometric mean of the normalized indices for each of the three mentioned dimensions. The dimension of health is evaluated according to life expectancy at birth. The educational dimension is measured using the number of years of schooling for adults aged 25 and over and the expected years of schooling for school-age children. The standard of living dimension is measured by gross national income per capita. The resulting values of these three HDI dimension indices are then aggregated into a composite index using the geometric mean (UNDP, 2023)

1.3 Impact of Corruption on HDI

Many studies have analyzed the impact of corruption on various macroeconomic variables (e.g. Mauro, 1996; Nizam ana Niaqvat, 2022, etc.), but only a few studies have conducted empirical research on the impact of corruption on humans. capital development (e.g. Qizilbash, 2001; Najar Nahavandi and Khorsand Asiabar, 2019; etc.). Mauro (1996) specifically dealt with these questions, in his work focused on the influence of corruption on government spending on education and concluded that corruption has a significant influence on the size of spending on education, the use of their use, and thus also on human capital, which is mostly approximated by the share of the population with at least a high school education in the workforce. Specifically, it states that a decrease in the perception of corruption by one point (on a range of 0-10) reduces government spending on education in relation to GDP by 0.7-0.9 percentage points.

In their work, Gupta et al. (2000) focus on the provision of health care and education. Their analysis is the finding that corruption affects the productive population, human capital, and technological progress through its effect on infant mortality rates and the "dropout" of primary and secondary school students. If the corruption rating drops by one point, it results in an increase in child mortality by 1.1-2.7 per 1000 births. In education), the deterioration of the perception of corruption will lead to an increase in the number of students who do not complete their studies, by 1.4-4.8 percentage points. Kaufmann, Kraay, and Zoido-Lobaton (2000) found that corruption reduces life expectancy, lowers population literacy, and increases infant mortality.

Vittal (2003) examined how corruption in countries with high levels of corruption affects the poor. Despite the argument that bribery can be seen as the price of speed and efficiency for the rich, in countries with high levels of corruption the poor must pay even for access to basic services. Since I pay a large portion of my income in bribes, the already significant income inequality is exacerbated. Using panel data analysis and Granger causality, Akcay (2006) investigated the influence of corruption on human capital development in a sample of sixty-three countries in the world and proved that *"more corrupt countries tend to have lower levels of human development. In brief, this study extends the list of negative consequences of corruption and argues that corruption in all its aspects retards human development"*. Corruption limits the development of human capital by 0.13, respectively. 0.48 percentage points depending on the used indicator of the level of corruption.

According to Akcay (2006), urbanization is a natural part of human capital development. Living in the city provides not only more opportunities for higher incomes but also better access to education, health care, and other social services. Also, Emara (2020) considers the rate of urban population as a factor influencing the development of human capital in a country. According to Akcay (2006), urbanization is a natural part of human capital development. Living in the city provides not only more opportunities for higher incomes but also better access to education, health care, and other social services. Abdulla (2021) showed that corruption affects several observed human capital inputs such as health status, school enrollment, and school dropout rates. *„According to the prediction derived from the empirical analysis, corruption harms the stocks of human capital. The counterfactual findings using the calibrated model suggest that the elimination of corruption increases aggregate output by 18–21% on average.“*

Governance is central to human development because, without it, power will almost certainly be used in ways that do not promote and sustain overall human development. The development of human capital is thus fundamentally determined by the volume of public spending in general (Kamalu et al., 2021).

2. MATERIALS AND METHODS

To investigate the impact of corruption on human development, data on corruption from two different sources were used. These are the Corruption Perception Index (CPI) compiled by Transparency International (TI) and the Control of Corruption (CC) compiled by the World Bank (WB). The CPI index ranges from 0 to 100, with a value of 0 indicating a high level of perceived corruption, while a value of 100 indicates a country without corruption. The CC indicator takes on values from -2.5 to + 2.5, where the lowest value again represents a high level of corruption, and conversely, the highest value means a country without corrupt practices. The empirical analysis will be carried out on nine transitional economies of Central and

Eastern Europe. HDI is used as the dependent variable. As already explained, the HDI measures a country's achievements in three aspects of human development, namely longevity, knowledge and a decent standard of living. The indicator ranks countries on a scale from 0 to 1, where 0 represents the lowest level of human capital development while 1 represents the highest level of human capital development.

To verify each other. of the relationship between corruption and human capital development, i.e. Hypothesis number 1, the method of correlation analysis was chosen. Hypothesis 2 and Hypothesis 3 on the direct influence of corruption on the development of human capital, respectively. influence through distribution channels, will be verified using regression analysis of panel data. The overview of the applied determinants for the data panel analysis and their resources is seen provided in Table 1.

Table 1. Used indicators for panel data analysis

Indicator	*Abbreviation*	*Unit*	*Source*
Human Development Index	HDI	0-1	UNDP
Corruption Perceptions Index	CPI	0-100	Transparency International
Control of Corruption	CC	-2,5 – 2,5	WorldBank
GNI per capita	GNI	USD (PPP)	World Bank
Life expectancy at birth	LEB	years	World Bank
Expected years of schooling	EYS	years	World Bank
Mean years of schooling	MYS	years	World Bank
Rural population	RP	% of the total population	World Bank
GDP per capita	GDP	USD (PPP)	Eurostat
General government final consumption expenditure	GE	% of GDP	Eurostat
Urban population	UP	% of the total population	World Bank

Source: own processing

Panel data analysis is a statistical method to analyze two-dimensional panel data that are a subset of longitudinal data where observations are for the same subjects each time. Because of the more significant information set in panel data, panel analysis is a good direction to address the multicollinearity problem. It also allows for dealing with the endogeneity and measurement error of various variables. It also makes it possible to account for heterogeneity by including time-invariant variables. Due to the fixed number of observed units (countries) in time, the resulting panel data set is balanced, and it is possible to use classic tools for estimating models with panel data (Baltagi, 2008). Baltagi (Ibid.) considers the basic regression model of panel data to be the model:

$$y_{it} = \beta_1 x_{it1} + \beta_2 x_{it2} + \ldots + \beta_k x_{itk} + \alpha_1 z_{i1} + \alpha_2 z_{i2}\, \alpha_3 + \ldots + \alpha_q z_{iq} + u_{it} \quad (1)$$

where the index i denotes the cross-sectional dimension i = 1,..., n, the index t the time dimension t = 1,..., t, the variables x_1 to x_k are explanatory variables not including the vector of units and the variables z_1 to z_q represent individual effects - diversity that can distinguish an individual or a whole group from other entities - a possible vector of units is included here. Individual effects do not change over time.

Due to the presence of fixed effects and lagged dependent variables among the regressors, equation (2) cannot be estimated using the method of least squares (OLS). As it is standard in panel data analysis, fixed effects can be solved using fixed effects (FE) or random effects (RE) estimators (for more information please see Baltagi, 2008).

3. RESULTS

The development of the HDI in the period from 1996 to 2019 in a selected set of countries is shown in Figure 2. The graph shows a positive trend in the development of this indicator, the monitored countries have come a long way in the monitored period toward the development of the human potential of their inhabitants. Except for the Czech Republic and partially Estonia, however, all transitive economies lag behind the European Union (EU) average throughout the monitored period, i.e. worsen the average rating, which also includes countries that did not go through the process of transformation from a centrally planned economy to a market economy. It is important to mention that the very process of joining the EU significantly and positively influenced the building of anti-corruption policy, the implementation of anti-corruption mechanisms, and the creation of a transparent economic environment (Linhartová and Halásková, 2022). The analyzed transition economies began to join the EU in 2004.

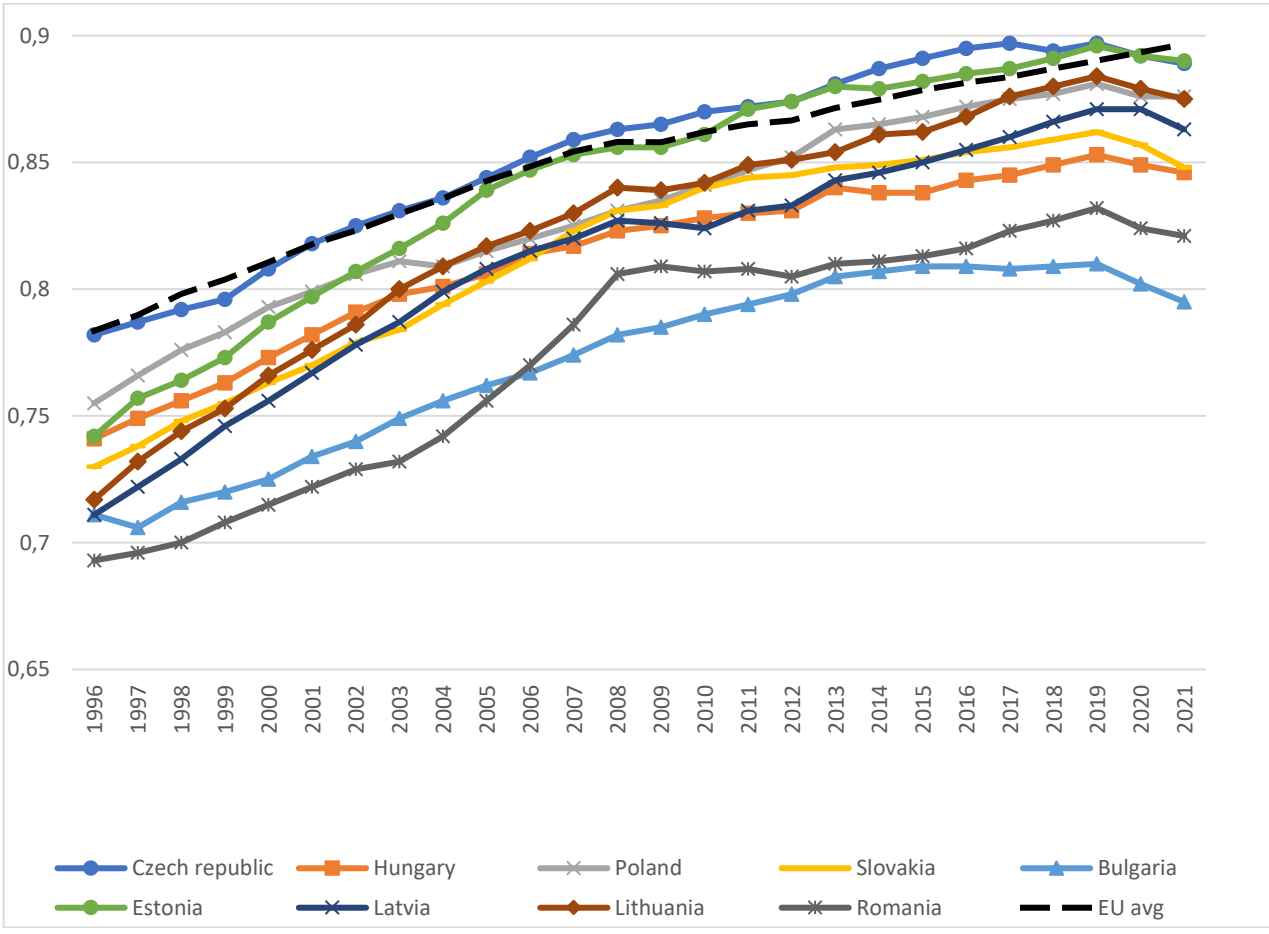

Figure 2. HDI development 1996-2021

Source: Own compilation based on UNDP (2023)

The development of CPI in analyzed countries is depicted in Figure 3. In recent years, according to Transparency International, there has been a significant improvement in the ranking of only 22 countries out of less than 200 countries evaluated. Within Europe, states show a tendency to decrease the incidence of corruption in the direction of the West. The best-placed state with the lowest incidence of this phenomenon is Estonia (Transparency International, 2022).

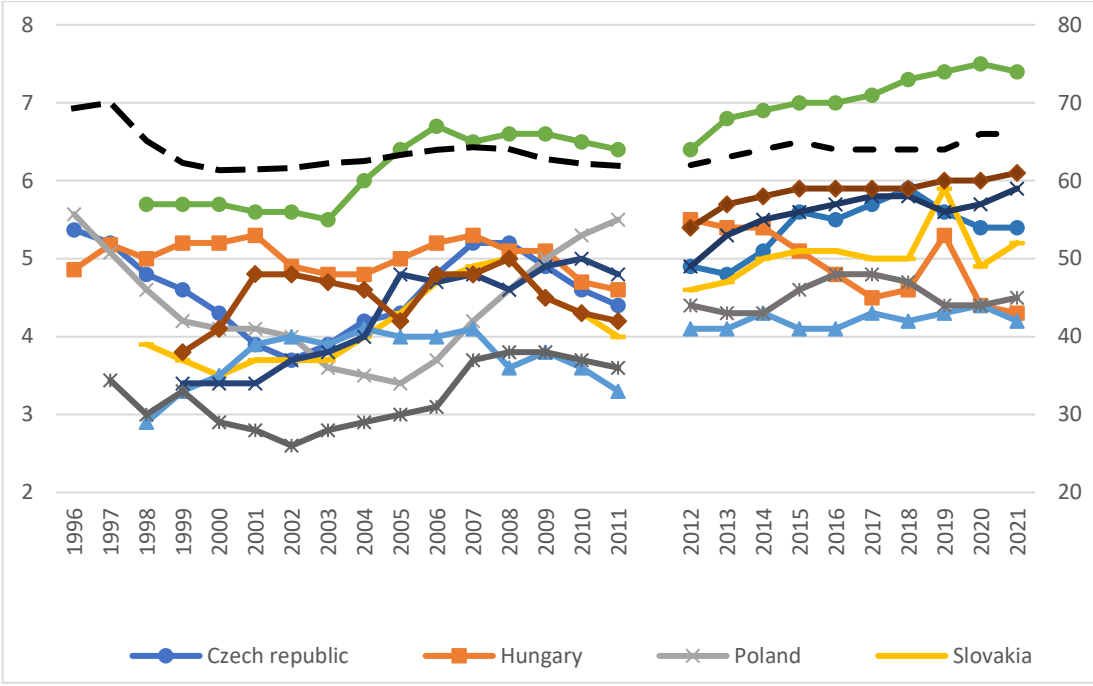

Figure 3. CPI development 1996-2021

Source: Own compilation based on Transparency International (2022)

The relationship between the human capital development index and the level of corruption was proven by correlation analysis. Thus, hypothesis number 1 was proven. A correlation matrix is depicted in Figure 4.

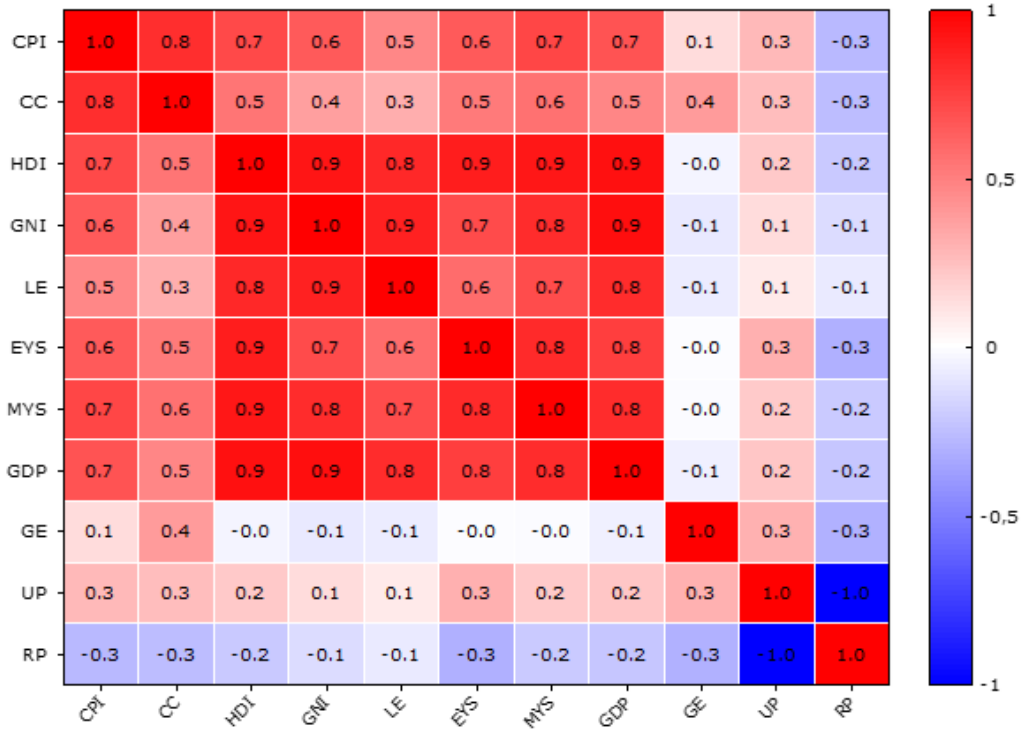

Figure 4. Correlation matrix

Source: Own elaboration

A strong correlation dependence was demonstrated especially for the CPI indicator. A possible cause may be the different construction of the CPI indicator compared to the CC indicator. The CPI is based on the perception of corruption by survey respondents, who are domestic and foreign businessmen, analysts, and representatives of the professional public from the evaluated countries. The index is published once a year, and the surveys used to compile it mostly contain questions focused on the bribery of public officials or commissions in public contracts. It is thus an indicator of so-called perceived corruption in the public sector. That is, the area in which subsectors cultivating human capital (education, sports, culture) are classified. It can therefore be summarized that there is a mutual relationship between the development of human capital and corruption, especially public sector corruption.

The following Figures 5 and 6 are scatter plots of corruption and human capital development indices. A simple linear regression shows a positive relationship between corruption and human development. Two corruption indices were used, both the Corruption Perception Index and Control of Corruption too. In other words, a better rating of a country's level of corruption goes hand in hand with a better level of human capital in the analyzed group of countries.

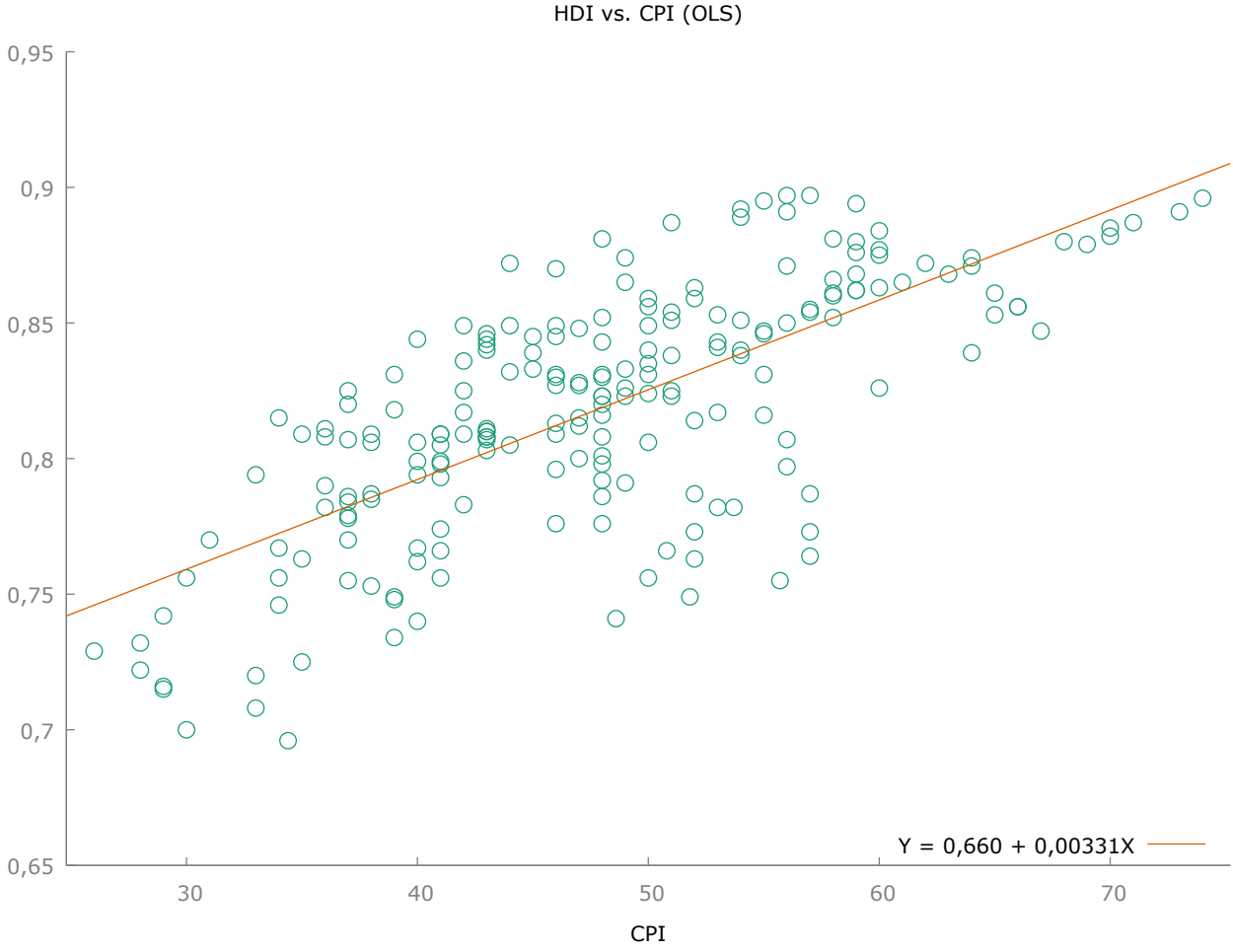

Figure 5. Scatter plot of HDI and CPI
Source: Own elaboration

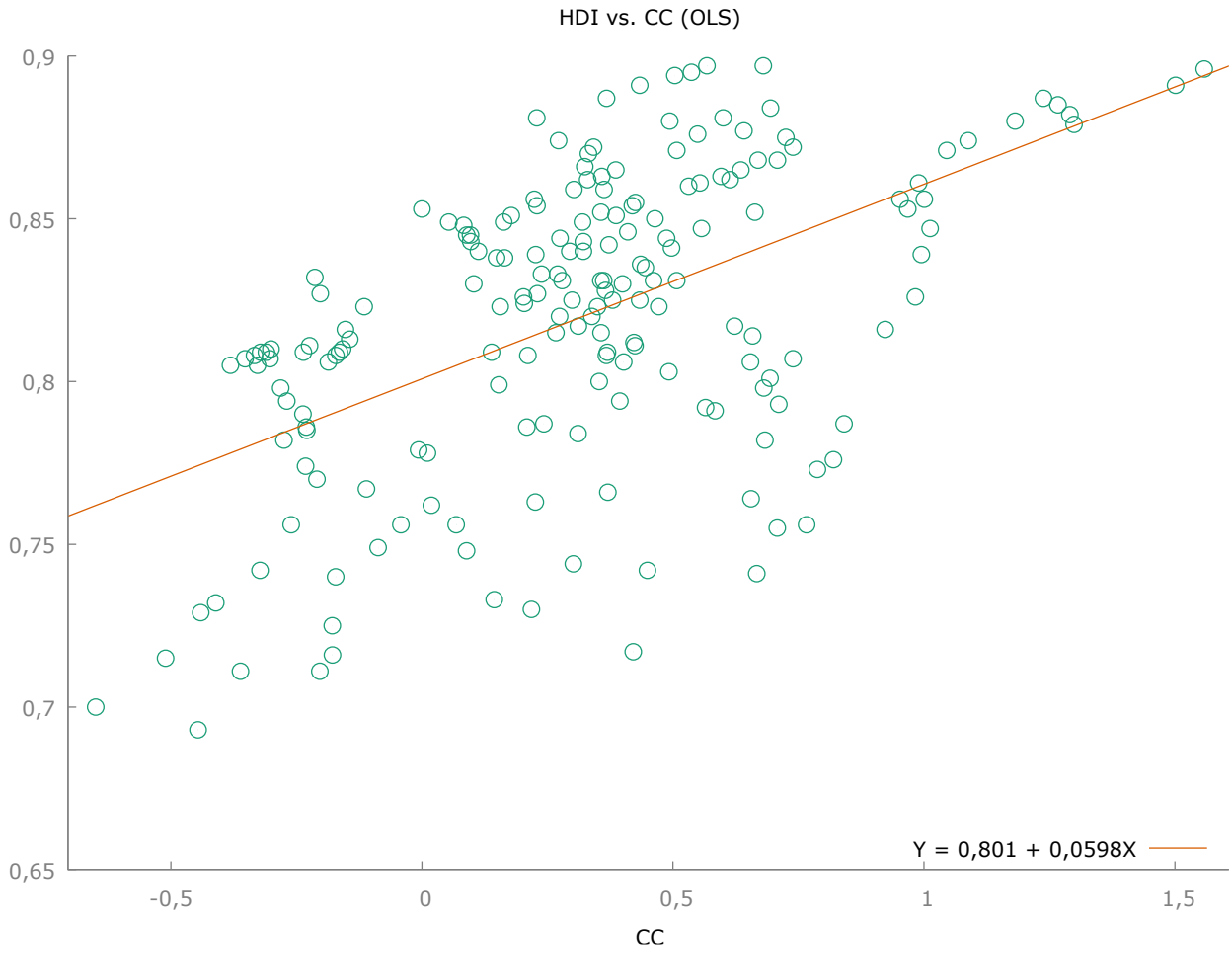

Figure 6. Scatter plot of HDI and CC

Source: Own elaboration

To verify the one-sided influence of corruption on human capital development, panel data analysis was applied. As already mentioned, several panel data models can be used. Recommendations about the suitability of individual panel models are given by panel diagnostics tests (see e.g. Baltagi, 2008). The output of the tests is a report on the suitability of using individual panel models. One frequently used panel test is the Breusch-Pagan test, which is performed to determine whether a pooled OLS or FEM model should be used. If the p-value > 0.05, the OLS model is considered appropriate. In the case of our data, the p-value is 2.07124e-017. A low p-value argues against the null hypothesis that the pooled OLS model is adequate and in favor of the random effects alternative.

Another panel diagnostic test used is the Hausman test, which is used as a basis for deciding whether FEM or REM is more appropriate. If the p-value is > 0.05, the REM is considered valid (Baltagi, 2008). In our case, the p-value of the Hausman test is $5.34023e^{-010}$. A low p-value argues against the null hypothesis that the random-effects model is consistent and in favor of the fixed-effects alternative. The aforementioned panel diagnostic tests identified that FEM should be used to perform the analysis. If the individual effects z_1 to z_q are unobservable but correlated with explanatory variables, the solution is to include all effects in the predictable conditional average using the relation $\alpha i = \alpha_1 z_{i1} + \alpha_2 z_{i2} \alpha_3 + \ldots + \alpha_q z_{iq}$ and the FEM equation is as follows (Baltagi, 2008):

$$y_{it} = \alpha_i + \beta_1 x_{it1} + \beta_2 x_{it2} + \ldots + \beta_k x_{itk} + u_{it} \quad (2)$$

where y_{it} is the dependent variable observed for the individual I at time x_{it1} and β is the $k \times 1$ matrix of parameters; α_i means a specific constant for each cross-sectional unit and u_{it} is the error term.

The estimation of the influence of independent variables on human development using regression analysis of panel data can then be given by the following equation:

$$HDI = \alpha_i + \beta_1 * COR + \beta_2 * GNI + \beta_3 * LE + \beta_4 * EYS + \beta_5 * MYS + \beta_6 * RP + \beta_7 * GDP + \beta_8 * GE + \beta_9 * UP + u_{it} \quad (3)$$

Table 3 shows the results of the panel data analysis using the fixed-effects model.

Table 3. Results of the panel data analysis – Fixed effects model

Variable	*Coeff.*	*Std. Error*	*t-ratio*	*p-value*	
const	0,0326607	0,0426629	0,7656	0,4451	
CPI	6,52876e-05	2,59047e-05	2,52	0,0527	*
CC	−0,00112216	0,00256709	−0,4371	0,6626	
GNI	−8,28858e-07	3,17290e-07	−2,612	0,0098	***
LE	0,00700941	0,000623748	11,24	<0,0001	***
EYS	0,0123584	0,000636275	19,42	<0,0001	***
MYS	0,00334071	0,00109729	3,045	0,0027	***
RP	−0,000664627	0,000348601	−1,907	0,0584	*
GDP	3,22015e-06	3,74676e-07	8,595	<0,0001	***
GE	−0,000630650	0,000351984	−1,792	0,0751	*
UP	0,000262186	0,000135079	1,941	0,0540	*
R^2	0,991077				
Adjusted R^2	0,985338				
Prob (F-statistic)	$6{,}5e^{-155}$				

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Source: Own elaboration

By analysing panel data, the influence of corruption on human capital in selected transitional economies was proven in the case of the CPI index at a significance level of 0.1. For the CC indicator, the effect is not statistically significant. The reason is likely to be the already mentioned different measurement methodology of both indices, where the CPI indicator takes into account public sector corruption, which is more fundamental to human capital. The second hypothesis was thus confirmed for the CPI indicator. Specifically, a one percentage point improvement in the CPI will lead to a 0.000065 percentage point improvement in the HDI. Other variables that were marked as statistically significant at the 10% significance level are Rural population, General government final consumption, and Urban population. All these variables influence the development of human capital in transitive economies in the period under review.

Higher statistical significance was demonstrated for the variables GNI, Life expectancy at birth years, Expected years of schooling, Mean years of schooling, and GDP per capita. All these mentioned variables should also affect the development of human capital, even at a significance level of 0.01.

In the previous model, it was possible to demonstrate a significant positive influence of the variables GNI, Life expectancy at birth years, Expected years of schooling, and Mean years of schooling on human capital. This is quite logical, as these are dimensions of the human development index. Here, the question arises as to whether these could be transmission channels through which corruption could also influence the development of human capital indirectly. The influence of corruption on these areas of human life has been proven by several empirical studies.

To verify this hypothesis, three models were constructed in which GNI, Life expectancy, Expected years of schooling, and Mean years of schooling became the explained variables. Models taking into account the stationarity of variables were built using formulas (4), (5), (6), (7) as follows:

$$GNI = \alpha_i + \beta_1 * COR + \beta_2 * HDI + \beta_3 * LE + \beta_4 * EYS + \beta_5 * MYS + \beta_6 * RP + \beta_7 * GDP + \beta_8 * GE + \beta_9 * UP + u_{it} \quad (4)$$

$$LE = \alpha_i + \beta_1 * COR + \beta_2 * GNI + \beta_3 * HDI + \beta_4 * EYS + \beta_5 * MYS + \beta_6 * RP + \beta_7 * GDP + \beta_8 * GE + \beta_9 * UP + u_{it} \quad (5)$$

$$EYS = \alpha_i + \beta_1 * COR + \beta_2 * GNI + \beta_3 * LE + \beta_4 * HDI + \beta_5 * MYS + \beta_6 * RP + \beta_7 * GDP + \beta_8 * GE + \beta_9 * UP + u_{it} \quad (6)$$

$$MYS = \alpha_i + \beta_1 * COR + \beta_2 * GNI + \beta_3 * LE + \beta_4 * EYS + \beta_5 * HDI + \beta_6 * RP + \beta_7 * GDP + \beta_8 * GE + \beta_9 * UP + u_{it} \quad (7)$$

Diagnostic tests recommended again the FEM. Table 4 shows the results of the panel data analysis using the fixed-effects model for the aforementioned regression equations.

Table 4. Results of the panel data analysis – Fixed effects model

GNI			*Life Expectancy*			*Expected years of schooling*			*Mean years of schooling*		
Variable	p-value		Variable	p-value		Variable	p-value		Variable	p-value	
const	<0,0001	***	const	<0,0001	***	const	0,3098		const	0,2067	
CPI	0,0099	***	CPI	0,1787		CPI	0,0994	**	CPI	0,0946	*
CC	0,8119		CC	0,5488		CC	0,9744		CC	0,0032	***
HDI	0,0098	***	HDI	<0,0001	***	HDI	<0,0001	***	HDI	0,0027	***
LE	<0,0001	***	RP	0,1638		RP	0,1531		RP	0,5471	
EYS	<0,0001	***	GDP	<0,0001	***	GDP	<0,0001	***	GDP	0,1159	
MYS	0,4533		GE	0,0120	**	GE	0,0833	*	v	0,0538	*
RP	0,1695		v	0,4100		v	0,2471		UP	0,0528	*
GDP	<0,0001	***	EYS	<0,0001	***	MYS	0,1868		GNI	0,4250	
GE	0,6080		MYS	0,5661		GNI	0,6080		LE	0,5661	
UP	0,4250		GNI	<0,0001	***	LE	<0,0001	***	EYS	0,1868	
R2	0,985041		0,971436			0,942079			0,912767		
Adjusted R2	0,981798		0,954901			0,882223			0,841163		
Prob (F-statistic)	$7,2e^{-137}$		$2,6e^{-114}$			$1,08e^{-89}$			$1,74e^{-75}$		

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Source: Own elaboration

To verify the statistical significance of the relationship between corruption and individual dimensions of the HDI, panel data analysis was also applied to them. It was verified whether individual dimensions could be transmission channels through which corruption affects the development of human capital in the monitored set of countries. Thus, the dependent variable was always a certain dimension influencing the variable CPI index, which in the analysis of panel data appeared as a statistically significant variable influencing the development of human capital. In the cases of GNI, Expected Years of Schooling and Mean Years of Schooling, a statistically significant influence (statistical significance at the 10% or 5% significance level) of corruption on this chosen dimension was demonstrated. Therefore, it can be assumed that corruption affects the development of human capital in the country through the transmission channel of the dimension "Knowledge" and the dimension "A decent standard of living". The "Long and healthy life" dimension has not been statistically proven. Hypothesis 3 was thus only partially proven.

4. DISCUSSION

The impact of bureaucratic corruption in particular on the economic performance of various countries has been a popular topic of various studies and debates for decades. Several empirical studies have confirmed the negative effect of corruption on human capital, through reductions in government spending on education, science and research, and health. However, the issue of the influence of corruption on the development of human capital, i.e. the main source of economic growth, is still largely unexplored territory. However, it can be assumed that corruption and human capital development are two closely related variables and the influence of corruption on human capital is undoubtedly significant.

The conclusions of the analysis confirm the conclusions of several authors (Akçay, 2006; Qizilbash, 2001) that highly corrupt countries tend to have a low level of human capital development, and the level of bureaucratic corruption defined by the CPI indicator was marked as a statistical variable in the regression model significantly influencing the HDI indicator. Akçay (2006) and Emar (2020) considers the level of urbanization as a factor influencing the development of human capital in a country. The analysis carried out confirms this assumption of theirs also for the selected transitive economies. In general, it can be summarized that the performed data analysis confirmed statistical significance at least at the 10% significance level for most variables that were selected as the main variables influencing the development of human capital in the country based on the literature review.

As mentioned earlier, empirical studies by foreign authors found that corruption not only affects several variables directly but also indirectly through transmission channels. The influence of corruption on the HDI indicator was confirmed through two out of three HDI dimensions. Hypothesis number 3 about the indirect influence of corruption through the life expectancy/knowledge/standard of living dimension was thus confirmed for the "knowledge" and "standard of living dimension". Thus, the performed analysis did not confirm the conclusions of the authors Kaufmann, Kraay and Zoido-Lobaton (1999) about the influence of corruption on life expectancy, through which corruption could influence the development of human capital.

CONCLUSION

The presented contribution carried out an empirical analysis of data from the period 1996-2021 to verify the influence of corruption on the development of human capital in selected European transitional economies. Even though the transformation process of the selected economies should be over and their entry into the European Union fundamentally influenced the anti-corruption policy of these countries, in terms of the level of bureaucratic corruption, the selected European countries still do not stand alongside those from Western or even Northern Europe.

By applying correlation analysis, the validity of hypothesis 1 on the mutual relationship between corruption and human capital development was verified. Through the analysis of panel data, it was found that corruption in the observed period had a statistically significant effect on the development of human capital in the selected set of countries, thereby verifying the validity of hypothesis 2 on the one-sided influence of corruption on the development of human capital. In addition to corruption, GDP, the number of rural residents, and public expenditures have also been proven to be other variables affecting human capital. Furthermore, the analysis of panel data revealed that corruption can affect human capital indirectly, through the dimensions "knowledge" and "standard of living". This verified the validity of hypothesis number 3, which was only partially confirmed.

The limitation of the results of the analysis of the impact of corruption on human development can be seen in the basic problem of quantifying corruption. Corruption is difficult to identify as well as quantify. Most of the currently existing indicators are based on soft data. On the other hand, the corruption indicators compiled by the World Bank and Transparency International, which were used in this study, are the most reliable that can currently be used for economic analysis.

The authors of this article see as a subject for further research not only the solution of the aforementioned relationship between corruption and the development of human capital in transition countries but also their wider context in European and international comparison. A detailed analysis of the dimensions

primarily influencing the development of human capital, i.e. the "knowledge" and "standard of living" dimensions, is also worth paying attention to. Several studies have shown the negative impact of corruption on the country's economic development. Here, from the area of transmission channels, the question arises as to whether human capital is the main transmission channel through which corruption affects the gross domestic product and other indicators of macroeconomic performance. This presents an interesting research question for the authors of this paper for further research.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Nguyen, T.P. Dinh, T.T.H. Tran, N.T., Nguyen, T.T.H. (2024),
"Exploring the Role of Institutional Quality, Trade Openness, and Financial Development in Driving the Real Exchange Rate: Evidence in Southeast Asia Countries",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 183-194.

Exploring the Role of Institutional Quality, Trade Openness, and Financial Development in Driving the Real Exchange Rate: Evidence in Southeast Asia Countries

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ARTICLE INFO

Received April 16, 2023
Revised from May 16, 2023
Accepted June 16, 2023
Available online April 15, 2024

JEL classification: F13 F31 F41

DOI: 10.14254/1800-5845/2024.20-2.15

Keywords:

Real exchange rate,
Southeast Asia countries,
institutional quality,
trade openness,
financial development.

ABSTRACT

This research is focused on investigating the potential factors driving real exchange rates (RER), including institutional quality, trade openness, and financial development. Advanced analysis methods such as Dynamic Ordinary Least Square (DOLS), Fully Modified Ordinary Least Square (FMOLS), Generalized and Simultaneous Quantile Panel Regression (GSQPR), and Granger Causality have been applied to a balanced panel of nine Southeast Asian economies from 2002 to 2020. The empirical results suggest that an improvement in institutional quality leads to the appreciation of the domestic currency compared to foreign currency. Additionally, a high degree of trade openness is associated with the depreciation of the domestic currency, which may be due to fluctuations in capital influx from international trade. These findings are consistent across most RER quantile levels through GSQPR. However, the effect of financial development, as measured by the bank's credit to the private sector, on the domestic currency value is observed only at lower quantile levels of RER. Furthermore, the study finds unidirectional causality relationships running from the identified drivers to RER, using the Granger causality approach. Based on the findings, the research discusses theoretical and policy implications for Southeast Asian economies.

INTRODUCTION

The determinants of the real exchange rate (RER) have been the subject of considerable research. RER is often viewed as a measure of a country's overall price competitiveness (Ayres et al., 2020; Cuestas *et al.*, 2022), indicating how well a country's products and services are priced in international markets

compared to those of other countries (Jaksic et al., 2021). In order to catch up with advanced and developed countries, emerging or frontier economies must improve their currency's purchasing power, as evaluated through RER. These markets have long recognized the importance of RER, despite the fact that its relevance in development and growth has been largely ignored by baseline development economics and growth theories (Stoykova, 2021). It is widely agreed that an RER decrease (increase) may not always result in better (poor) competitiveness (Ayele, 2019) and positive (negative) economic growth (Ibid., 2022). Indeed, the decision to adjust RER in order to increase a country's competitiveness is complex, given the numerous theoretical and empirical factors that influence RER. Thus, this study aims to contribute to the ongoing debate on significant RER determinants in emerging and frontier economies by shedding light on newly identified drivers of RER. RER can be influenced by several emerging factors based on the premise that an increase in domestic demand compared to foreign demand leads to the appreciation of the domestic currency and vice versa (Vaitonis and Masteika, 2021). The literature on RER identifies two categories of variables: external fundamentals and domestic fundamentals. The former include trade barriers and domestic and foreign goods preferences (Guzman et al., 2018; Wanwan et al., 2022; Hossain et al., 2022). Accordingly, the increasing trade barriers cause a country's currency to appreciate, while higher demand for a country's exports drives its currency to appreciate and vice versa. Meanwhile, the latter encompasses productivity in which differences in productivity between traded and non-traded goods sectors can impact the equilibrium real exchange rate in the long run (Mano and Castillo, 2015; Azcona, 2017). However, prior studies have only limitedly addressed several predictors of the RER, while institutional quality, trade openness, and financial development are also considered potential keys (Chaudhry et al., 2022; Xiao et al., 2022; Aliyev et al., 2022; Shevchuk, 2022). These factors lay the foundation for developing the economic environment, promoting trade liberalization, and creating resources for production and business activities (Adeel-Farooq et al., 2017; Conrad and Jagessar, 2018). Indeed, RER has the potential to be influenced by these potential factors, which have unfortunately been overlooked in most previous studies.

In light of these arguments, this study aims to address the gap in the literature by investigating the predictors of RER in Southeast Asian countries. This region is an intriguing case study as its financial markets are developing rapidly, with diverse funding instruments, while its institutions are comparatively weaker than those of newer nations (Albaity et al., 2022; Zhang and Kim, 2022). Additionally, the region has witnessed increased openness to international trade, which could exacerbate the fragility and weak features linked to the rapid economic growth rates (Le et al., 2022; Salgado and Anand, 2022). As a result, because the nature of emerging and frontier economies differs from that of developed industrial economies, this region's unique characteristics necessitate further examination. From this introduction, the rest of this study proceeds as follows. Section 2 reports a brief literature review and develops hypotheses for each link of main concepts. Section 3 displays the methodology and data. Section 4 provides the empirical findings, and Section 6 for the conclusion.

1. LITERATURE REVIEW

This section elaborates on related literature on institutional quality – real exchange rate nexus, trade openness – real exchange rate nexus, and financial development – real exchange rate nexus. Afterward, corresponding hypotheses for each case of these nexuses are developed.

1.1 Institutional quality – real exchange rate nexus

Looking at the theoretical aspect, the impact of institutional quality in international trade operations is significant. Adequate institutions can facilitate contract enforcement, and poorly-functioning institutional quality could discourage traders' willingness to trade abroad due to an increase in costs and risks of trade activities (Feenstra et al., 2013; Dorożyński et al., 2021; Ajide and Soyemi, 2022; Tao et al., 2022). To conduct international trade effectively, traders have a strong desire to obtain information, which is relatively difficult and costly, forming an integral part of transaction costs (Seyoum and Ramirez, 2019). Good institutions could decrease ambiguity and, as a result, boost mutual trust (Nguyen and Wong, 2021; Nguyen et al., 2019). Traders are also initially faced with the problem of moral hazard in an international

trading environment (Abaidoo, 2019). However, there is limited research on the direct impact of institutional quality on RER.

Possible political risks associated with institutional quality include voice and accountability, political stability, government effectiveness, quality of regulation, the rule of law, and corruption (Kaufmann and Kraay, 2002; Gasimov et al., 2023). Such risks negatively affect macroeconomic fundamentals such as RER. Corruption and political risks, on the other hand, create uncertainty in government policies, discourage foreign investors, and lead to capital flight, causing inflation and fluctuated RER (Zeeshan et al., 2022). Given the limited number of studies investigating the relationship between exchange rates and institutional quality in emerging and developing countries, this study revisits the determinants of RER and its relevance to institutional quality, focusing on the augmented Balassa-Samuelson effect. Therefore, the first hypothesis is stated as follows:

H1: Good institutional quality could lead to the appreciation of the domestic currency

1.2 Trade openness – real exchange rate nexus

The relationship between trade openness and RER may be explained by the idea that when RER appreciates, domestic products become more expensive to the rest of the world. This can lead to a reduced demand for domestic goods and services and an increased desire for foreign products. Furthermore, protectionism, such as tariff barriers, quotas, or other measures, may impede imports and contribute to RER appreciation. It should be noted that some have suggested a reverse impact in which a high degree of trade liberalization could cause domestic depreciation (Dornbusch, 1974). Therefore, the relationship between trade openness and RER can be explained by the interaction among trade openness, trade liberalization, influencing the prices and demand for goods and services, and ultimately affecting RER. Other studies, such as those by Zakaria and Shakoor (2011) and Yusoff and Febrina (2014), suggest that economic openness can result in RER devaluation in some emerging nations. However, studies by Romelli *et al.* (2018) and Calderón and Kubota (2018) have not been able to establish a clear connection between trade openness and RER, possibly due to the various factors involved in trade policies or the unique characteristics of the countries studied. Therefore, based on the indirect evidence and arguments on the trade openness-RER relationship, this study proposes the following second hypothesis:

H2: The increase in trade openness could lead to the depreciation of the domestic currency

1.3 Financial development – real exchange rate nexus

Demir and Dahi (2011) posit that a well-developed financial sector benefits high-value-added exports (i.e., manufacturing products) that primarily rely on external financing. Due to the limited empirical research on the direct impact of financial development on RER, there is a need to draw on the indirect impact via FDI from prior studies. For instance, Saborowski (2009) looks at the importance of financial development in mitigating the effects of FDI on the exchange rate. Additionally, in addition to FDI, volatile non-FDI also shows a bigger appreciation impact; one might predict that financial development is more important in determining the influence of non-FDI on real exchange rates. By lowering communication costs and offering more investment opportunities, a well-functioning financial sector could decrease market friction and efficiently allocate financial resources (Beck and Levine, 2005). An efficient financial system could monitor a business's behavior, promote corporate governance, and control and decrease macroeconomic and production volatility (Easterly and Kraay, 2000). In line with these benefits of financial development, Braun and Raddatz (2007) show that a well-functioning financial system might be associated with risk diversification and prevent directing capital inflows to local consumption, which does not improve the productive potential of domestic economies. This could be an implication for RER in the long run. Therefore, the third hypothesis is proposed as follows:

H3: The financial development could lead to the appreciation of the domestic currency

2. DATA AND METHODOLOGIES

2.1 Data

This study uses a sample of nine countries in Southeast Asia, including Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam over the period of 2002-2020. Due to missing data in the study period, Lao D.P.R. and Timor-Leste are excluded. This creates a strongly balanced sample, providing more robust findings. All studied variables are summarized in Table 1 below.

Table 1. Summary of studied variables

Variables	*Explanation*	*Sources*
Real exchange rate (RER)	The real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs. It reflects the amount of domestic currency in exchange for that of foreign currency.	WDI (World Bank)
Institutional quality (IQ)	Average calculation based on the means of 06 sub-items including (1) Voice and accountability; (2) Political stability and Absence of Violence and Terrorism; (3) Government effectiveness; (4) Quality of regulation; (5) Rule of law; and (6) Control of Corruption. The estimated value gives the country's score on the aggregate indicator in units of standard normal distribution, i.e., ranging from approximately -2.5 to 2.5.	WGI (World Bank)
Financial development (CREDIT)	Domestic credit to the private sector by banks (% of G.D.P.)	WDI (World Bank)
Trade openness (TRADE)	Trade is the sum of exports and imports of goods and services measured as a share of GDP	WDI (World Bank)

Note: WGI denotes World Governance Indicators, and WDI is World Development Indicators.

2.2 Model

Given previous studies noted in the literature pertaining to the significant potential effect of institutional quality, trade openness, and financial development on RER, this study proposes a model capturing these determinants of RER as follows:

$$RER_{i,t} = \beta_0 + \beta_1 IQ_{i,t} + \beta_2 TRADE_{i,t} + \beta_3 CREDIT_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where i and t denote country and year, respectively. ε is the error term. RER is the real exchange rate, showing the amount of domestic currency in exchange to that of foreign currency. IQ is institutional quality calculated by taking the average value of six components for institutional quality dimensions. $TRADE$ is trade openness computed as the sum of exports and imports divided by G.D.P. $CREDIT$ stands for financial development, which is represented by the ratio of a bank's credit to the private sector over G.D.P. The coefficients β_1, β_2, and β_3 are the long-term parameters of real exchange rate associated with institutional quality (IQ), trade openness ($TRADE$), and financial development ($CREDIT$), respectively. As expected in the above respective hypotheses, the signs of β_1 and β_3 are negative, while that of β_2 is positive.

2.3 Testing procedure

Stationary properties of all variables are examined using a comprehensive array of approaches encompassing the first- and second-difference of unit root test. That former includes Levin-Lin-Chu (LLC) and Im Pesaran and Shin (IPS), whereas the latter consists of Cross-sectional Im Pesaran and Shin (CIPS) and Cross-sectional Augmented Dickey-Fuller (CADF). After confirming the stationarity of the panel time series, the Pedroni-based, Kao-based, Johansen-based, and Westerlund-based co-integration are tested in order

to establish the co-integration linkage among variables. Given this, the long-term relations among variables of interest could be tested by employing OLS., FMOLS, and DOLS to confirm the above hypothesis and hence examine significant predictors of RER. Afterward, the robustness of results is demonstrated through the Quantile Panel Regression (GSQPR) and Granger causality approach (Gujarati *et al.*, 2017).

3. Empirical findings

3.1 Descriptive statistics

The descriptive statistics are performed in Table 2. This study observed that the positive skewness values for all variables greater than zero could display the skewed properties to the right. Moreover, the excess values of kurtosis over zero show the fat-tailed distribution phenomenon of all variables. This could imply the rejection of normally distributed characteristics, again confirmed by the Jarque-Bera test. These phenomena also indicate the use of appropriate econometric models to capture the link between RER and the explanatory factors (i.e., institutional quality, trade openness, and financial development). Hence, this study uses several cutting-edge approaches, such as DOLS, FMOLS, and GSQPR, to examine the above predictors of RER

Table 2. Data statistics summary

Variables	*Mean*	*Std. Dev.*	*Skewness*	*Kurtosis*	*Jarque-Bera*	*Prob.*
RER	4.570	3.645	0.264	1.446	19.194***	0.000
IQ	-0.171	1.017	1.132	3.642	39.474***	0.000
CREDIT	62.167	42.247	0.223	1.532	16.774***	0.000
TRADE	133.202	98.588	1.366	4.528	69.807***	0.000

Note: *** reports a statistical significance level of 1%.

3.2 Panel unit root test

Table 3 reports panel time series stationarity results using first-difference (LLC and IPS) and second-difference (CIPS and CADF) to test unit roots. Accordingly, a majority of time-series variables have a unit root at the root level, but they are stationary at the first difference, as noted I(1). It is worth noting that the stationarity of all variables is confirmed at least a 5% significance level, indicating that this study may proceed with all variables without any concern and deletion.

Table 3. Unit root test of stationary

Variables	*LLC*		*IPS*		*CIPS*		*CADF*	
	I(0)	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*
RER	0.003	-6.435***	1.880	-4.043***	-0.990	-2.528**	-1.421	-2.379**
IQ	-0.207	-10.475***	-0.045	-9.593***	-2.082	-4.473***	-1.677	-2.789***
CREDIT	-0.329	-7.113***	1.288	-5.866***	-1.956	-3.530***	-1.634	-2.728***
TRADE	-0.206	-10.919***	0.705	-10.485***	-1.309	-3.994***	-1.156	-2.779***

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively. The null hypothesis implies no stationarity of variables.

3.3 Panel co-integration test

After the stationary test, this study will look at the co-integration test to determine how these factors capture the long-run linkage. This study approach LLC, IPS, and ADFF tests to investigate whether panel co-integration exists for all variables of interest. The null hypothesis asserts that no co-integration is evidenced in all tests. By employing the Pedroni and Kao integration test (as reported in Tables 4 and Table 5, respectively), this study finds evidence of the rejection of the null hypothesis, showing a long-run influence among our variables. In addition, the test findings of Johansen-based co-integration in Table 6 also illustrate that the null hypothesis implying no co-integration among variables is rejected.

Table 4. Pedroni-based co-integration test

Test-Statistics	*No intercept or trend*	*Individual intercept*	*Intercept and Trend*
Panel PP-Statistic	-1.105*	-4.570***	-1.979*
Panel ADF-Statistic	-1.673**	-4.678***	-2.075***
Group PP-Statistic	-2.217**	-0.796	-1.994**
Group ADF-Statistic	-3.097***	-1.424*	-2.138**

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively.

Table 5. Kao-based co-integration result

	t-statistic	*Prob.*
ADF	-1.703**	0.044
Residual variance	0.126	
HAC variance	0.122	

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively.

Table 6. Johansen-based co-integration test

No. of CE(s)	*Fisher Stat.*		*Fisher Stat.*	
	Trace test	*Prob.*	*Max-eigen test*	*Prob.*
None	133.2***	0.000	104***	0.000
At most 1	49.48***	0.000	47.34***	0.000

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively.

For more robustness of co-integration, this study approach Westerlund-based co-integration displayed in Table 7 and obtain qualitatively similar findings with a long-term link among studied variables. The long-run relation also suggests the appropriateness of using DOLS and FMOLS to investigate the significant factors driving RER

Table 7. Westerlund-based co-integration tests

Statistic	Value	Z-value
Gt	-3.426***	-3.795***
Ga	-1.432	4.066
Pt	-8.275***	-2.378***
Pa	-6.673	0.36

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively.

3.4 OLS, FMOLS, and DOLS estimations

In addition to standard OLS, FMOLS, and DOLS are approached to estimate a long-term coefficient on RER's determinants for estimating the long-run linkage among studied variables. FMOLS is based on the use of the Newey-West correction to address the autocorrelation of the error term. However, if lagged variables and lead variables are captured in our models to limit autocorrelation of the error term, the preferable option of DOLS is utilized.

Table 8 shows the significant predictors of RER as follows. First, institutional quality is negatively related to RER at a 1% significance level, suggesting that the more institutional quality improves, the more the domestic currency will appreciate. This result supports H1, which implies that the institutional quality of governance could create a favorable climate for private sectors by reducing production costs, guaranteeing property rights, ensuring political stability, facilitating institutional arrangements, and attracting foreign direct investment. In this sense, well-functioning institutions indicate that individual rights are respected, contracts are secured, and property rights are protected. The soundness and efficiency of institutional administration with little corruption have a driving impact on international trade and hence economic development.

Second, trade openness has a positive relationship with RER at the 1% statistical significance level, indicating that the larger the trade openness, the more domestic currency depreciates, which does not support H2. This result can be explained by the fact that openness of trade into the world implies flexibility in capital flows which is important for developing countries mainly depending on international trade. However, the Southeast Asian economies are characterized by an unsustainable high level of growth rate. It is widely accepted that strong fluctuations in capital flows are inevitable, thereby putting pressure on the domestic currency to depreciate.

Third, financial development represented by the bank's credit to the private sector has a negative relationship with RER, showing that when the financial market proceeds, the domestic currency will appreciate. However, this result is not statistically significant, which does not support H3. To take deeper steps, this study applies both generalized and simultaneous panel quantile regression so as to possibly determine any patterns in the credit-exchange rate nexus.

Table 8. OLS., FMOLS, and DOLS estimations (Y= RER)

	OLS. estimations		*FMOLS estimations*		*DOLS estimations*	
Variables	*Estimated coefficients*	*t-statistic*	*Estimated coefficients*	*t-statistic*	*Estimated coefficients*	*t-statistic*
IQ	-4.425***	-18.660	-4.147***	-11.168	-3.906***	-12.290
TRADE	0.029***	8.923	0.026***	5.209	0.027***	7.330
CREDIT	-0.005	-0.670	-0.002	-0.233	-0.010	-1.244

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively.

3.5 Quantile panel regression

To provide more insights into the significant determinants of RER above, generalized Quantile Panel Regression was utilized to examine the effects of institutional quality, trade openness, and financial development on the distribution of RER. This approach allows for illustrating the impact of explanatory variables on the conditional distribution of the dependent variable, which is based mainly on the information captured in the studied sample. Therefore, this study could confirm the robustness of OLS, FMOLS, and DOLS regression results and look more at the heterogeneous or homogeneous impact of IQ, TRADE, and CREDIT on different values of RER. The results in Table 9 show that institutional quality and trade openness consistently impact the exchange rate. Accordingly, in most of the RER percentiles, an increase in institutional quality increases the value of the domestic currency (for quantiles 10-75), while a large trade openness is

associated with a decrease in the value of the domestic currency (for quantiles 25-90). Again, this result confirms the results obtained from OLS, FMOLS, and DOLS reported previously.

One interesting point is that financial development stimulates domestic currency appreciation at the low percentile of the exchange rate (quantiles 25-50). This exciting result could be justified by the notion that the private sector of Southeast Asian countries is mainly dependent on financing activities in the banking system, and financial development in terms of banks' credit implies that bank capital plays an increasingly important role in mobilizing financial resources for enterprise in particular and the economy in general. In order to fuel growth, businesses could get access to these banks' credit, thereby improving productivity and operational efficiency. Furthermore, a well-functioning financial sector could eliminate market frictions and efficiently allocate financial resources due to reduced information costs and investment opportunities. Hence, these forces intuitively promote the appreciation of the domestic currency.

Table 9. Generalized quantile panel regressions (Y=RER)

	Q10	*q25*	*q50*	*q75*	*q90*
IQ	-3.57***	-4.163***	-5.871***	-7.077***	-7.077
	[-2.606]	[-11.523]	[-15.901]	[-10.937]	[-14.151]
TRADE	0.005	0.024***	0.028***	0.039***	0.055***
	[1.283]	[9.019]	[10.931]	[4.637]	[5.048]
CREDIT	0.004	-0.013***	-0.010*	-0.001	-0.016
	[0.647]	[-2.663]	[-1.782]	[-0.062]	[-0.744]

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively. t-statistics in brackets.

To avoid the sensitivity of results to the selection of the quantile panel regression approach, this study employs a simultaneous quantile regression approach in supplementing the generalized quantile analysis aforementioned. This allows for overcoming the assumption of homoscedasticity and normal distribution. The results can be seen in Table 10, which is qualitatively similar to the findings reported.

Table 10. Simultaneous quantile panel regression (Y=RER)

	Q10	*Q25*	*Q50*	*Q75*	*Q90*
IQ	-0.915***	-3.476***	-3.486***	-4.018***	-3.111***
	[-3.030]	[-5.470]	[-14.070]	[-6.680]	[-4.680]
TRADE	0.004*	0.022***	0.022***	0.01	-0.003
	[1.760]	[4.520]	[8.560]	[1.190]	[-0.360]
CREDIT	0.004	-0.015**	-0.019***	0.015	0.016
	[1.160]	[-2.010]	[-3.330]	[1.030]	[1.050]

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively. t-statistics in brackets.

Additionally, this study shows the diagram of the findings illustrated in Figure 1. The dotted line represents the predicted coefficient from the OLS regression and its corresponding confidence interval at 95%. The solid line is the calculated coefficient from the quantile regression. The shaded area denotes the corresponding interval confidence at 90%. If the confidence interval contains a value of zero, the corresponding estimated coefficients could not overcome the significance level test. This study finds the robustness of the results as follows. First, at all quantiles, institutional quality has a negative impact on RER, showing the appreciating effect of the domestic currency. Moreover, coefficients of IQ indicate an overall relatively stable trend from low to high quantile levels. Second, TRADE has a positive effect on RER for a majority of

the quantile level, suggesting the depreciating influence of trade openness on the domestic currency. Third, at low and middle quantiles, CREDIT has a negative marginal impact on RER, in which this effect follows a stable trend and turns out insignificant at large quantiles. Accordingly, financial development significantly impacts domestic currency appreciation at lower quantiles far from middle levels. This result is consistent with those reported in generalized quantile panel regression.

Figure 1. The plot chart for simultaneous quantile panel regression with confidence intervals at 90% for the determinants of RER

3.6 Granger causality

If there is a long-run co-integration among variables of interest, the Granger causality could occur in both directions, such as uni and bidirectional causality between studied variables. The results in Table 11 show that unidirectional causality links run from institutional quality, trade openness, and financial development to RER

Table 11. Granger causality

Null hypothesis	*Granger Causality*		*Conclusion*
	F-Statistic	Prob.	
IQ does not Granger Cause RER	5.235**	[0.024]	IQ → RER
CREDIT does not Granger Cause RER	3.100*	[0.080]	CREDIT → RER
TRADE does not Granger Cause RER	3.639*	[0.058]	TRADE →RER

Note: ***, **, and * report statistical significance level at 1%, 5%, and 10%, respectively.

CONCLUSION

The RER plays a crucial role in determining the allocation of domestic production and expenditure between foreign and domestic products. When the RER of a country appreciates, it may become less competitive than other countries (Ayres *et al.*, 2020; Cuestas *et al.*, 2022). Emerging and frontier markets, which are low and middle-income economies in transition to more advanced economies, need to improve their price and non-price competitiveness to catch up with advanced countries. Therefore, RER is a critical factor in the economic growth of these markets. Our study attempts to comprehensively examine potential drivers of RER in Southeast Asian countries, including institutional quality, trade openness, and financial development, using a variety of econometric methods, such as DOLS, FMOLS, GSQPR, and Granger causality, to provide more robust results. Crucial findings could be drawn as follows: (i) The improved institutional quality may lead to an appreciation of domestic currency relative to foreign currency, which is consistent across quantile levels of RER; (ii) A high degree of trade openness may lead to a depreciation of the domestic currency, which may be attributed to fluctuations in capital influx by opening up to international trade. This conclusion is true over most RER quantile levels; and (iii) The appreciating impact of financial development, as measured by bank credit to the private sector, on the value of local currency appears at lower RER quantile levels. These findings are confirmed through significant Granger-cause from predictors such as institutional quality, trade openness, and financial development to RER

Based on these findings, this study suggests several policy implications. Our study demonstrates that an improvement in institutional quality is likely to lead to an appreciation of the domestic currency. A favorable environment created by well-functioning institutional attributes can attract more investors and traders to engage in trade relationships with the host country, increasing the domestic currency's value. Furthermore, financial development can help increase the production capacity of businesses through increased access to credit from the banking sector, ultimately leading to a rise in the value of the local currency. However, opening up to the global market can increase dependence on cross-border trading activities, making the economy more vulnerable. Therefore, strengthening institutional quality, promoting financial market development, and carefully managing exposure resulting from trade openness can improve the value of the domestic currency.

Although this study has endeavored to include new drivers of RER for a comprehensive sample of Southeast Asian countries, there are other potential factors that this study could not address. Moreover, there is a concern related to the small sample size of this study. Future studies can consider replicating the research model by incorporating additional potential predictors of RER or using different scenarios. However, it is essential to note that future research should take into account valid co-integration testing when including additional factors driving RER into the model. Additionally, alternative econometric approaches may be useful for capturing more valid and robust factors.

ACKNOWLEDGMENTS

The first author is grateful for financial support from Van Lang University, Vietnam. The fourth author also thanks Professor Wing-Keung Wong for his ongoing counseling and encouragement. This research is funded by the University of Economics Ho Chi Minh City (UEH), Vietnam. All shortcomings in this study are within our responsibility.

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Montenegrin Journal of Economics

For citation:

Elkrghli, S., Almansour, B.Y. (2024), "An Empirical Investigation of Risk Management Factors in Private Construction Projects in Benghazi City", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 195-207.

An Empirical Investigation of Risk Management Factors in Private Construction Projects in Benghazi City

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ARTICLE INFO

Received April 15, 2023
Revised from May 15, 2023
Accepted June 15, 2023
Available online April 15, 2024

JEL classification: D81, G32, L74, N6

DOI: 10.14254/1800-5845/2024.20-2.16

Keywords:

Technical risk,
resource risk,
financial risk,
legal risk,
management risk.

ABSTRACT

Sustainability is a critical consideration in the management of construction projects. Effective risk management is a key requirement to achieve sustainability goals, as it helps to minimize the negative impacts on the environment and society. Also, it optimizes resource utilization, and ensure project's economic viability. This study aimed to identify the factors that impact construction risk management in Benghazi city using a quantitative approach and questionnaires to collect data. The study analyzed 140 questionnaires to gain insights into the types of risks faced by construction projects in the city and how they are managed. The study's findings indicate that HR risk, technical risk, resource risk, financial risk, legal risk, management risk, and time risk significantly impact construction risk management. These findings underscore the importance of effective risk management in construction projects, which is critical to achieve sustainability goals. By implementing effective risk management strategies, construction projects can mitigate risks, improve projects' performances, and increase their chances of success. The results can inform future risk management strategies and provide valuable insights into the factors that impact construction risk management in Benghazi city, contributing to sustainable construction practices.

INTRODUCTION

Project management involves the utilization of skills, techniques, and tools to carry out project activities in a manner that meets or surpasses the expectations and requirements of stakeholders. An integral part of this process is project risk management, which entails identifying potential risks associated with a project and implementing measures to address them (Imran et al., 2022). According to Mitkov (2023) project risk management involves activities that aim to maximize the consequences of positive events and minimize the impact of negative events. As such, all projects are susceptible to risks, and the ability to adapt to changes is critical for survival. However, several project managers have yet to recognize the importance of including project risk management as a fundamental process (Zainudin, Haron and Hizami Ales@Alias, 2021; Urbański et al., 2019).

According to Shayan et al. (2022), effective risk management is crucial to project management as unmanaged or unaddressed risks are a leading cause of project failures. Although several publications have been devoted to the subject for risk management, there is a lack of up-to-date information on its actual implementation in practice. Moreover, risk management has emerged as a critical component of decision-making in construction and is widely acknowledged as an essential tool in project management (Jiang et al. 2020; Czajkowska and Kadłubek, 2015; Strupczewski et al., 2021; Meekaewkunchorn et al., 2021).

Risk management is a systematic process that involves identifying, evaluating, and responding to project risks. Its aim is to enhance the likelihood and impact of positive occurrences while reducing the probability and effects of negative events on project objectives (Kulikova, 2020; Croitoru et al., 2021). Effective risk management is an essential aspect of good management and is fundamental to achieving favorable business and project outcomes and ensuring efficient procurement of goods and services. Many managers are already engaged in some form of risk management, including conducting sensitivity analysis on financial projections, using scenario planning for project evaluation, assessing contingency allowances in cost estimates, negotiating contract terms, and developing contingency plans (Wehbe and Hamzeh, 2013).

Benghazi, a city situated in Northeastern Libya, has experienced remarkable growth and development in the construction industry in recent years. As the number of construction projects rises, so does the risk of various hazards that could potentially impede the success of these ventures. Therefore, it is vital to comprehend and manage these risks to ensure the efficient and cost-effective completion of private construction projects in Benghazi.

This research aims to identify the risks to which private construction projects are exposed in the city of Benghazi. The study investigates the types of risks that are commonly encountered in construction projects, including human resources, technical, resources, financial, legal, and time risks. Through a comprehensive survey, the study identifies the frequency and severity of these risks and determine the most significant ones that require attention from relevant authorities such as project managers and stakeholders. The findings of this study contribute to the development of risk management strategies that can be implemented to improve the outcomes of private construction projects in Benghazi. This paper aims to bridge the existing gap in literature on the specific risks faced by private construction projects in Benghazi, and provide a basis for future research in this field.

1. LIBYAN CONSTRUCTION INDUSTRY

The Libyan construction industry has seen significant growth and development in the last two years, particularly in major cities such as Tripoli and Benghazi. The construction industry is a vital sector of the Libyan economy and plays a significant role in the country's development.

The construction industry in Libya is categorized into residential, commercial, and public works sectors. With the heightened investment in infrastructure such as roads, bridges, and public works, the sector has undergone significant transformation. This growth has been further fueled by increased foreign investment and government funding, offering prospects for both domestic and foreign construction companies to invest in the industry. However, the Libyan construction industry faces multiple challenges that hinder its success. One of the primary challenges is the lack of skilled and trained personnel. The construction sector necessitates a competent workforce to execute quality projects within tight timelines. The shortage of skilled labor has consequently led to decreased productivity and quality in the construction industry (Elsonoki and Yunus, 2020).

Another significant challenge facing the Libyan construction industry is the lack of effective regulatory frameworks and standards. The absence of a comprehensive regulatory framework has led to sub-standard construction practices, low-quality materials, and inadequate safety measures on construction sites. These factors increase the risk of accidents, delays, and other hazards that can impact the success of construction projects. Furthermore, the political and economic instability in Libya has affected the growth and development of the construction industry (Khalil, Rathnasinghe and Kulatunga, 2021).

2. LITERATURE REVIEW

Risk management processes and analysis are crucial aspects of the construction industry. It is essential to understand the potential risks that may arise during a project's life cycle and the steps required to manage and mitigate them effectively. In recent years, numerous studies have been conducted to investigate risk management processes and analysis in the construction industry.

A study by Goh and Abdul-Rahman (2013) investigated the impact of risk management on construction project success in Malaysia. The study involved a questionnaire survey of 600 construction professionals, and the results showed that effective risk management practices, such as risk identification, risk analysis, and risk response planning, had a significant impact on project success. Renault and Agumba (2016) aimed to provide a concise literature review on risk management in the construction industry. They recognized that the construction industry is a high-risk sector that requires careful consideration of risks in decision-making due to its intricate nature and constantly changing project environment. The authors focused on the latest studies related to risk management and acknowledged that it was not feasible to cover all the definitions of risk. The research primarily involved a literature review that examined various aspects related to the concept of risk, risk management in construction, and the methods employed in the construction industry in Libya.

Moreover, a study conducted by Wu et al. (2017) focused on identifying and evaluating the critical risk factors that affect construction projects' success in China. The study involved collecting data from 86 construction projects using a questionnaire survey, and the results indicated that risks related to the project's financial and technical aspects had the most significant impact on project success. Additionally, the study found that effective risk management measures, such as risk identification, risk analysis, and risk response planning, were essential in managing and mitigating risks.

Xiong et al. (2018) in China focused on risk management processes and analysis in the construction industry. The study used quantitative methods, the results introduce several challenges which are, first improving the utilization and dissemination of quantitative risk assessment methods and technologies; second, augmenting the decision-making processes related to risk; third, executing comprehensive safety risk management plans throughout all stages of the project; finally establishing a shared platform for reporting and analyzing safety accidents in geotechnical engineering.

A study conducted by Pham et al. (2020) analyze the critical risk factors that affect equipment management and offer suitable solutions. To accomplish this objective, a survey was conducted among construction industry experts with extensive experience in equipment management, using a questionnaire to evaluate the likelihood and severity of risk factors. The survey results identified risk factors that could affect equipment management, which were classified into six groups: site organization-related risks, management-related risks, owner-related risks, supplier-related risks, legal risks, site condition-related and external risks. A total of 75 questionnaires were sent to construction equipment management experts. The findings indicate that management-related factors are the primary cause of risks and challenges for equipment management in construction firms.

Jiang et al. (2020) identified technical risk as one of the most significant factors affecting project performance and suggested that effective risk management strategies should be put in place to address technical risks in construction projects. Therefore, the results of this study are consistent with recent research, highlighting the importance of managing technical risk in construction risk management.

Another study by Muthukrishnan and Ganapathi (2021) investigated the importance of risk management practices in construction projects in India. The study used a questionnaire survey to collect data from 132 construction professionals, and the results indicated that risk management practices were crucial for project success. The study found that effective risk management practices, such as risk identification, risk analysis, and risk response planning, were crucial in managing and mitigating risks.

Shibani and colleagues (2022) aimed to investigate and evaluate the prominent risks inherent in the Lebanese construction industry, with a specific emphasis on financial and economic risks. To accomplish their research objectives, the authors conducted a questionnaire survey among professionals in the construction industry in Lebanon. The findings of the survey revealed that the industry is susceptible to an

array of internal and external risk factors, with financial risks being the most significant. Currency fluctuations, inflation, and lack of solvency were identified as the primary financial risks faced by the industry. Furthermore, the authors discussed the potential advantages and significance of implementing risk management strategies within the Lebanese construction industry. Risk management practices can aid in minimizing the effects of such risks and improve project success rates. Nevertheless, the authors recognized various obstacles to implementing effective risk management, such as limited resources, lack of understanding of the concept, and hesitancy to invest in such practices.

In summary, the literature review indicates that risk management processes and analysis are essential aspects of the construction industry. Effective risk management practices, such as human resource risk, technical risk, resource risk, financial risk, legal risk, management risk, and time risk are crucial for project success. Furthermore, the studies suggest that a comprehensive risk management framework that considers the financial and technical aspects of a project is necessary to manage and mitigate risks effectively.

2.1 Hypotheses development

The development of hypotheses is supported by several previous studies that have highlighted the importance of risk management in the construction industry. The validity of hypotheses shown in table 1 has been confirmed by numerous prior investigations. (Chan & Kumaraswamy, 1997; Assaf & Al-Hejji, 2006; Alaghbari et al., 2007; Ramanathan et al., 2012; Gurmu & Aibinu, 2017; Pham et al., 2020; Civelek et al., 2022). A study conducted by Pham et al., (2020) found that management-related factors are the primary cause of risks and challenges for equipment management in construction firms.

Table 1. Supported Hypotheses on Factors Influencing Construction Risk Management

	Hypothesis
1	There is a significant effect of human resource risk on construction risk management
2	There is a significant effect of technical risk on construction risk management
3	There is a significant effect of resource risk on construction risk management
4	There is a significant effect of financial risk on construction risk management
5	There is a significant effect of legal risk on construction risk management
6	There is a significant effect of management risk on construction risk management
7	There is a significant effect of time risk on construction risk management

3. METHODOLOGY

A quantitative approach was used in this study to examine the various types of risk management in the construction industry in Benghazi - Libya. The study focused specifically on private construction industry, and a total of 148 questionnaires were distributed to respondents selected through simple random sampling method. Out of these, 140 questionnaires were considered usable and were analyzed statistically. The data generated from these questionnaires was used to gain insight into the types of risks that construction projects in Benghazi city are exposed to, and how these risks are managed.

By using a quantitative approach, the study aimed to provide a detailed understanding of the risk management practices and processes used in the construction industry in Benghazi - Libya, and to identify any potential gaps in the current practices. The study also aimed to examine the differences in the perceptions of risk management among respondents based on demographic factors, such as their age, gender, educational level, and experience in the construction industry. Overall, the use of a quantitative approach allowed for a deep and comprehensive understanding of the risk management practices in the private construction industry in Benghazi - Libya, which can help inform future research and guide the development of effective risk management strategies and policies.

The researchers conducted a validity and reliability tests to evaluate the accuracy and consistency of the construct. The reliability of the measurement was defined as an estimation of the consistency of the results obtained. Therefore, we employed Cronbach's alpha to estimate the reliability of each scale used in the study (Hair et al., 2015). Cronbach's alpha is a commonly used measure of internal consistency reliability that assesses the extent to which the items on a scale are interrelated and measure the same underlying construct.

Table 2 provides the Cronbach's alpha coefficients for all factors that were measured, indicating the level of reliability for each factor. The higher the Cronbach's alpha coefficients, the greater the reliability of the scale. This analysis helped to ensure that the data collected in the study was reliable and could be used to draw valid conclusions on the factors that affecting risk management in the construction industry in Benghazi city.

Table 2. Results of Measurement Testing

Dimensions	*Cronbach's Alpha*	*Validity*	*N of Items*
Human Resource Risk	0.729	0.747	6
Technical Risk	0.701	0.729	6
Resource Risk	0.719	0.753	6
Financial Risk	0.757	0.798	4
Legal Risk	0.737	0.795	6
Management Risk	0.763	0.793	6
Time Risk	0.741	0.786	4
Construction Risk Management	0.739	0.785	6

The table above provides information on the dimensions of risk and their corresponding Cronbach's alpha and validity scores. In this study, the number of items for each dimension ranged from 4 to 10. All dimensions had Cronbach's alpha values above 0.7, which indicates a good level of reliability (Taber, 2018). The validity score indicates how well the items measure the construct they are intended to measure. In this study, the validity scores were above 0.7 for all dimensions, indicating that the items were measuring the intended constructs with a good level of accuracy.

The objective of this research is to determine the factors that impact the construction risks management in Benghazi - Libya. To achieve this, an econometric model known as Ordinary Least Squared (OLS) has been utilized to investigate the factors that impact the construction risks management. The standard equation for Ordinary Least Squared (OLS) is presented below:

$$\mathrm{CRM_i} = \beta_0 + \beta_1 \mathrm{HRM} + \beta_2 TEC + \beta_3 RES + \beta_4 FIN + \beta_5 \mathrm{LEG} + \beta_6 MAN + \beta_7 TIM + \varepsilon_i \quad \text{.....(1)}$$

Where,

CRM : Construction Risks Management
HRM : Human Resource risk
TEC : Technical risk
RES : Resource risk
FIN : Financial risk
LEG : Legal risk
MAN : Management risk
TIM Time risk
e : Error
B0 : Constant

4. THE RESULTS AND HYPOTHESES TESTING

4.1 Respondents Profile

Table 3 displays the analysis of the demographic characteristics of the respondents who participated in the study. It provides an overview of the distribution of gender, age, marital status, education level, and occupation among the sample population.

Table 3. Respondents' Demographic Analysis

		n	*Percentage*
Gender	Male	122	87%
	Female	18	13%
Age	25 - 35	84	60%
	36 - 45	32	23%
	Above 45	24	17%
Marital Status	Married	84	60%
	Single	56	40%
Education Level	Diploma Degree	3	2%
	Bachelor Degree	121	86%
	Master Degree	15	11%
	PhD Degree	1	1%
Occupation	CEO	4	3%
	Contractor	14	10%
	Director	11	8%
	Engineer	103	74%
	Project manager	7	5%

The majority of the respondents were males 87%, while only a small percentage was female 13%. The gender disparity in the sample is not surprising, given that the construction industry is traditionally male-dominated. The findings may not fully represent the perspectives and experiences of female professionals working in the Benghazi's construction industry, highlighting the need for more inclusive research practices. Regarding age, 60% of the respondents were in the age group of 25-35 years, which is a relatively young demographic. This may indicate that the construction industry in Libya is attracting young professionals, which can bring fresh perspectives and innovative ideas. However, it is also essential to ensure that experienced professionals are involved in decision-making processes to ensure the industry's sustainability and resilience.

In terms of marital status, the majority of the respondents were married 60%, while 40% were single. Regarding education, the majority of the respondents 86% hold a Bachelor's degree, while only 2% has a Diploma degree. This indicates that higher education is highly valued among professionals in the Libyan construction industry, which can lead to higher levels of expertise and specialization. Additionally, 11% of the respondents has a Master's degree, and 1% has a PhD, which may indicate the existence of a highly skilled and educated group of professionals in the industry.

Regarding occupation, the majority of the respondents were Engineers 74%, followed by Contractors 10% and Directors 8%. Only 3% of the respondents were CEOs, and 5% were project managers. These

findings suggest that the study focused on professionals who are involved in the technical aspects of construction projects, such as design, implementation, and supervision.

4.1 Descriptive Statistics

Descriptive statistics is a statistical technique that entails summarizing and describing the fundamental features of data in a research study. Prior to exploring the descriptive statistics, we established the level of satisfaction which is based on the Likert scale, with scores ranging from high to low. This was achieved by dividing the number of levels by the total number of responses, resulting in a scale of 1 to 5, where 5 represents the highest level of satisfaction. The criteria for interpreting the mean satisfaction level is shown in table 4, with a mean score of 0.80.

Table 4. The standards for comprehending the mean values of satisfaction levels

n	*Mean Scores*	*Level of Satisfaction*
1	1 - 1.8	Very Low
2	1.81 - 2.6	Low
3	2.61 - 3.40	Moderate
4	3.41 - 4.20	High
5	4.21 - 5.00	Very High

Table 5. Descriptive statistics

	N	*Mean*	*Std. Deviation*	*Meaning*
HRM Risk	140	3.1607	.70751	*Moderate*
Technical risk	140	2.6667	.53383	*Moderate*
Resource risk	140	3.5214	.54781	*High*
Financial risk	140	2.8583	.55409	*Moderate*
Legal risk	140	3.1119	.84025	*Moderate*
Management risk	140	2.5857	.66026	*Low*
Time risk	140	2.8488	.68175	*Moderate*
Construction Risk Management	140	2.9833	.64791	*Medium*

Table 5 shows the descriptive statistics for various types of risks, including HRM risk, technical risk, resource risk, financial risk, legal risk, management risk, time risk, and construction risk management. For HRM risk, the mean is 3.1607, and the standard deviation is 0.70751. This means that the responses to HRM risk range from relatively low to high, with a higher mean indicating a moderate level of HRM risk overall. The standard deviation indicates that the responses are relatively spread out from the mean, indicating a significant variability in the responses. This indicates that some respondents perceive HRM risk to be very low or very high, while others perceive it to be moderately high or moderately low. For example, some participants may perceive the HRM risk to be very low if they feel that the HRM practices in their organization are well-established and well-executed, and there are no significant issues or challenges. On the other hand, some participants may perceive the HRM risk to be very high if they feel that the HRM practices in their organization are poorly managed or executed, and there are many issues or challenges that could impact the organization's performance and success. Similarly, some participants may perceive the HRM risk to be moderately high or moderately low, depending on their personal experiences, perceptions, and observations of the HRM practices in their organization. For instance, some participants may feel that while there are some HRM issues and challenges in their organization, they are not significant enough to cause major problems or risks. Conversely, some participants may feel that the HRM issues and challenges in their organization are significant enough to pose a moderate level of risk to the organization's performance and success.

For technical risk, the mean of 2.6667 indicates that the responses for technical risk range from relatively low to moderate, with a lower mean suggesting that the level of technical risk is relatively lower overall. This means that the participants may perceive that their organization is relatively well-equipped to manage technical risks, or that there are fewer technical challenges or issues that could impact the success of their projects. Moreover, the standard deviation of 0.53383 suggests that the responses for technical risk are relatively close to the mean. This indicates that there is a smaller variability in the responses, implying that the participants' perceptions of technical risk are more uniform and less diverse compared to their perceptions of HRM risk.

For resource risk, the mean of 3.5214 indicates that the responses for resource risk range from relatively low to high, with a higher mean indicating a moderate to high level of resource risk overall. This means that the participants perceive that there are significant challenges or issues related to resource allocation and management, which could impact the success of their projects. These challenges could include, for example, insufficient budget, limited staff or expertise, or inadequate equipment or materials. Furthermore, the standard deviation of 0.54781 suggests that the responses for resource risk are relatively spread out from the mean. This indicates that there is significant variability in the participants' perceptions of resource risk. Some participants may perceive resource risk to be extremely high, while others may perceive it to be relatively low. This variability in responses highlights the importance of addressing resource risk from multiple angles and considering different perspectives to effectively manage it.

The mean of 2.8583 for financial risk shows that the participants perceive financial risk to be relatively low to moderate. This means that they perceive that there are some potential financial risks associated with their projects, but the overall level of risk is not perceived to be very high. These financial risks could include, for example, unexpected cost overruns, inadequate financing, or cash flow problems. The standard deviation of 0.55409 for financial risk in Table 5 indicates that the responses are relatively close to the mean. This means that there is relatively less variability in the participants' perceptions of financial risk compared to other types of risk such as HRM risk or resource risk. In other words, the majority of participants have similar perceptions of financial risk.

For legal risk, the mean is 3.1119, and the standard deviation is 0.84025. The relatively high mean for legal risk indicates that the respondents perceive legal risk to be a significant concern in the construction industry. The standard deviation indicates that the responses are spread out from the mean, suggesting that some respondents perceive legal risk to be a very high concern, while others perceive it to be a relatively lower concern. The wide variability in responses may be due to differences in the types of legal risks that are perceived to be most relevant to the construction industry, such as contract disputes, liability issues, or regulatory compliance. Overall, the results suggest that legal risk is an important consideration for construction firms, and that there is a need for effective risk management strategies to mitigate these risks.

For management risk, the mean is 2.5857, and the standard deviation is 0.66026. The relatively lower mean for management risk suggests that respondents perceive management risk to be a lesser concern in the construction industry compared to other types of risks. The standard deviation indicates that the responses are relatively close to the mean, indicating a smaller variability in the responses. This suggests that the respondents generally agree on the level of management risk in the industry, and that there is a consensus that management risk is not as significant as other types of risks such as resource or legal risks. However, it is important to note that effective management is crucial to the success of any construction project, and that inadequate management can lead to delays, cost overruns, and other problems that can impact the overall success of the project. Therefore, while management risk may not be perceived as a significant concern by respondents, it remains an important area for construction firms to focus on in order to mitigate potential risks and ensure project success.

The mean value of 2.8488 for time risk indicates that the respondents, on average, perceive time risk to be relatively low to moderate. This means that they view the risk of delays or time-related problems in construction projects to be moderate or not particularly concerning. However, the standard deviation of 0.68175 indicates that there is a significant variation in the responses, suggesting that some respondents perceive time risk to be more significant than others. Therefore, it is essential to analyze the individual

responses to identify the reasons for this variability and take appropriate measures to mitigate time-related risks in construction projects.

For construction risk management, the mean is 2.9833, and the standard deviation is 0.64791. This means that the responses to construction risk range from relatively low to moderate, with a moderate mean indicating a moderate level of construction risk overall. The standard deviation indicates that the responses are relatively spread out from the mean, indicating a significant variability in the responses. This means that some respondents perceive construction risk to be very low or very high, while others perceive it to be moderately high or moderately low.

5. FACTORS INFLUENCING CONSTRUCTION RISK MANAGEMENT

Regression analysis was utilized to examine the effects of factors that influence construction risk management. To prepare for multiple linear regression analysis, several assumptions were assessed and confirmed, including data size, outliers, normality, linearity, heteroscedasticity, and multicollinearity, as recommended by (Taber, 2018). Table 6 illustrates the factors affecting construction risk management.

Table 6. Factors Affecting Construction Risk Management

Model	*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*	*Collinearity Statistics*	
	B	*Std. Error*	*Beta*			*Tolerance*	*VIF*
(Constant)	1.441	0.525		2.744	0.007		
HR Risk	0.161	0.086	0.176	1.882	0.022	0.653	1.53
Technical risk	0.313	0.107	0.258	2.941	0.004	0.742	1.348
Resource risk	0.099	0.096	0.084	1.027	0.030	0.862	1.16
Financial risk	0.057	0.092	0.049	0.623	0.044	0.925	1.081
Legal risk	0.257	0.073	0.27	3.52	0.001	0.97	1.031
Management risk	0.186	0.063	0.241	2.956	0.004	0.861	1.161
Time risk	0.018	0.075	0.018	0.242	0.009	0.985	1.015
R^2	14.7%						
F	6.15						
Normality	The data is normally distributed						
Heteroscedasticity	There is no heteroscedasticity issue						

The R^2 value shows the proportion of variance in construction risk management explained by the risk factors included in the study. In this case, the R^2 value is 14.7%, indicating that the selected risk factors can only explain a small proportion of the variance in construction risk management. The F-value in the table indicate the overall significance of the regression model. In this case, the F-value is 6.15, indicating that the regression model is statistically significant. Furthermore, the study found that there was no issue of normality or heteroscedasticity, indicating that the data used in the analysis were valid and reliable.

Based on the table above, it is evident that all factors have a notable impact on construction risk management. Specifically, the risk associated with HR has a significant influence on construction risk management, as indicated by a probability value of 0.022. In other words, there is a low probability that this relationship occurred by chance. Therefore, it can be inferred that effective management of HR risk is crucial for successful construction risk management. The finding shows that human resources risk has a significant influence on construction risk management is consistent with previous studies such as (Jiang et al., 2020; Pham et al., 2020). The findings of the analysis reveal that technical risk has a substantial impact on construction risk management, with a probability value of 0.004. This indicates that the relationship between technical risk and construction risk management is highly unlikely to be due to chance. As a result, the finding that technical risk has a significant influence on construction risk management is

reliable and valid. Recent studies have also supported the findings of this study, indicating that technical risk is a critical factor in construction risk management. This results are in line with previous studies findings (Jiang et al., 2020; Pham et al., 2020).

Furthermore, the results show that resource risk has a significant impact on construction risk management, as evidenced by its probability value of 0.030. This means that there is strong evidence to suggest that changes in resource risk are associated with changes in construction risk management. Therefore, it is important for construction project managers to pay more attention to resource risk in order to effectively manage overall project risk. The presence of financial risk has a statistically significant effect on construction risk management. The probability value of 0.044 suggests that there is a 4.4% chance that the observed relationship between financial risk and construction risk management is due to chance alone. This finding highlights the importance of considering financial risk when managing risks in construction projects, as it can have a significant impact on the overall success of the project. Effective management of financial risk can help to minimize the negative consequences that financial risks can have on a construction project, such as cost overruns and delays. This findings are consistent with previous studies' findings (Kubasova, Tkach and Tsvigun, 2018; Zhu, 2021).

Moreover, the observed relationship between legal risk and construction risk management is statistically significant, with a very low probability value of 0.001. This indicates that the presence of legal risk has a strong impact on the management of risks in construction projects. Legal risk refers to the potential for legal action or other legal consequences arising from the construction project. This may include issues related to compliance with laws and regulations, contract disputes, and litigation. When legal risks are not effectively managed, they can result in delays, cost overruns, and reputational damage for the project and its stakeholders. The low probability value of 0.001 suggests that there is a very low likelihood that the observed relationship between legal risk and construction risk management is due to chance.

The results emphasize the significance of including legal risk in the risk management process of construction projects and implementing effective strategies to reduce its potential adverse effects. Our findings align with previous research that has identified legal risk as a critical factor that can substantially influence construction risk management, as reported by Banik and May (2006).

The observed relationship between management risk and construction risk management is statistically significant, with a probability value of 0.044. This indicates that the presence of management risk has a measurable impact on the management of risks in construction projects. Management risk refers to the potential for errors, oversights, or poor decision-making by project managers and other stakeholders involved in the construction project. When management risks are not effectively managed, they can lead to delays, cost overruns, and other negative consequences for the project and its stakeholders. The probability value of 0.044 suggests that there is a 4.4% chance that the observed relationship between management risk and construction risk management is due to chance. While this is not as low as some other probability values, it still suggests a statistically significant relationship between the two variables. This finding highlights the importance of effective project management practices, and the need to implement strategies to mitigate management risks in order to improve the overall success of construction projects. Recent studies have also highlighted the importance of effective project management practices and the impact of management risk on the success of construction projects (Goh and Abdul-Rahman, 2013; Muthukrishnan and Ganapathi, 2021).

Finally, the results indicate that the presence of time risk has a significant impact on the management of risks in construction projects. Time risk refers to the potential for delays, disruptions, or other issues related to project scheduling and deadlines, which can result in cost overruns and negative consequences for the project and stakeholders if not managed effectively. The probability value of 0.009 is indicative of a strong relationship between time risk and construction risk management, with a low likelihood (0.9%) that this relationship is due to chance. This results are in line with the findings reported by (Gładysz et al., 2015). These findings emphasize the crucial role of effective time management practices in construction projects, and the need to implement risk mitigation strategies to address time risks and improve project outcomes. Based on the analysis and findings, the results can be summarized in table 7.

Table 7. Summary of Results and Hypotheses Testing

Hypotheses	*Sig*	*Decision*
There is a significant effect of human resource risk on construction risk management	0.022	Accepted
There is a significant effect of technical risk on construction risk management	0.004	Accepted
There is a significant effect of resource risk on construction risk management	0.030	Accepted
There is a significant effect of financial risk on construction risk management	0.044	Accepted
There is a significant effect of legal risk on construction risk management	0.001	Accepted
There is a significant effect of management risk on construction risk management	0.004	Accepted
There is a significant effect of time risk on construction risk management	0.009	Accepted

CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCHES

The construction industry is known to have a significant impact on the environment, economy, and social well-being of communities. Hence, it is imperative to investigate the factors that impact private construction risk management to ensure sustainable development. By managing risks effectively, construction projects can minimize negative impacts on the environment and communities, as well as improve their economic sustainability. The empirical study conducted in Libya provides insights into the factors influencing construction risk management, which can contribute to sustainable development in the country. By identifying and addressing these factors, construction projects can be executed more sustainably and mitigate negative impacts on the environment and society.

In conclusion, the findings of this study indicate that all the selected factors, including HR risk, technical risk, resource risk, financial risk, legal risk, management risk, and time risk, have a significant impact on construction risk management. The results highlight the importance of effective management of these risks to ensure the success of construction projects.

Based on the study's results, we recommend that construction project managers should pay close attention to the identified risks and develop strategies to mitigate them effectively. In particular, the management of HR, technical, resource, financial, legal, management, and time risks should be given priority to improve the overall success of construction projects.

In summary, exploring factors influencing construction risk management is crucial to achieving sustainability in the construction industry, and the empirical study conducted in Libya provides valuable insights in this regard. One limitation of this study is that it was conducted only in Libya, and the results may not be generalizable to other countries or regions with different cultural, social, and economic contexts. Additionally, the study only focused on the seven selected risk factors and did not consider other potential factors that may impact construction risk management. Furthermore, the study relied on self-reported data from construction professionals, and their responses may be subject to biases or inaccuracies.

Future research could explore the relationship between these risks and other factors that may impact construction risk management, such as project size and complexity, stakeholder engagement, and project team dynamics. Additionally, research could focus on identifying the most effective risk management strategies for each type of risk to provide more comprehensive guidance to construction project managers. Moreover, research could explore the potential impact of emerging technologies, such as artificial intelligence and machine learning, on construction risk management practices. Finally, exploring the impact of the COVID-19 pandemic on construction risk management practices could also be an important area for future research. The pandemic has had significant impacts on the construction industry, and has likely introduced new types of risks that need to be considered in risk management strategies. This could include risks related to supply chain disruptions, labor shortages, and changes in regulations and safety protocols. Additionally, research could also explore the use of emerging technologies in managing these new types of risks.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Vo, D.H., Tran, N.P. (2024), "Sectoral Intellectual Capital and Sector Performance in an Emerging Market",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 209-220.

Sectoral Intellectual Capital and Sector Performance in an Emerging Market

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ARTICLE INFO

Received June 29, 2023
Revised from July 28, 2023
Accepted August 28, 2023
Available online April 15, 2024

JEL classification: L52, M21, N20

DOI: 10.14254/1800-5845/2024.20-2.17

Keywords:

Sectoral intellectual capital,
Sector performance,
MVAIC,
DCCE,
Vietnam.

ABSTRACT

The role of creating long-term competitive advantage of intellectual capital for firms, industries, regions and countries has been widely recognized. However, the measurement of sectoral intellectual capital has largely been ignored in intellectual capital literature. Hence, this study proposes a method to measure sectoral intellectual capital index based on the modified value-added intellectual coefficient model (MVAIC) model. In addition, this paper also examines the contribution of sectoral intellectual capital index to industries performance across 12 industries in the Vietnamese economy from 2011 to 2018. Besides, the dynamic common correlated estimator (DCCE) technique is utilized in this study. Our results strongly confirm that sectoral intellectual capital index makes a positive contribution to both return on assets and return on equity across indutries in Vietnam. In addition, our findings indicate that securities sector has the highest sectoral intellectual capital index, while technology has the lowest. This study shed the light on the role of sectoral intellectual capital on industries performance. In addition, our study also provides a valuable framework for policy makers in managing and enhancing sectoral intellectual capital within emerging markets.

INTRODUCTION

In the era of knowledge economy, intellectual capital is considered one of the most valuable assets of an organization, region or country (Markhaichuk & Zhuckovskaya, 2019; Ujwary-Gil & Godlewska-Dzioboń, 2022). Tian & Liu (2019) indicate that intellectual capital is the engine that drives economic growth and technological progress. Liu et al. (2021) state that intellectual capital plays the important role of intangible assets, it helps to exploit important knowledge that affects the innovation ability of enterprises, industries and regions. Marcin (2013) emphasizes that intellectual capital is a fundamental resource for value creation at the sectoral, regional and national levels.

In addition, from being one of the poorest countries in the world in the mid-1980s, Vietnam has achieved rapid economic growth and sustainable development goals in the last 10 years (Baum, 2020). These achievements of Vietnam are based on broad-based economic reforms and national development

strategies, focusing on five main sectors: education, health, roads, water and electricity infrastructure (Baum, 2020; Duong et al., 2022). Nguyen & Gregar (2018) emphasize the role of knowledge management in innovation of Vietnamese firms. Besides, Tran & Vo (2020) also affirm that intellectual capital has a positive influence on firm's performance in Vietnam. In addition, the financial sector is more efficient in using intellectual capital than the non-financial sector in Vietnam. Dutt (1990) asserts that imbalance between sectors can slow down economic development. In particular, the coronavirus pandemic affects the economies of countries around the world in a "K-shaped recovery". The characteristic of this type of recovery is that some sectors will improve, while others will continue to decline (Nikkei, 2021). Hence, it is necessary to measure and evaluate the efficiency of intellectual capital across sectors in Vietnam and other emerging markets.

Previous studies have measured intellectual capital at the firm (Xi et al., 2023; Soetanto & Liem, 2019), regional (Liu et al., 2021; Marcin, 2013) and country (Vo & Tran, 2022; Lin & Edvinsson, 2011). However, the previous studies have largely ignored to measure intellectual capital at the sector level. Hence, this study proposes a sectoral intellectual capital index to fill this research gap.

This study contributes to knowledge on intellectual capital in the following ways. First, based on MVAIC model, we develop a sectoral intellectual capital index to compare the accumulation of the intellectual capital across industries in Vietnam using a panel data spanning from 2011 to 2018. Second, previous intellectual capital measurements focus on the consideration of sectoral or regional intellectual capital at specific point of time and its relationship with the sectoral performance. This study investigates the long-term effect from the accumulation of the sectoral intellectual capital to the performance of 12 industries.

The rest of this paper is organized as follows. Following this introduction, Section 2 discusses briefly literature on intellectual capital. The development of the sectoral intellectual capital index (SICI) is presented and discussed in section 3. The applications of this newly developed index (SICI) are conducted in section 4. Section 5 of the paper provides concluding remarks and policy implications.

1. REVIEW OF LITERATURE

1.1 Intellectual capital and its components

Soetanto & Liem (2019) point out that there is still no uniformly acceptable definition of intellectual capital. Previous studies have defined and classified intellectual capital and its components in different ways. Brooking (1996) describes intellectual capital as intangible assets that allow a firm to operate. Intellectual capital as knowledge, intellectual property, and information that can be ultilized to create firm's wealth (Stewart, 1997). In addition, Roos et al. (1997) consider that intellectual capital includes all intangible assets, such as trademarks, patents. Besides, Bontis & Fitz-enz (2002) indicate that intellectual capital includes knowledge, information and intellectual property that contribute to increased competitiveness. Furthermore, Dean & Kretschmer (2007) point out that intellectual capital is an intangible asset that contributes to improving the performance of organizations.

In addition, there is no consensus on how to divide the components of intellectual capital. Sveiby (1997) considers intellectual capital based on three aspects: external structure, internal structure and employee competencies. Based on the Saint-Onge model, Westberg & Sullivan (1998) divide intellectual capital into three components: human capital, structural capital and customer capital. Sullivan (2000) indicates that intellectual capital includes 2 main components: human capital and intellectual assets. Intellectual capital includes four aspects: lexical, negative semantic, positive semantic and connotative (Jardon & Martinez-Cobas, 2021).

Although there is no consensus on definition and classification, intellectual capital is still considered as a driving force to create a long-term competitive advantage of an organization, industry, region or country (Liu et al., 2021; Vo & Tran, 2022).

1.2 Intellectual capital measurements beyond the firm level

Previous studies have measured intellectual capital in the firm level (Shehzad et al., 2023; Costa et al., 2014), regional level (Liu et al., 2021; Nitkiewicz et al., 2014) and national level (Vo & Tran, 2022; Lin & Edvinsson, 2011). However, the previous studies have largely ignored to measure intellectual capital at the sector level.

Nitkiewicz et al. (2014) point out that the concept of intellectual capital is mainly applied to firms and organizations. However, this concept is gradually being expanded and one of the directions of development is to define and classify knowledge capital and its components at the sectoral and regional level. Pedro et al. (2018) shows that strategically innovative organizations spread knowledge not only to their own but also to industry, region and country. Thus, through sectoral and regional intellectual capital analysis, public policies can find solutions to improve sectoral and regional intellectual capital to achieve sustainable development (Medina et al., 2007). Countries around the world are increasingly interested in regional as well as sectoral approaches to intellectual capital (Marcin, 2013). At the same time, issues of effective sectoral and regional innovation strategy have become important. Poyhonen & Smedlund (2004) use systemic interpretation of the functioning of inter-organizational networks by using theme-based interviews of 11 mechanical wood processing small firms in the eastern part of Finland. They reveal that innovation network functioned best, while the production network had poorly and insufficient structured information flows.

In addition, Edvinsson & Bounfour (2004) examine Intellectual Capital dynamic Value (IC-dVAl) approach to measure intellectual capital performance at regional level in France. They find that Paris area and Toulouse region are the two regions with the highest intellectual capital, while Corsica lags behind. Xia & Niu (2010) propose a system of 27 indicators to measure regional intellectual capital of 29 provinces and cities of China. They estimate regional intellectual capital level by using principal components analysis (PCA) and cluster analysis. The results show that intellectual capital efficiency of eastern China is higher than western China. Nitkiewicz et al. (2014) utilize data envelopment analysis (DEA) for evaluate regional intellectual capital in across Polish regions. The results show significant differences between Polish regions in terms of intellectual capital efficiency. Pedro et al. (2018) emphasizes the need to develop a new sectoral as well as regional approach to intellectual capital in relation to regional and sectoral development theories. Thereby, contributing to promoting the management of intangible resources in sectors and regions. Based on percolation theory methods, Markhaichuk & Zhuckovskaya (2019) measure regional intellectual captial of 8 Russian federal districts in 2017. They find that intellectual capital is disproportionately distributed between 8 districts. It has a lower level in remote territories while concentrating closer to the capital. Liu et al. (2021) reveal that there are differences in the level of regional intellectual capital in different regions in China. In addition, the regional intellectual capital ranking is largely in line with the province's gross domestic product ranking.

Although there have been many studies measuring intellectual capital at the firm, regional or national level, however, the issue of measuring intellectual capital at the sector level has been largely ignored in previous studies. Based on the modified value-added coefficient (MVAIC) model, this study proposes a sectoral intellectual capital index (SICI) by examining the intellectual capital efficiency of each enterprise in the sector. In addition, the author uses total assets as a weight to create the intellectual capital index of industry.

2. METHODOLOGY

2.1 Sectoral intellectual capital index

In order to construct a comprehensive sectoral intellectual capital index, we utilize modified value-added coefficient (MVAIC) model, which is widely used to measure intellectual capital in firm level (Tran & Vo, 2022; Soetanto & Liem, 2019).

Table 1.Modified value-added coefficient model

Variables	*Definition*
MVAIC	HCE + SCE + RCE + CEE
HCE	VA/HC
SCE	(VA-HC)/VA
RCE	RC/VA
CEE	VA/CE
SIZE	Natural logarithm of the total assets

Notes*:* **VA** is calculated as total profit before taxes add employee expenditures; Human capital **(HC)** is defined as employee expenditures; Structural capital **(SC)** is computed as the difference between value-added and human capital. Relational capital **(RC)** is measured as selling, marketing and advertising expenses; Capital employed **(CE)** is estimated by the difference between total assets and the value of intangible assets

Based on MVAIC model, this study proposes the sectoral intellectual capital index (SICI) by examining the intellectual capital efficiency of each firm in the sector. In addition, author uses total assets as the weight to make up the intellectual capital of that sector. SICI is defined as follows:

$$SICI = \sum_{i=1}^{n} w_i Y_i$$

where:

- number of sample firms in the sector.
- w_i is the weight assigned to firm *i* in the sector $\left(w_i = {K_i}/{K}\right)$.
- K and K_i are the total assets of all sample firms in the sector and total assets of each firm, respectively, to which the weight for each firm is calculated.
- Y_i is the intellectual capital efficiency of firm i, calculated by MVAIC.

2.2 Other variables

To measure sector performance, we utilize return on assets (ROA) and return on equity (ROE) to compute sector financial performance, in line with previous studies (Dalwai & Salehi, 2021; Smriti & Das, 2018).

In addtion, this study also utilizes SIZE and LEV as control variable. SIZE is computed as the natural logarithm of total assets. LEV is calculated as the ratio between total debt and total assets. The regression models are calculated as present in Table 2.

Table 2. Regression models

Model	*Regressions*
1	$ROA_{it} = \beta_0 + \beta_1 SICI_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \varepsilon_{it}$
2	$ROE_{it} = \beta_0 + \beta_1 SICI_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \varepsilon_{it}$

2.3 Sample and Data

This study utilizes data collected from the annual reports of listed firms in Vietnam during 2011-2018 period. Firms used must be in continuous operation, without mergers and acquisitions during the research period. After removing the unsatisfactory data, the sample including 150 firms is used. The selected firms are then classified into 12 industries.

3. EMPIRICAL RESULTS AND DISCUSSION

3.1 Descriptive statistics

Table 3 presents the descriptive statistics of all variables. The average ROA and ROE of all sector in Vietnam in 2011-2018 are 0.103 and 0.161, respectively. Food and Pharmaceuticals have higher returns on total assets and equity, while Banking and Service have lower performance. The average SICI is 4.341, in which Energy, Securities, Food and Real estate are higher than average. In addition, the results state that banking has the lowest return on assets, while this industry uses the highest total assets of all industries.

Table 3. Descriptive statistics

Sector	*ROA*	*ROE*	*SICI*	*SIZE*	*LEV*
All sectors	0.103	0.161	4.341	10.871	0.560
Aviation	0.051	0.166	3.677	11.775	0.664
Banking	0.011	0.123	3.321	15.152	0.522
Education	0.109	0.158	3.549	7.378	0.410
Energy	0.063	0.160	6.624	10.882	0.653
Food	0.204	0.329	6.341	11.380	0.453
Insurance	0.031	0.115	4.265	11.489	0.645
Oil and gas	0.108	0.166	2.789	11.767	0.609
Pharmaceuticals	0.182	0.162	3.439	9.206	0.561
Real estate	0.054	0.194	5.435	12.137	0.693
Securities	0.068	0.115	6.578	10.385	0.601
Service	0.104	0.151	3.309	8.596	0.433
Technology	0.250	0.089	2.760	10.309	0.479

Notes: **ROA** denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets of the sector; LEV is calculated as the ratio between total debt and total assets.

Table 4 shows Pearson's correlation coefficient matix. The results indicate that correlation coefficient between ROE and SICI is statistically significant at 5 per cent. Besides, we test multicollinearity through variance inflation factor (VIF). The results show that all variables are below 2, which imply that multicollinearity is not a problem in this study.

Table 4. Correlation matrix and the variance inflation factor among variables

Sector	*ROA*	*ROE*	*SICI*	*SIZE*	*LEV*	*VIF*
ROA	1.000					
ROE	0.300***	1.000				
SICI	-0.093	0.389***	1.000			1.06
SIZE	-0.429***	-0.022	0.066	1.000		1.17
LEV	-0.438***	-0.075	0.238**	0.380***	1.000	1.23

Notes: **, *** *significant at 5% and 1% level, respectively*

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets of the sector; LEV is calculated as the ratio between total debt and total assets.

In addition, this study also examines the fluctuations of the sectoral intellectual capital over the years in the period 2011-2018. The results in Figure 1 show that SICI has been relatively stable over the last 4 years. Securities, Energy, Food and Real Estate have higher SICI than the rest. Specifically, the securities industry had the highest SICI and had a strong growth since 2016. Meanwhile, Energy had a strong increase in SICI in the period 2011-2014 but declined in the following years. Especially, Technology has the lowest SICI among 12 industries in Vietnam. The results indicate that there is a difference in the efficiency of using intellectual capital of industries in Vietnam. High intellectual capital-intensive industries such as Banking, Technology (Firer & Williams, 2003) have not yet exploited intellectual capital commensurately.

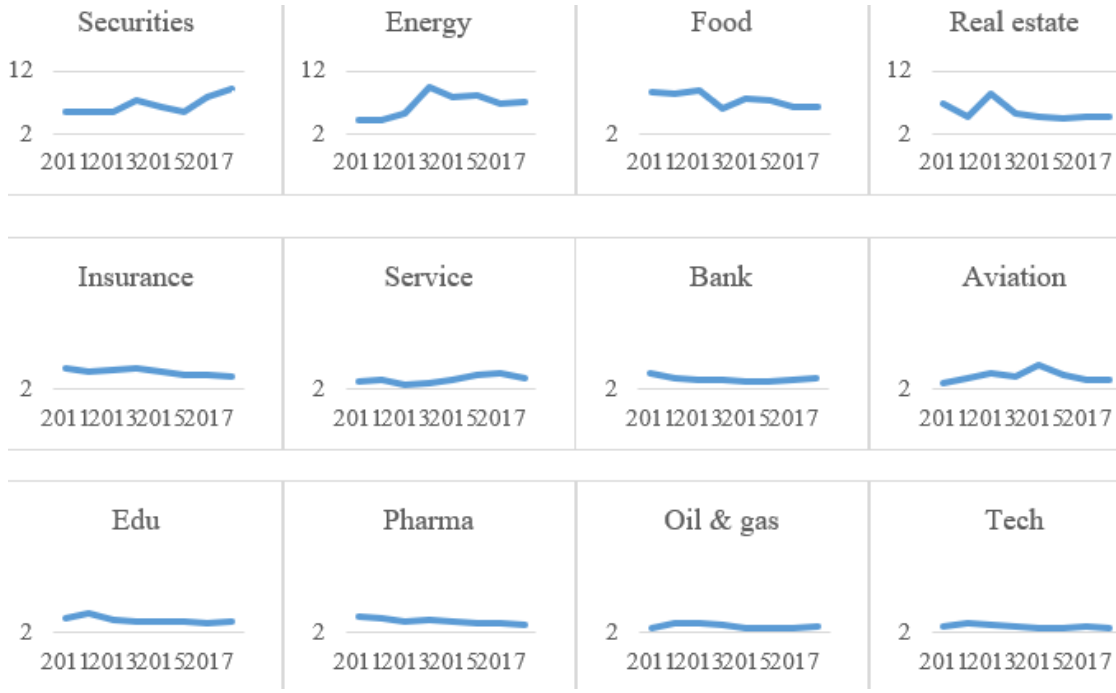


Figure 1. Sectoral intellectual capital index in 2011-2018 period

3.2 Cross-sectional dependence test

Next, this study examines the cross-sectional dependence by employing Pesaran (2015) tests. The results in Table 5 indicate that the null hypothesis of cross-section independence can not be rejected, except SIZE. In other words, the level generation's panel unit root tests should present more reliable inference. In addition, these findings reveal that not disturbance in one sector will not significantly affect the other industries in Vietnam.

Table 5. Cross-section dependence test results

Variables	*ROA*	*ROE*	*SICI*	*SIZE*	*LEV*
CD test	-0.902	0.212	0.310	19.808***	-0.836
p-value	0.367	0.832	0.757	0.000	0.403

Notes: *** significant at 1% level, respectively

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets of the sector; LEV is calculated as the ratio between total debt and total assets.

3.3 Slope homogeneity test

Besides, we also explore the slope homogeneity by using Pesaran & Yamagata (2008) technique. As presented in Table 6, we can reject the null hypothesis of slope homogeneity. This mean that we should consider to deal with slope homogeneity issues.

Table 6. Slope homogeneity test results

	Slope homogeneity test	
	Δ	Δ_{adj}
Equation (1)	2.726*** (0.006)	5.099*** (0.000)
Equation (2)	1.767* (0.077)	3.306*** (0.001)

Notes: *, *** significant at 10% and 1% level, respectively.

3.4 Panel unit root test

In the next step, the study also utilizes unit root tests as proposed by Pesaran (2003). This test explores the stationarity and to detect the integration order of concerned variables. The results in Table 7 suggest that all variables are stationary at the first-difference generation. The results imply that long-run co-integrating relationship among the variables is possible utilized in this study.

Table 7. Panel unit root test results

Variables	*Level*		*First Difference*		*Order of Integration*
	Constant (1)	*Constant and Trend (2)*	*Constant (3)*	*Constant and Trend (4)*	
ROA	-0.118	8.530	-4.355***	-3.611***	I (1)
ROE	11.116	-2.984***	-5.254***	-5.054***	I (1)
SICI	0.368	-2.911***	-5.569***	-3.472***	I (1)
SIZE	11.116	-1.755**	-4.057***	-2.354***	I (1)
LEV	2.992	0.349	-1.590*	-2.438***	I (1)

Notes: **, **, *** significant at 10%, 5% and 1% level, respectively. The Z[t-bar] is shown.*

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms

3.5 Panel cointegration test

In addtion, this study explore the nature of the long-run relationship among the variables by using the Kao (1999); Pedroni (1999; 2004); and Westerlund (2005) cointegration test. The results in Table 8 support a view that long-run relationship between sectoral intellectual capital and industry performance should be considered in the study.

Table 8. Results of the cointegration test

	Model 1	*Model 2*
Kao		
Modified Dickey-Fuller t	-2.079**	0.637
Dickey-Fuller t	-7.725***	-4.118***
Augmented Dickey-Fuller t	-2.821***	-2.418***
Unadjusted modified Dickey-Fuller t	-3.298***	-3.557***
Unadjusted Dickey-Fuller t	-8.174***	-7.289***
Pedroni		
Modified Phillips-Perron t	4.717***	4.213***
Phillips-Perron t	-3.896***	-6.375***
Augmented Dickey-Fuller t	-5.580***	-6.213***
Westerlund		
Variance Ratio	2.104**	6.026***

Notes: **, *** significant at 5% and 1% level, respectively

3.6 Dynamic common correlated estimator

Table 9 presents dynamic common correlated estimator results. The results in both models show that sectoral intellectual capital has a positive impact on industry performance. In particular, an increase in the sectoral intellectual capital will increase the level of return on assets and return on equity in these industries. In addition, total assets has a negative impact on sector performance in these industries. Meanwhile, we consider that the ratio between total debt and total assets does provide a strong and significant impact on industries performance in Vietnam.

Table 9. Dynamic Common Correlated Estimator (DCCE) results

Variables	*Model 1 (ROA)*	*Model 2 (ROE)*
SICI	0.017*	0.102*
SIZE	-0.174***	-0.044
LEV	0.203	1.083*
Number of observations	84	84
R^2 (Mean group)	0.76	0.35

Notes: *, *** significant at 10% and 1% level, respectively.

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms.

3.7 Panel Granger causality test

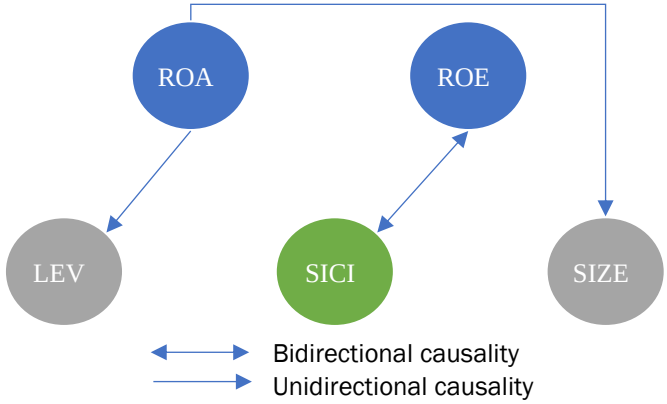
Finally, the study explores the causality between sectoral intellectual capital and industry performance by using a panel Granger causality method (Engle & Granger, 1987). As presented in Table 10, the results confirm bidirectional causality relationship between SICI and ROE. In addition, the causality relationship between SICI and ROA is not statistically significant. The results of these causal relationships between sectoral intellectual capital and industry performance are summarized in Figure 2.

Table 10. Results of panel causality test

Hypothesis	*F-statistic*	*Conclusion*
ROA → SICI	0.156	There is no causal relationship between sectoral intellectual capital and return on assets.
SICI → ROA	0.525	
ROA → SIZE	2.444*	Unidirectional causality from return on assets to total assets.
SIZE → ROA	1.313	
ROA → LEV	2.488*	Unidirectional causality from return on assets to financial leverage.
LEV → ROA	1.139	
ROE → SICI	2.593*	Bidirectional causality between sectoral intellectual capital and return on equity.
SICI → ROE	2.945*	
ROE → SIZE	0.051	There is no causal relationship between total assets and return on equity.
SIZE → ROE	0.582	
ROE → LEV	0.262	There is no causal relationship between financial leverage and return on equity.
LEV → ROE	0.564	
SICI → SIZE	0.760	There is no causal relationship between sectoral intellectual capital and total assets.
SIZE → SICI	0.905	
SICI → LEV	0.008	There is no causal relationship between sectoral intellectual capital and financial leverage.
LEV → SICI	0.785	
SIZE → LEV	0.380	There is no causal relationship between total assets and financial leverage.
LEV → SIZE	0.626	

Notes: * significant at 10% level.

A → B indicates unidirectional Granger causality running from A to B.
ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms



ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms

Figure 2. Causal relationships between all variables

CONCLUDING REMARKS AND POLICY IMPLICATIONS

The important role of intellectual capital as the long-term competitive advantage has been confirmed in previous studies (Tian & Liu, 2019). Measuring intellectual capital at various levels including at firms, regions, and nations have also been conducted (Liu et al., 2021; Vo & Tran, 2022). However, previous studies appear to have largely neglected to measure the intellectual capital at the industry level. Based on the modified value-added intellectual coefficient model (MVAIC), this study develops a sectoral intellectual capital index (SICI). Besides, this study also examines the impact of SICI on return on the performance of the industries, which is proxied by return on total assets (ROA) and return on equity (ROE), for 12 industries in Vietnam using the dynamic common correlated estimator (DCCE). Findings from this study indicate that Securities, Energy, and Food industries have accumulated the relatively higher level of the intellectual capital in Vietnam in comparsion with other industries during the research period. Meanwhile, Banking and Technology industries have been ranked very low in relation to the intellectual capital efficiency. The findings imply that these two industries have not yet fully recognised the important role of intellectual capital. In addition, our empirical results confirm the positive and significant impact of the sectorail intellectual capital on the performance of the Vietnamese industries using both ROA and ROE.

Policy implications have emerged based on the above findings for regulators and policymakers. Empirical evidence in this study indicates that significant differences in the level of intellectual capital across industries are confirmed. Banking and Technology industries, which are generally considered the intellectual-capital-intensive industries. However, it appears that these two industries have not effectively utilized intellectual capital properly. Firms in these two industries should focus on investing in intellectual capital. Improving human capital efficiency and training, and improving the professionalism for employees. Besides, firms also need to better utilise a structural capital. Specifically, processes, facilities, and intellectual property should be invested and utilised more effectively to improve the efficiency of intellectual capital. In addition, our results confirm the positive effect of financial leverage on industry performance. Hence, firm managers need to consider an optimal debt structure to add value to the business.

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Poliakov, R., Kulinich, T., Vechirko, I., Lavrov, R. (2024), "Impact of Profitability of Ukrainian Enterprises on Their Bankruptcy",
Montenegrin Journal of Economics, Vol. 20, No. 2, pp. 221-235.

Impact of Profitability of Ukrainian Enterprises on Their Bankruptcy

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ARTICLE INFO

Received August 19, 2023
Revised from September 18, 2023
Accepted October 18, 2023
Available online April 15, 2024

JEL classification: G33, C53, M11

DOI: 10.14254/1800-5845/2024.20-2.18

Keywords:

Profitability,
bankruptcy,
financial difficulties,
operating activity,
business activity, business closures.

ABSTRACT

Company bankruptcy is a mechanism that serves a dual purpose. On the one hand, it facilitates the removal (liquidation) of financially insolvent enterprises from the market, particularly those unable to settle their accounts payable and lacking prospects for growth. On the other hand, it plays a vital role in establishing the necessary conditions for restoring solvency and liquidity, thus ensuring opportunities for future development. This can be achieved, in particular, by concluding an amicable agreement and rehabilitation procedure. Shifting the focus in the crisis management system from the challenge of acquiring borrowed capital to enhancing profitability is a promising approach to overcome financial difficulties faced by companies. This shift not only reduces the likelihood of bankruptcy but also minimizes the prospect of subsequent liquidation. The purpose of the paper is to investigate how the profitability of operating activities in Ukrainian enterprises affects the number of bankruptcy cases, because it is an important task in preventing financial difficulties, bankruptcy, and liquidation of companies. The paper conducts a correlation and regression analysis to assess the impact of the profitability of operating activities on the number of bankruptcy cases completed with the approval of the liquidator's report. Based on the statistical data from the State Statistics Service of Ukraine (SSSU) for the period from 2014 to 2021, the above-mentioned analysis shows a negative relationship between the profitability of operating activities of Ukrainian enterprises and the number of completed bankruptcy cases approved by the liquidator's report (r = -0.86; D = 0.74). It has been determined that operating activity of Ukrainian enterprises accounts for 74% of all factors affecting the number of bankruptcy cases completed with the approval of the liquidator's report. The validation of the constructed regression equation and the estimation of its parameters confirm its statistical reliability and alignment with real economic processes. Specifically, the Fisher transformation (F = 4.11) exceeds the tabulated value (Ft = 2.45), i.e. (F > Ft), Se = 0.45; C_95% = 1.96). Based on the constructed equation, the number of bankruptcy cases completed with the approval of the liquidator's report was forecasted as an important task in preventing financial difficulties faced by companies,

their bankruptcy, and liquidation within the framework of crisis management.

INTRODUCTION

In a market economy, bankruptcy is an integral part of companies' functioning and a mechanism that allows unprofitable and insolvent enterprises, including those with negative profitability, to be removed from the market. On the other hand, this mechanism, when accompanied by rehabilitation measures and amicable agreements, allows them to resume operations and ensures their continued development (Prusak, 2018; Civelek et al., 2022). Between 2021 and 2022, the business activity situation for the vast majority of EU enterprises deteriorated, as indicated by the Business Registration and Bankruptcy Index (BRBI). With an average BRBI value of 121.2% across the EU27 in 2022, the business activity situation significantly worsened in some countries. For instance, in France, this value is 1.55 times higher than the average, and in Romania, it is 1.51 times higher (Eurostat, 2023). The average value of the indicator of business demographics of enterprises, known as the Death Rate of All Enterprises (DRE), as of January 1, 2021, for 14 countries that are members of the Organization for Economic Cooperation and Development (OECD), was 6.99% (OECD, 2020). This indicates that, on average, every fourteenth enterprise is liquidated throughout the year, particularly through bankruptcy proceedings. In Ukraine, the situation is more severe; according to the DRE, on average, one in ten enterprises is liquidated (SSSU, 2019).

To prevent company bankruptcies and their subsequent liquidation, it is essential to explore additional tools that can effectively manage relevant financial indicators (Pardal et al., 2021; Kislovska & Tamosiuniene, 2022; Roshchyk et al., 2022). These indicators include solvency; liquidity; coverage ratio; expenses and financial results from core, operating, financial, and investment activities; net profit, profitability, etc. Indicators such as capital turnover and profitability, especially from operating activities, depend on how efficiently a company utilizes its assets. The increase in profitability of operating activities fosters equity growth, enabling companies to attract additional credit resources while minimizing the risk of insolvency and, consequently, reducing the likelihood of bankruptcy. Furthermore, the level of an enterprise's liquidity is so critical in determining the likelihood of bankruptcy that in Germany, proof of a liquidity (solvency) deficit of a legal entity serves as the basis for initiating insolvency proceedings based on § 17 of Insol-venzordnung (1994), signifying the existence of payment inability for the debtor. As evident from the court practice, a debtor's liquidity deficit of up to 10% is allowed, as stated by the German Supreme Court in its judgment of May 24, 2005 in case IX ZR 123/04 (URTEIL, 2005). "If the deficit is less than 10%, it is insufficient to prove insolvency." Additionally, it is noteworthy to mention the recent stance of the German Supreme Court, outlined in its judgment on June 28, 2022, in case II ZR 112/21 (URTEIL, 2022): "*It is therefore considered acceptable to demonstrate insolvency by means of the liquidity status as of the key date, combined with a financial plan for three weeks after the key date, where daily deposits and withdrawals are compared*...". Thus, the control over positive liquidity by German companies should now be strengthened.

Simultaneously, liquidity, solvency, and coverage ratio indicators will play a pivotal role not only in Germany but also in other countries. For example, in England, by virtue of the provisions of Article 123(1)(e) of Insolvency Act 1986 (Insolvency Act, 1986), the court can initiate winding up proceedings if it's proven that the debtor will be unable to meet its obligations as they fall due. Moreover, considering that stagnation of mentioned indicators can result in payment suspension, and this circumstance, in line with the provisions of Art. L631-1 and Art. L640-1 French Commercial Code (French Commercial Code (2022), serves as the basis for initiating regular rehabilitation or liquidation procedures, respectively. Certainly, in Ukraine, payment inability also serves as a ground for initiating bankruptcy proceedings, and given an enterprise's low liquidity, the enterprise could easily become insolvent. Hence, the paper proposes conducting a study on the impact of profitability of operating activities on the number of bankruptcy cases completed with the approval of the liquidator's report. The aim is to identify potential areas for decreasing the probability of companies' bankruptcy and liquidation.

1. LITERATURE REVIEW

Financial difficulties of companies profoundly influence the risk of their bankruptcy. It has been found that profitability has a significant negative impact on financial distress (Dankiewicz, 2020; Oktari et al, 2023). Profitability refers to a company's operational efficiency, which is determined by its ability to generate profits (Susanto et al., 2022). Alongside other metrics like liquidity and solvency, profitability serves as a vital measure to assess a company's efficiency. This indicator is used to evaluate the likelihood of financial difficulties, including bankruptcy (Poliakov et al., 2023). The research conducted on the use of the profitability indicator (Albulescu, 2015), has confirmed its significant negative impact on financial difficulties, a conclusion supported by other scholars (Wibowo & Susetyo, 2020; Vu & Nwachukwu, 2021). Return on assets also has a negative impact on financial distress and stands as a crucial bankruptcy indicator (Putri & Sutrisno, 2023).

The causes of bankruptcy can stem from economic and financial factors, or a combination of both. The developed indicator, known as the bankruptcy index, which combines profitability and leverage of bankrupt firms, led to the conclusion that profitability influences the likelihood of bankruptcy. Consequently, this insight enables more effective management strategies. Viable firms can be reorganized to sustain profitability, while unviable ones can be liquidated (Aguiar-Díaz & Ruiz-Mallorquí, 2015). Revenue management is a crucial strategy for minimizing the risk of company bankruptcy. (Biddle, G. et al., 2020). The findings of the study have demonstrated that the likelihood of a company experiencing a financial crisis is contingent on various factors, including liquidity, profitability, asset productivity, market capitalization, and leverage. It is stressed that companies should carefully monitor their financial indicators, particularly operational profitability and market metrics, to mitigate the risk of bankruptcy. (Rachman, 2022). Based on the use of logistic regression, it is proved that financial indicators affect the prediction of financial difficulties, particularly bankruptcy of enterprises. Thus, the return on assets was found to have a positive impact on the financial distress of companies (Paramartha & Wiagustini, 2021; Kudej et al., 2021).

A study into the impact of profitability management on bankruptcy risk has shown that there is no connection, but if companies implement several business leadership strategies in their activities, this significantly reduces the risk of bankruptcy (Agustia et al., 2020). In addition, the risk of company bankruptcy significantly affects the decisions of all stakeholders (Lukason & Mifiano, 2019; Lesníková et al., 2022), especially through the use of models and financial ratios that allow it to be assessed. Thus, based on regression analysis, it was found that the profitability ratio has a negative impact on the financial difficulties faced by companies (Kalbuana et al, 2022). A study of the Indonesian Stock Exchange (when assessing the relevant statistical base for the period 2015-2017) based on correlation and regression analysis showed that return on assets has a significant negative effect on the financial difficulties of the analyzed companies (Moch, R. et al., 2019). Furthermore, conducted was a study employing correlation analysis, utilizing the banking sector of Iran as an illustrative case. Consequently, the study emphasizes the correlation between profitability, competition, and instances of bank failures (Badirkhani, 2019).

Using profitability as an intermediate variable, the impact of liquidity, operating capacity and leverage on financial distress, particularly bankruptcy, in manufacturing firms is determined (Kozlovskyi et al., 2020). Leverage and profitability have a significant impact on the financial difficulties of these companies. Profitability proved to be a partial mediator of the relationship between liquidity, leverage, and operational capacity to overcome financial difficulties. The study concluded that such indicators as return on equity, return on investment, and the debt-to-equity ratio of companies significantly affect financial challenges, especially bankruptcy. Promising recommendations were made for predicting bankruptcy, emphasizing that if operating costs are efficient, the profitability of operating activities will be higher and the risk of bankruptcy will be lower (Kadarningsih et al., 2021).

The correlation analysis of Malaysian companies in 2012-2014 proves that large companies with efficiently managed assets improve operating income and, therefore, ultimately improves operating profitability. It is concluded that there is no significant relationship between liquidity (current ratio and profitability), and a negative relationship between asset turnover and profitability (Alarussi & Alhaderi, 2018). When applying logistic regression, using the example of a study of companies listed on the stock exchange in Indonesia, we reached a conclusion that non-financial variables (corporate governance, market information, macro factors) do not have a direct impact on bankruptcy. However, they have a significant impact

on return on equity (Kozlovskyi et al., 2023), which in turn has an impact on company bankruptcy (Nuraini et al., 2021). On reviewing the above literature on the problem of financial difficulties, in particular bankruptcy, we deduced that the profitability of companies is an important factor (Kozlovskyi et al., 2021), which significantly affects the future prospects of their development and profitability. The analysis of the studies done by the above-mentioned scientists allowed us to formulate the hypothesis that the profitability of companies significantly affects financial difficulties and the risk of bankruptcy. While reviewing the literature on the problem under study, we did not happen to find scientific works analyzing the impact of operating profitability on the probability of bankruptcy. Therefore, the paper proposes to study the impact of operating profitability (as the ratio of the enterprises' operating income to their operating expenses) on the number of bankruptcy cases of Ukrainian enterprises closed with the approval of the liquidator's report.

2. METHODOLOGY

The study includes the following steps: to analyze the value of the Business registration and bankruptcy index for the period 2016-2022 for individual EU-27 countries (according to the data available in the Eurostat database). Analyze the Death rate of all enterprises in 2013-2020 for the countries that are members of the Organization for Economic Cooperation and Development (OECD) (according to the OECD statistical database and the data available). Analyze the value of the Death rate of all enterprises in 2013-2019 in Ukraine (according to the State Statistics Service of Ukraine (SSSU) database). Analyze the judicial statistics of the results of bankruptcy cases in Ukraine for the period 2014-2022 (according to the statistical database Judicial statistics of the Supreme Court of Ukraine). Analyze the dynamics of the level of profitability of the general and operating activities of Ukrainian enterprises, in particular by their size. Investigate the impact of operating profitability on the number of bankruptcy cases completed with the approval of the liquidator's report based on the statistical database of the State Statistics Service of Ukraine and Judicial statistics of the Supreme Court of Ukraine. Build a correlation and regression equation of the impact of operating profitability on the number of bankruptcy cases completed with the approval of the liquidator's report with justification of its statistical reliability (Ilyash et al., 2020; Shevchuk et al., 2023). Forecast the number of bankruptcy cases completed with the approval of the liquidator's report, taking into account the built correlation and regression equation.

According to the methodological guidelines for using enterprise financial statements for statistical purposes (State Statistics Service of Ukraine, 2014), the sources enabling statistical analysis of operational profitability include the following financial statement forms: "Balance Sheet" (Form Number One), "Income Statement" (Form Number Two), and "Notes to the Annual Financial Statements" (Form Number Five).

The study uses the profitability (loss) indicator of operating activities of enterprises (excluding those primarily engaged in "*Wholesale and retail trade; repair of motor vehicles and motorcycles*"). This indicator is calculated according to the formula (State Statistics Service of Ukraine, 2014):

$$R_{od} = FR_{od} / C_{od} \cdot 100\%, \quad (1)$$

where: R_{od} is the profitability (loss) of operating activities of enterprises; FR_{od} is the financial result from operating activities of enterprises; C_{od} is the expenses of operating activities of enterprises.

The impact of operating profitability (x) on the number of bankruptcy cases completed with the approval of the liquidator's report (Y) is determined by applying correlation and regression analysis. The correlation and regression analysis in assessing the impact of operating profitability on the number of bankruptcy cases (Halkiv et al., 2020) completed with the approval of the liquidator's report involves the construction of a correlation equation (formula 2): (Chatterjee et al, 2013):

$$Y_x = a_0 + a_1 x, \quad (2)$$

where Y_x is a linear equation; a_0, a_1 are the parameters (coefficients) of the equation; x is the influence factor.

The unknown parameters of the regression equation (a0, a1) should be determined through the least squares method. To achieve this, a system of normal equations is established. The strength of the

relationship is assessed using the linear correlation coefficient. The portion of variance in the analyzed performance attribute (Y) attributable to the factors (x) included in regression equation 1 is ascertained using the coefficient of determination (D). It is suggested to assess the reliability of the multiple correlation coefficient (as well as the correlation equation as a whole) by calculating the F-criterion (F). In addition to the closeness of the relationship, the following indicators are used to assess the adequacy of the regression equation (1) to real processes: sample correlation coefficient (z), standard error (Se), lower limit of the confidence interval of the correlation coefficient (rL), upper limit of the confidence interval of the correlation coefficient (rU). Fig.1 shows the algorithm for identifying the impact of operating profitability on the number of bankruptcy cases closed with the approval of the liquidator's report.

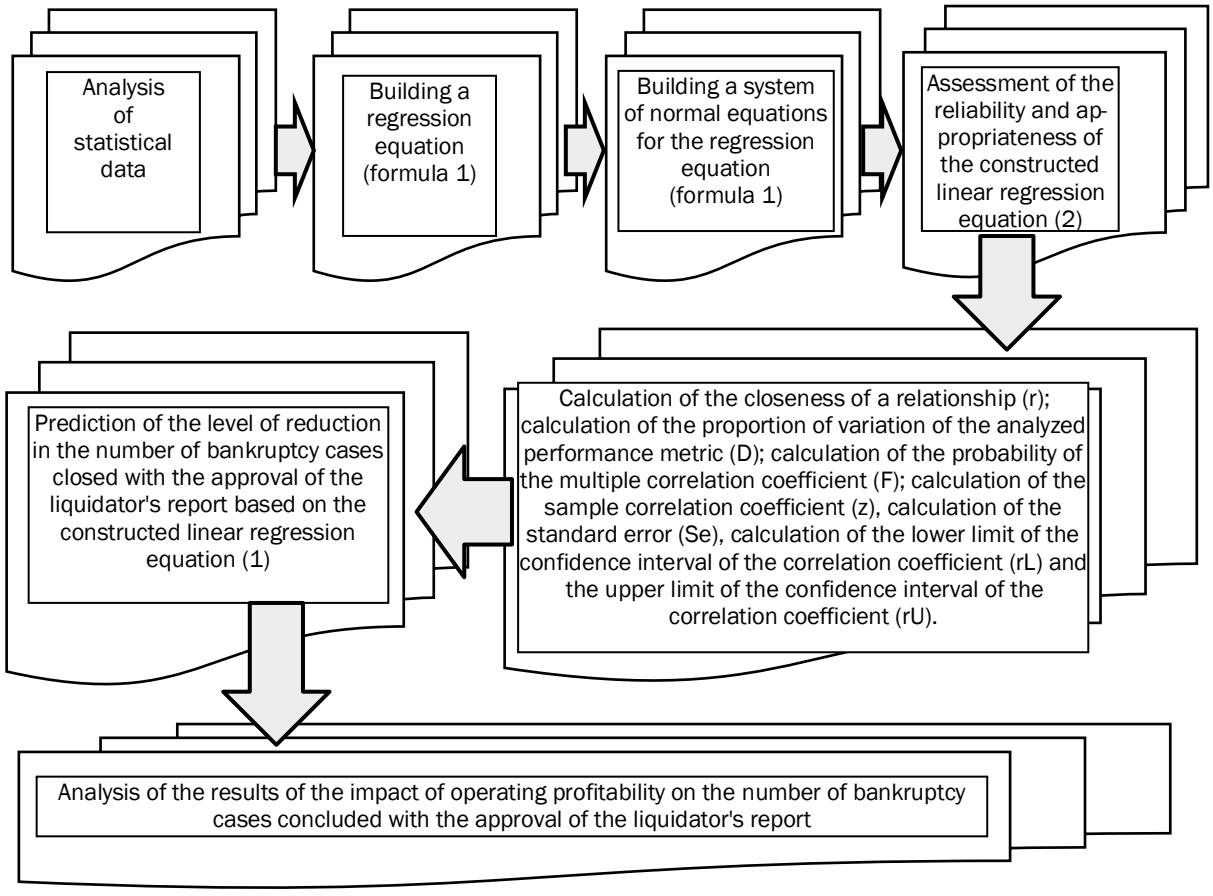

Figure 1. Algorithm for detecting the impact of operating profitability on the number of bankruptcy cases closed with the approval of the liquidator's report

The adequacy and reliability of the constructed correlation-regression equation (formula 1) to determine the impact of the profitability of operating activities (x) on the number of bankruptcy cases closed with the approval of the liquidator's report was assessed using MS Excel. The functions of the MS Excel statistical package were used to calculate the F-criterion and determine its tabular value.

3. RESULT

This section analyses the value of the business registration and bankruptcy index for the period 2016-2022 for the EU-27 countries as a whole, including countries such as Belgium, Bulgaria, Denmark, Germany, Estonia, Ireland, France, Italy, Spain, Latvia, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Iceland, Norway and Spain. The article analyses the death rate of all

enterprises in 2013-2020 in the countries that are members of the Organization for Economic Cooperation and Development (OECD) and in Ukraine for the period 2013-2019. The article examines the court statistics regarding the outcomes of bankruptcy case reviews in Ukraine from 2014 to 2022. Specifically, it focuses on various aspects, including the total number of cases completed; cases completed with the approval of the rehabilitation (restructuring) manager's report; cases completed with the approval of the composition agreement; cases completed with the approval of the liquidator's report; cases closed due to the fulfillment of all obligations to creditors. The dynamics of the level of profitability of general and operational activities of Ukrainian enterprises, in particular by their size (large, medium, small, micro) in 2010-2021 is considered. The influence of operating profitability on the number of bankruptcy cases closed with the approval of the liquidator's report is studied. A correlation-regression equation of the influence of profitability of business activity on the number of bankruptcy cases closed with the approval of the liquidator's report is constructed with the justification of its statistical reliability, and a forecast of the number of bankruptcy cases closed with the approval of the liquidator's report is made taking into account the constructed correlation-regression equation.

3.1 Analysis of business demography and bankruptcy statistics

The statistical basis for the analysis of the business registration and bankruptcy index is taken from the official Eurostat website (Eurostat, 2023). The base year is 2015. A summary of the business registration and bankruptcy index in the EU countries is presented in Table 1.

Table 1. Values Business registration and bankruptcy index (BRBI), % (2015 = 100%), %

Country	*Year*						
	2016	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*
EU-27 countries	101.6	105.0	109.9	116.5	105.5	121.2	121,2
Belgium	105.0	97.7	112.3	126.3	123.4	138.5	123.1
Bulgaria	109.6	103.7	100.3	93.6	70.6	79.7	80.3
Denmark	113.3	125.9	142.8	147.7	123.3	119.4	100.9
Germany	94.2	93.1	90.0	88.5	77.5	79.0	78.1
Estonia	107.1	116.2	123.2	128.6	130.9	148.7	123.0
Ireland	107.1	112.4	117.0	118.7	93.1	102.3	93.7
Spain	107.6	100.5	100.9	99.7	83.8	107.6	106.2
France	106.9	116.4	132.7	153.1	159.4	186.0	188.1
Italy	94.7	91.7	90.8	94.7	77.7	89.0	84.0
Latvia	90.5	83.2	86.9	85.5	73,1	75.4	72.5
Lithuania	103.0	111.7	116.0	123.4	131.2	144.8	138.9
Luxembourg	101.5	106.9	109.3	111.2	99.7	103.1	97.7
Malta	1032.8	106.2	111.8	126.1	121.2	137.9	142.2
Netherlands	103.8	106.2	111.8	126.1	121.2	137.9	142.2
Poland	97.5	101.2	108.2	105.1	92.1	103.5	108.3
Portugal	100.6	110.0	125.6	137.2	104.4	115.5	134.2
Romania	95.7	141.8	130.0	147.7	122.4	161.1	182.5
Slovenia	98.4	99.4	103.5	105.4	95.1	108.2	115.4
Slovakia	108.0	136.6	139.2	143.3	135.6	143.1	128.1
Iceland	112.8	109.3	96.9	93.9	103.8	132.8	127.1
Norway	101.0	98.0.	97.7	102.3	103.8	105.7	92.0

Sourse: (Eurostat, 2023).

According to the BRBI, more cases of negative values were recorded in such countries as France, Romania, Slovakia, Latvia and Estonia. For example, in the dynamics of France, the BRBI shows a steady upward trend from 106.9% in 2016 to 188.1% in 2022. In other words, in 2022 the BRBI value will increase by 88.1% compared to 2015, which is four times higher than the BRBI value for the 27 EU countries. In Romania, the BRBI value is 95.7% in 2016 and 182.5% in 2022. Estonia, an EU country, has a similar dynamic, with a BRBI of 107.1% in 2016 and 148.7% in 2021. In 2022, however, the BRBI drops significantly to 123%, which is as close as possible to the European average. The Netherlands also shows a similar trend, with a value of 103.8% in 2016 and this BRBI rising to 142.2% in 2022. Other countries show unstable dynamics in the development of the BRBI. The BRBI value deteriorates significantly in 2021-2022, mainly due to the impact of the COVID-19 pandemic in the EU and globally. The statistical data is derived from various sources including the Organisation for Economic Co-operation and Development (OECD) and the State Statistics Service of Ukraine (SSSU). It utilizes the business demography indicator for enterprises, specifically the "death rate of all enterprises" (DRE), and the corresponding values can be found in Table 2.

Table 2. Death rates of all enterprises, 2013-2020, % (data from 10.10.2023 for 2021-2022 are not available in the OECD and SSSU statistical databases

Country	*Year*							
	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Austria	6.00	5.50	5.40	5.70	4.90	4.30	5.20	4.10
Belgium	4.10	4.10	2.90	3.30	3.00	3.10	2.90	3.20
Czech Republic	8.30	7.90	7.60	8.00	7.30	7.10	8.20	..
Denmark	11.00	10.60	11.00	9.20	9.90	10.20	10.20	12.20
Estonia	9.00	7.90	7.10	7.80	9.80	10.70	10.30	9.90
Finland	7.30	7.20	7.10	6.80	6.70	6.60	7.30	10.40
France	5.30	5.60	5.30	4.70	4.90	4.70	4.60	3.90
Germany	8.30	8.30	7.80	7.90	7.80	8.70	11.70	9.50
Greece	..	..	6.50	6.90	..	2.90	3.00	..
Hungary	9.00	8.80	8.20	8.60	8.20	6.80	9.70	..
Iceland	9.80	10.20	9.90	10.10	9.90	10.20	11.50	8.70
Ireland	..	6.40	6.40	5.90	8.50	8.80	..	5.70
Italy	7.80	7.40	7.30	6.90	6.50	5.80	7.90	..
Korea	12.10	14.10	..	..	..	..	..	..
Latvia	13.00	9.00	5.90	14.20	9.80	10.30	9.60	..
Lithuania	14.20	15.70	14.30	16.70	15.60	14.90	18.00	..
Luxembourg	7.60	8.00	8.10	7.30	7.30	7.00	7.50	..
Netherlands	7.90	6.40	6.10	6.90	5.40	5.70	5.70	7.30
Norway	5.70	5.00	6.80	6.30	6.50	5.10	3.40	2.50
Poland	11.60	10.60	9.10	9.60	9.20	9.70	10.10	8.80
Portugal	13.90	13.30	12.90	12.40	12.50	12.80	13.50	..
Slovak Republic	12.70	10.40	9.20	8.80	8.70	8.60	10.40	..
Slovenia	9.00	8.20	8.90	9.60	8.00	7.80	8.10	6.10
Spain	9.50	8.20	8.50	9.00	7.90	8.00	8.60	..
Sweden	6.60	6.00	5.80	6.00	5.90	5.40	5.60	5.60
Switzerland	6.30	6.70	6.90	6.70	6.90	6.70	7.40	..
Turkey	12.00	11.40	11.40	11.20	12.10	11.50	..	..
United Kingdom	9.90	9.90	10.80	10.10	11.70	..	..	..
Ukraine	6.6	12	7.7	5.9	6.6	6.3	10.2	..

Source: OECD, 2020; SSSU, 2019.

The analysis of the DRE values shows that the highest death rate in the total number of enterprises was recorded in Lithuania. In 2019, the DRE was 18%, which means that almost every fifth enterprise is closed down. In OECD countries such as Denmark, Estonia, Finland, Germany, Hungary, Latvia, Poland, Slovakia, Slovenia, Spain, and the United Kingdom, the DRE is close to 10%, that is about 10% of enterprises are liquidated annually. Turkey has a much higher value, with the DRE of about 12%. The lowest DRE values are found in the following countries: Austria, Belgium, France, Greece, and Norway. For example, in 2020, Norway had the lowest number of liquidations, with only one in 40 companies being liquidated, while in Belgium and France, approximately one in 28 companies was closed down.

Comparing the dynamics of the DRE in Ukraine, it exhibited an unstable trend from 2013 to 2020. In 2020, the DRE in Ukraine stood at 10.2%, meaning that approximately 10 enterprises were liquidated, whereas in 2013, only about 15 enterprises were liquidated. In 2019, the DRE in Ukraine was considerably higher compared to the rates in other countries listed in Table 2. For instance, it is 1.96 times higher than in Austria, 3.5 times higher than in Belgium, and 1.24 times higher than in the Czech Republic. However, it is lower compared to countries such as: Estonia by 1.0098 times; Germany by 1.14 times; Iceland by 1.13 times; Lithuania by 1.76 times; Portugal by 1.32 times; Slovakia by 1.019 times.

By the number of employees, companies employing up to 9 people make up the largest share of the liquidated Ukrainian enterprises in a particular group (12.2% in 2012) (SSSU, 2019). It is noted that the larger the number of employees at the enterprises, the lower the DRE. Thus, according to the 2019 data, at enterprises employing from 10 to 49 people, the DRE was 1.8; similarly, for those with staff headcount from 50 to 249, it was 1; for those with 250 or more employees, it was 0.6. In other words, enterprises with more than 250 employees will have the DRE approximately 20.33 times lower compared to enterprises with fewer than 9 employees. Court statistics on the outcomes of bankruptcy (insolvency) cases in Ukraine are presented in Table 3.

Table 3. Court statistics on the outcomes of bankruptcy cases from 2014 to 2022

Indicators	*Year*								
	2014	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*
The number of cases that have been successfully implemented, including:	3324	2406	2101	1691	1368	1184	745	2210	1894
with the approval of the restructuring manager's report;	4	8	1	1	..	4	4	10	5
with the approval of the settlement agreement;	70	53	48	32	65	68	14	8	6
with approval of the liquidator's report;	2989	2159	1844	1546	1055	953	612	665	462
in connection with the fulfilment of all obligations to the creditor.	29	6	18	14	8	2	10	26	24

Source: Judicial statistics of the Supreme Court of Ukraine, 2023.

The number of cases that have been implemented in Ukraine is declining every year. Thus, in 2022, in comparison to 2014, they decreased by 43%, including 84.5% with the approval of the liquidator's report. Despite this trend, the number of cases completed with the approval of the restructuring report has shown instability, going from 4 cases in 2014 to 5 in 2020. In 2022, the number of cases completed with restructuring is 92.4 times fewer than liquidation and 77 times fewer than those approved with a settlement agreement. This trend can be attributed to the elimination of the institution (M. Draskovic et al., 2016) of a special amicable agreement as a judicial procedure with the entrance in force of the Code of

Ukraine on bankruptcy procedures in 2019. Therefore, it is likely that this statistical indicator will continue to stagnate in the future.

3.2 Analysis of profitability of the total and operating activities

Table 4 provides figures on profitability (loss) of operating and total activities of Ukrainian enterprises during the period of 2010-2021, in particular by their size (large, medium, small and micro businesses). Statistics as of 10.10.2023 for 2022 are not available in the SSSU.

Table 4. Profitability of the total and operating activities of Ukrainian enterprises by size from 2010 to 2021

Years	*The level of profitability (loss) of operating activities of enterprises*					*The level of profitability (loss) of all activities of enterprises*				
	total	*including*				*total*	*including*			
		large	*medium*	*small*	*micro*		*large*	*meduim*	*small*	*micro*
2010	4.0	3.9	5.0	1.8	-3.5	0.5	0.2	2.3	-5.7	-13.9
2011	5.9	6.2	6.0	4.2	0.8	1.8	3.3	1.2	-2.5	-8.0
2012	5.0	5.2	5.0	4.1	-0.1	1.0	0.9	2.2	-3.3	-10.2
2013	3.9	5.0	3.2	2.2	-2.3	-0.7	0.6	-0.1	-6.2	-16.1
2014	-4.1	0.7	-3.6	-17.9	-30.1	-14.2	-11.1	-12.5	-26.5	-40.2
2015	1.0	4.0	0.0	-4.2	-8.2	-7.3	-7.0	-5.0	-13.6	-20.4
2016	7.4	8.8	6.9	5.2	-0.4	0.6	2.4	0.7	-3.6	-11.7
2017	8.8	11.2	7.3	6.5	2.4	3.0	5.2	3.1	-2.0	-8.0
2018	8.1	9.1	7.0	8.3	4.7	4.5	5.2	4.6	2.7	–1.8
2019	10.2	10.3	10.0	10.7	9.3	7.6	6.8	8.6	7.0	3.3
2020	6.2	8.3	5.4	3.9	1.0	0.9	1.0	2.1	-1.8	-5.5
2021	12.6	17.1	7.6	15.0	12.0	10.1	12.8	7.3	11.1	7.4

Source: SSSU, 2022.

The information presented in Table 4 gives reasons to draw conclusions that from 2010 to 2021, the profitability of operating activities exhibited unstable dynamics of development. The highest level of return on operating activities (ROA) was recorded in 2021 at 12.6%, and the lowest in 2013 at 3.9%. In 2014, the ROA was -4.1%. Analyzing the level of DER by enterprise size, we can see that the highest level is in large enterprises, with a rate of 17.1% in 2021. Micro-enterprises had a 5.1 percentage points lower DER in 2021 than large enterprises and 0.6 percentage points lower than the average.

The ROA level is higher compared to the level of total profitability of enterprises (TPE). In general, the ROA level is 2.5 p.p. higher than the TPE level in 2021. Comparing the ROA in 2021 with the TPR by size, the following features can be observed. The ROA levels by size (large, medium, small, and micro enterprises) are higher than the TPR levels by 4.3 p.p., 0.3 p.p., 3.9 p.p., and 4.6 p.p. in 2021, respectively. It is important to note that during the period of 2010-2020, small enterprises and microenterprises had a predominantly negative TPE, except for 2019.

3.3 The impact of operating profitability on the number of bankruptcy cases that have been completed with the approval of the liquidator's report

To examine the impact of operating profitability on the number of successfully completed bankruptcy cases with the approval of the liquidator's report, a correlation and regression analysis was employed to establish regression equations (Formula 1) and summarize the results in Table 5.

Table 5. Data on the impact of operating profitability (x) on the number of bankruptcy cases that have been completed with the approval of the liquidator's report (Y)

Year	*x*	*Y*	*r*	*D*	*F*	*Ft*	*z*	*Se*	*C_95%*	*rL*	*rU*
2014	-4.1	2989	-0.86	0.74	4.11	2.45	-1.29	0.45	1.96	-0.97	-0.39
2015	1.0	2159									
2016	7.4	1844									
2017	8.8	1546									
2018	8.1	1055									
2019	10.2	953									
2020	6.2	612									
2021	12.6	665									

Source*:* compiled on the basis of Table 3 and Table 4 - SSSU, 2021; Judicial statistics of the Supreme Court of Ukraine, 2023

Based on the conducted correlation-regression analysis (using the data from Table 5), a correlation-regression equation was constructed:

$$Y = 2308.54 - 132.9x \quad (3)$$

The developed correlation-regression equation (Formula 2) is described by the following parameters: r = -0.86; D = 0.74; Fisher ratio (F = 4.11) exceeds the normative (tabular) value (Ft = 2.45), i.e., (F > Ft); z = -1.29; Se = 0.45; C_95% = 1.96; rL = -0.97; rU = -0.39.

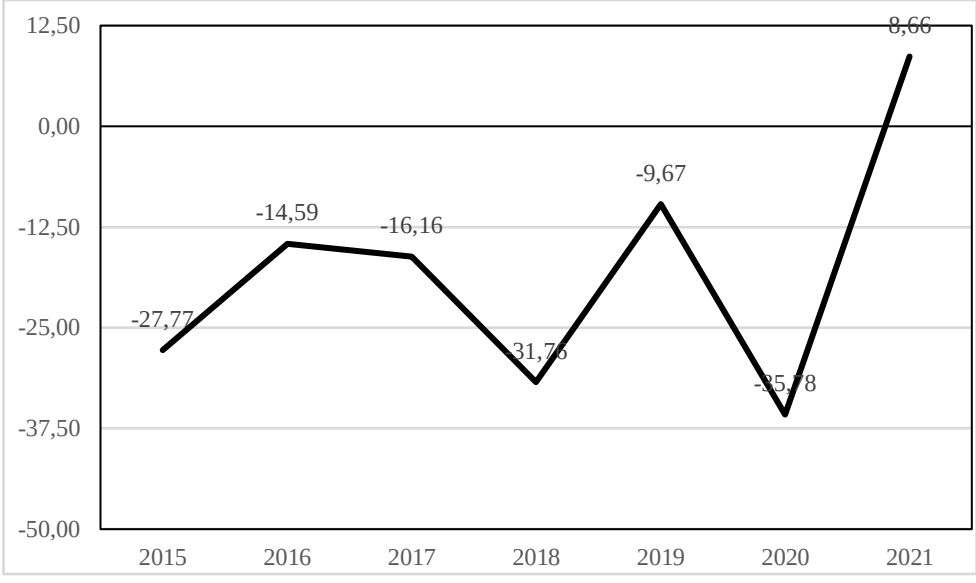

Figure 2. Decrease (increase) in the number of bankruptcy cases finalized with the liquidator's report (compared to the previous year), %

According to the correlation and regression equation (formula 2), operating activity of Ukrainian enterprises accounts for 74% of all factors affecting the number of bankruptcy cases completed with the

approval of the liquidator's report, with other factors constituting the remaining 26%. This equation demonstrates a negative and inversely proportional relationship. In other words, a 1% increase in operating profitability results in a decrease of 132.9 cases of bankruptcy finalized with the approval of the liquidator's report. The constructed correlation and regression equation allows us to predict the decrease in the number of bankruptcy cases completed with the approval of the liquidator's report. Figure 2 illustrates the calculation of the percentage by which the number of bankruptcy cases completed with the approval of the liquidator's report has decreased or increased compared to the previous year (data from Table 5).

Using the computed data on fluctuations (both increase and decrease) in the number of bankruptcy cases completed with approval from the liquidator's report compared to the previous year, as depicted in Figure 1, we determined an average value of -18.5% using the MS Excel software. Furthermore, we similarly established the average percentage growth in operating profitability for the period spanning 2014-2021, which equates to 6.03%. In a hypothetical scenario, we aim to project the extent to which the number of bankruptcy cases completed with the approval of the liquidator's report will decrease between 2023 and 2028. In 2023, we anticipate an increase in operating profitability at a rate mirroring the calculated average of 6.03%, taking into account the potential impacts of the COVID-19 pandemic and ongoing conflicts. Subsequently, our forecasts predict a subsequent 18.5% growth in operating profitability compared to the previous level. The forecasted data, based on the correlation and regression equation (Formula 2), is visualized in Figure 3.

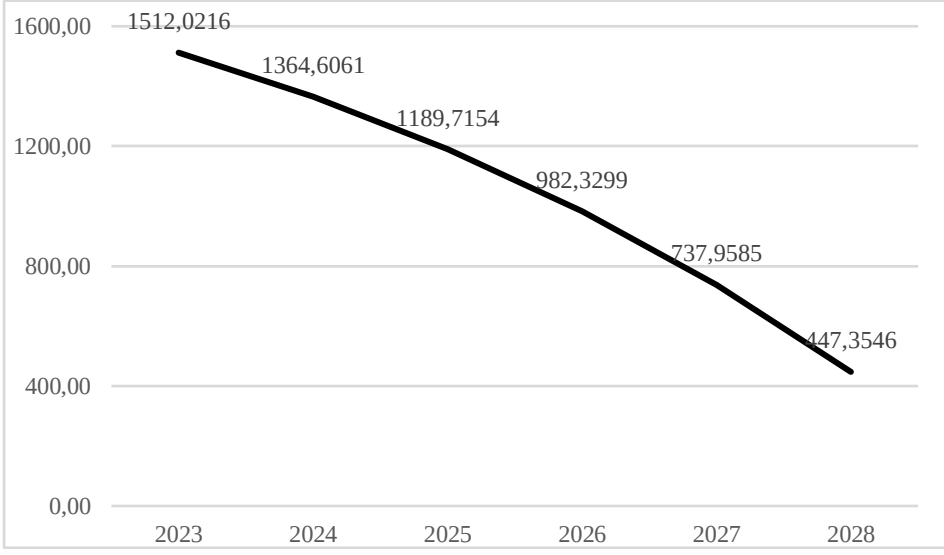

Figure 3. Forecast of the number of bankruptcy cases concluded with the approval of the liquidator's report for the period 2023-2028 (based on Formula 2)

The data show that at the operating profitability level of 6.03%, the number of bankruptcy cases completed with the approval of the liquidator's report will be 1512, and if the operating activity of Ukrainian enterprises grows to 14.09%, the number of bankruptcy cases completed with the approval of the liquidator's report will be 447.

4. DISCUSSION

The study showed that the situation in the field of business activity of companies in the vast majority of EU countries over the past few years has been unstable and worrying. This is evidenced by an increase in the Business registration and bankruptcy index (BRBI) in the vast majority of EU-27 countries compared to the corresponding value in 2015. The death rate of all enterprises (DRE) in the EU27 and Ukraine also has an unstable development trend. In Ukraine, almost every tenth enterprise out of the total number of enterprises is liquidated. In Ukraine, this value is about twice as high compared to such countries as

Austria, Belgium, France, and Norway. This circumstance demonstrates the necessity to return the institution of a special amicable agreement to the bankruptcy procedure in Ukraine. It is also possible to highlight the low efficiency of the rehabilitation procedures available in Ukraine – both the classic rehabilitation procedure in a bankruptcy case and the pre-bankruptcy rehabilitation. It is also worth noting the practical effectiveness of the triad of procedures in the French insolvency procedure, since providing the debtor with access to the judicial rehabilitation procedure before the moment of its insolvency, namely in the presence of its low liquidity, as can be seen from the statistical data, allows to "save the life" of the company.

Many factors influence the bankruptcy and liquidation of enterprises, with a particular emphasis on profitability and solvency indicators. Numerous studies have highlighted the significance of profitability and solvency alongside solvency and liquidity in contributing to financial difficulties, including bankruptcy and liquidation of companies (Lukason & Mifiano, 2019; Susanto et al., 2022; Poliakov & Zayukov, 2022, 2023; Aguiar-Díaz & Ruiz-Mallorquí, 2015; Biddle et al., 2020; Rachman, 2022; Agustia et al., 2020, and many others). The impact of profitability and solvency on the likelihood of bankruptcy has been extensively studied, highlighting that loss-making operations and negative or low profitability significantly increase the risk of bankruptcy and liquidation (Oktari et al., 2023; Wibowo & Susetyo, 2020; Putri & Sutrisno, 2023; Paramartha & Wiagustini, 2021; Kalbuana et al., 2022; Moch et al., 2019; Badirkhani, 2019; Kadarningsih et al., 2021; Alarussi & Alhaderi, 2018; Nuraini et al., 2021).

When assessing the likelihood of bankruptcy, various profitability indicators are considered, including return on assets (Paramartha & Wiagustini, 2021; Moch et al., 2019). However, the impact of operating profitability on the likelihood of bankruptcy has not been thoroughly investigated. Optimizing operating costs and increasing financial results from operational activities enable companies to generate sufficient net profit for maintaining regular operations (Kozlovskyi et al., 2019). This, in turn, reduces their reliance on borrowed capital, thus enhancing solvency and liquidity. Therefore, if operating costs are managed efficiently, operating profitability will be higher, and the risk of bankruptcy will be lower (Kadarningsih et al., 2021). This paper aims to examine the influence of operating profitability on the number of bankruptcy cases concluded with the liquidator's report approval.

Through calculations based on the statistical database (SSSU, 2022), a correlation and regression equation was formulated, enabling us to conclude that profitability of operating activity of Ukrainian enterprises accounts for 74% of all factors affecting the number of bankruptcy cases completed with the approval of the liquidator's report. The equation indicates that this influence is negative and inversely proportional. In other words, with a 1% increase in the profitability of operating activities, the number of bankruptcy cases completed with the approval of the liquidator's report is expected to decrease by 132.9 units. This constructed correlation and regression equation enables us to predict the decrease in the number of bankruptcy cases completed with the approval of the liquidator's report.

CONCLUSION

In line with the study's objective, the paper examines how the profitability of operational activities in Ukrainian enterprises affects the number of bankruptcy cases that are finalized with the approval of the liquidator's report. A negative correlation was found between the profitability of operating activities and the number of bankruptcy cases completed with the approval of the liquidator's report ($r = -0.86$; $D = 0.74$). This implies that in 74% of cases, operating activity of Ukrainian enterprises affects the number of bankruptcy cases completed with the approval of the liquidator's report; in the remaining 26% of cases, other factors dominate. The devised correlation and regression equation exhibits statistical reliability and adequacy to real economic processes, including a Fisher's coefficient ($F = 4.11$) exceeding the normative (tabular) value ($Ft = 2.45$), i.e., ($F > Ft$); $z = -1.29$; $Se = 0.45$; $C\_95\% = 1.96$; $rL = -0.97$; $rU = -0.39$.

The findings of the study will help Ukrainian enterprises to improve their management practices, particularly, to reduce the likelihood of their bankruptcy and liquidation. The devised correlation-regression equation enables the author to predict how the number of bankruptcy cases completed with the approval of the liquidator's report will change with fluctuations in the operating profitability of Ukrainian enterprises. If the level of operating profitability for Ukrainian enterprises remains at 6.03%, the number of bankruptcy cases completed with the approval of the liquidator's report is estimated to be 1512. With the growth of

operating activities of Ukrainian enterprises to 14.09%, the number of bankruptcy cases completed with the approval of the liquidator's report will be 447.

Thus, the level of profitability in the operating activities of Ukrainian enterprises is an objective factor that affects the completion of bankruptcy cases with the approval of the liquidator's report. The management's primary objective is to prioritize the optimization of operating expenses (including material costs, labor costs, social contributions, depreciation of non-current assets, and other expenses), financial and investment costs, and to increase revenues from the company's core, financial, and investment activities. This strategy will lead to an increase in net profit and profitability, particularly in operating activities.

A sufficient amount of net profit will reduce Ukrainian enterprises' dependence on borrowed capital, thereby improving their solvency and liquidity. Effective management of operating profitability will lower the risk of bankruptcy and liquidation of enterprises, specifically reducing the number of completed bankruptcy cases with the approval of the liquidator's report. Furthermore, it will facilitate an increase in the number of cases related to the rehabilitation procedure and settlement agreements.

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ELIT
Economic Laboratory Transition
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Montenegrin Journal of Economics

For citation:

Sembiyeva, L., Zhagyparova, A., Zhumadillayeva, A., Zholamanova, M., Bekbolsynova, A., Zhanabergenova, M. (2024), "Applying Advanced Artificial Intelligence to Predict the Green Bond Market in Kazakhstan: Fostering Sustainable Financial Instruments and Environmental Objectives", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 237-250.

Applying Advanced Artificial Intelligence to Predict the Green Bond Market in Kazakhstan: Fostering Sustainable Financial Instruments and Environmental Objectives

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ARTICLE INFO

Received May 20, 2023
Revised from June 20, 2023
Accepted July 20, 2023
Available online April 15, 2024

***JEL classification**: G10, G17, G20*

DOI: 10.14254/1800-5845/2024.20-2.19

***Keywords**:*

Artificial intelligence,
green bonds,
securities market & investing,
sustainable financial instruments.

ABSTRACT

This study focuses on the utilization of advanced artificial intelligence methodologies for predicting the trajectory of the green bond market in Kazakhstan. The research aims to facilitate the growth of sustainable financial instruments while actively contributing to the achievement of environmental objectives. By leveraging innovative AI techniques, the analysis seeks to provide accurate forecasts, thereby aiding the development and support of the green bond market. This initiative aligns with Kazakhstan's drive for sustainable development and environmental protection, reinforcing the use of green financial instruments, such as green bonds, supported by governmental initiatives. Active development of the green bond market in Kazakhstan and in the world, as well as increased interest in sustainable financial instruments make it relevant to study the possibilities of using artificial intelligence to analyze and forecast this market. The green bond market contains a large amount of data, including information on projects, environmental performance, rates and yields. The relevance of the study is that the use of deep artificial intelligence to forecast the green bond market in Kazakhstan may lead to the development of more accurate and efficient methods of analysis and forecasting, which in turn may contribute to the development of the market for green financial instruments and contribute to the achievement of environmental goals. Kazakhstan is actively developing a sustainable development policy, including environmental protection and carbon footprint reduction, so green financial instruments such as green

bonds are receiving government support. The purpose of the study is to analyze the use of deep artificial intelligence to forecast the green bond market in Kazakhstan.

INTRODUCTION

Deep artificial intelligence (hereinafter referred to as DAI) provides powerful tools for analyzing large volumes of data and identifying patterns. This can be particularly useful when analyzing the green bond market, given the diversity of environmental projects and conditions. GII is able to process and analyze data at a higher level, which can improve the accuracy of forecasts and reduce the risks of errors. The green and sustainable finance market in Kazakhstan is actively developing. The vast majority of existing market participants are just beginning to become interested in the topic of sustainable development, issuers are revising their goals to take into account sustainability goals, and investors are changing their focus towards responsible investing.

An ecosystem approach to financing aims to connect different ways of attracting green investments at the local, regional and national levels, along with government programs to improve environmental literacy of the population, develop entrepreneurial skills and the financial literacy of companies, especially small businesses. Issuers in Kazakhstan, including the government, local corporations and financial institutions, have begun actively issuing green bonds to finance projects related to ecology and sustainability. This may include projects in the areas of renewable energy, energy efficiency, waste management and other environmental initiatives.

Thus, the ecosystem approach is “green” and includes a whole set of institutions, strategies and tools that help attract investment and create favorable conditions for the growth of “green” businesses. Financial ecosystem for venture capital, “green” based on loans and bonds, crowdfunding, as well as various methods of government financial and non-financial support and incentives. Developing a market for green and sustainable financial instruments in Kazakhstan not only helps finance environmental projects, but also promotes social and economic responsibility and helps the country move towards sustainable development. In this regard, Kazakhstan is developing and implementing regulation and standards for green financial instruments and includes defining criteria and standards for green bonds and other products, as well as measures to improve transparency and reporting.

1. RESEARCH BACKGROUND

The financial sector has greatly impacted the monetary well-being of consumers, traders and financial institutions. In the current era, artificial intelligence is redefining the boundaries of financial markets based on modern machine learning and deep learning algorithms. These methods are widely used for forecasting prices of financial instruments, analyzing market trends, identifying investment opportunities, optimizing portfolios, etc. The functioning of a country's financial market is a critical factor in determining its overall economic health, allowing economists and financial experts to assess the country's current economic condition. Among the various financial markets, the stock market stands out as a key driving force.

The rise of artificial intelligence (AI) as a technology to promote economic growth and social empowerment has prompted researchers to systematically study current problems and report on related opportunities (Duan and Edwards, 2019; Kopka, 2022; Wach et al., 2023). Modern AI research is focused on shaping our daily lives, solving complex social problems and countering environmental challenges to protect the global ecosystem and sustainability (Baabdullah et al., 2022; Dubey et al., 2019; Dwivedi et al., 2021; Wamba et al., 2021). The diversity and scope of the AI literature confirms the multidisciplinary and interdisciplinary nature of research, which covers various aspects related to the quality of organizational decision making (Li et al., 2022), customer purchasing decisions (Giza & Wilk, 2021; Yeo et al., 2022), personalization products and services (Micu et al., 2022), public sector (Di Vaio et al., 2022) and many others.

Data-driven decision making requires processing large volumes of complex data, and methods based on artificial intelligence and machine learning can provide critical information to businesses in an efficient and flexible way. There are a significant number of review articles on stock price forecasting and forecasting (Polamuri et al., 2019; Deepak et al., 2021; Payal et al., 2022) caused by the fact that due to the boom of artificial intelligence and machine learning, the frequency of publications has increased significantly. Intelligent decision support systems, specifically those focusing on the role of intelligent software agents in data analysis within knowledge-based systems are debated in the paper of Popîrlan and Stefănescu (2011). Exploiting advanced technology, these intelligent software agents offer significant support by processing and analyzing complex data, providing insights, and facilitating informed decision-making useful for transactions managers.

Hazar and Babuşcu in their paper highlights the substantial influence of FinTech across diverse sectors, showcasing how these advancements streamline transactions, boost accessibility, promote financial inclusion, fortify security measures, and enhance overall efficiency within financial activities. The conclusion emphasizes the considerable potential and ongoing development of fintech, underscoring the necessity for deeper exploration and integration to maximize their advantages while addressing potential challenges in their adoption. Stock market forecasting is a regression use case since stock prices are continuous (Seethalakshmi, 2018). Most researchers tend to solve the problem of price forecasting or stock value series forecasting. It is also important to know the movement of stock prices. Therefore, it is necessary to explore the use of modern deep learning and machine learning algorithms to predict and classify stock and bond trends. Analyzing stock and bond price movements using modern deep learning and machine learning algorithms is an important tool for investors, traders and financial analysts. Here are the benefits and opportunities these methods provide:

- Price forecasting. Machine learning and deep learning techniques can be used to create models that can predict the future movements of stock and bond prices. This can help investors make more informed decisions about buying, selling or holding securities.
- Trend analysis. Machine learning algorithms can analyze large volumes of historical data and identify trends and patterns in price movements. This allows you to identify investment opportunities based on current market trends.
- Risk management. Machine learning methods can be used to assess the risk of an investment. Data analytics and risk modeling enable investors to make more informed decisions about portfolio diversification and risk management.
- Classification of assets. Machine learning models can classify assets based on various characteristics, which helps investors determine which assets are suitable for their investment goals.
- Trading strategies. Deep learning algorithms can be used to develop trading strategies, including arbitrage, high-frequency trading, and automated trading systems.
- Forecasting profitability and coupon yield. Machine learning can help estimate future stock and bond returns, as well as bond coupon yields.
- Event analysis. Machine learning methods can analyze news and event data to identify the impact of news on stock and bond prices.
- Improving the efficiency of decision making. Automating data analysis and forecasting helps increase decision-making efficiency and reduce human error.

However, it is important to understand that financial instrument markets can be subject to high volatility and sudden changes, and forecasts may not be reliable. Therefore, decisions based on analysis using machine learning, deep learning or deep artificial intelligence must be complemented by expert analysis and consideration of fundamental factors. The use of artificial intelligence (AI) in green bond forecasting can provide valuable tools for investors, issuers and regulators, improving the transparency and efficiency of the green financial instruments market. The use of AI can help improve the transparency of the green bond market and improve the reporting of environmental and sustainable projects, which is important for investors and regulators.

Green bonds are bonds whose proceeds are used to finance or refinance (in whole or in part) new and/or existing green projects and which comply with one or more green finance standards (Green Bond

Principles (GBP) of the International Capital Market Association (ICMA), Climate Bonds Standard (CBS), Climate Bonds Initiative (CBI). The starting point in the development of the green bond market is considered to be 2007, when for the first time the European Investment Bank issued green bonds in the amount of 600 million euros to finance projects in the field of renewable energy sources. The impetus for the creation of the market was a request from institutional investors - pension funds in the Scandinavian countries for a more informed approach to investing, the need to integrate ESG criteria and principles of sustainable development into the investment decision-making process. An obvious advantage of green bonds for society as a whole is support for the implementation of environmental/climate-related projects - the green bond instrument is attractive to both issuers and investors for a number of reasons (Table 1).

Table 1. Positive aspects of green bonds

for issuers	*for investors*
Strengthening the organization's reputation as an environmentally responsible business, demonstrating commitment to the principles of sustainable development	The ability to finance environmental projects with a transparent and traceable use of funds and achieve your ESG goals
Opportunity to diversify the investor base by attracting a new type of responsible investor with a green investment mandate and focus on sustainable responsible investing	Strengthening the investor's reputation as an environmentally responsible organization investing in sustainable development projects
Potentially lower acquisition costs in international markets due to the greenium discount	Investors' consideration of sustainable development factors when making investment decisions is an additional tool for timely identification of possible investment risks in the long term

Source: Compiled by the authors

2. DATA AND RESULTS

Exploring the possibilities of using deep artificial intelligence (hereinafter - AI) in forecasting the green bond market in Kazakhstan is an important and relevant task in today's world, where sustainable development and environmental sustainability play an increasingly important role. In this context, such research may include the following aspects (Figure 1).

Exploring the potential use of deep AI in forecasting the green bond market in Kazakhstan represents an important step towards sustainable development and efficient use of financial resources in the country. Such research can contribute to more accurate and informed decision-making both at the level of the government and at the level of private investors and financial organizations.

The green bond market is a financial market in which companies, authorities and other organizations issue bonds or other financial instruments to raise funds to be used for projects and initiatives that have a positive environmental and social impact. The main purpose of green bonds is to finance projects aimed at sustainable development, reducing environmental impact and improving social responsibility (Table 2).

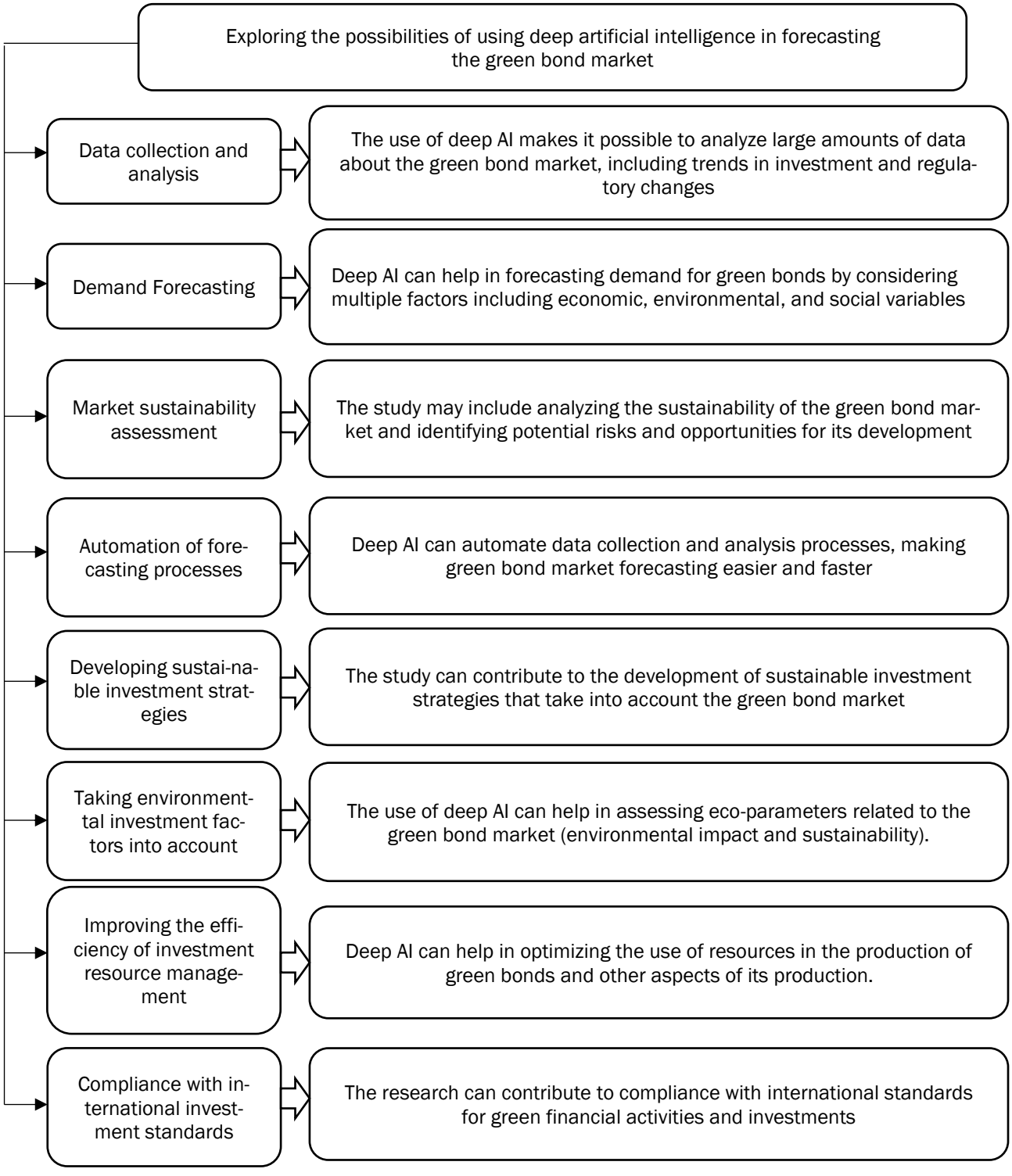

Figure 1. Exploring the use of deep artificial intelligence in green bond market forecasting

Source: Compiled by the authors

Table 2. Main characteristics of the green bond market

№	*Indicator*	*Main characteristics*
1	Environmental and social projects	Green bonds are designed to finance projects related to environmental sustainability, such as renewable energy deployment, greenhouse gas emission reductions, energy efficiency improvements and other projects with positive environmental and social impacts.
2	Strict standards	In order for a financial instrument to be considered "green," it must meet certain environmental and social standards set by international organizations or regulatory bodies. This ensures transparency and investor confidence
3	Investors with sustainable values	Investors who purchase green bonds typically have sustainable values and an interest in sustainable development. They are ready to support projects that improve the environment
4	Information transparency	Green bond issuers are required to provide information on how funds raised through green financial instruments are used and assess their impact
5	Development of regulation	Many countries are introducing green market regulation to ensure standards and protect investor interests

Source: Compiled by the authors

Green bonds allow companies and organizations to raise investment for projects that contribute to a more sustainable and environmentally friendly future. This tool is becoming increasingly popular around the world as more companies and investors commit to sustainable development. Issuing green bonds must meet four key elements (Figure 2).

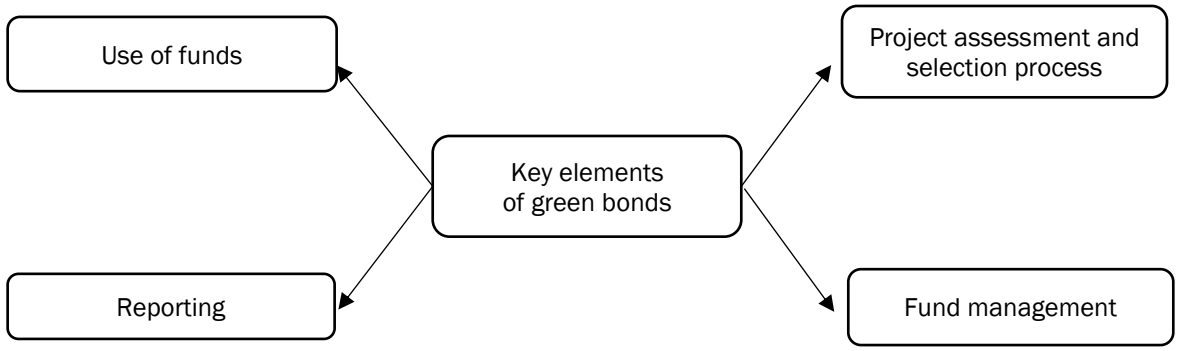

Figure 2. Main elements of green bonds

Source: Compiled by the authors

According to Figure 2, the main elements of green bonds include:

- Use of funds - the issuer must use proceeds from the placement of bonds for the implementation of environmental projects, which must be properly described in the documentation for the issue of securities.
- Project assessment and selection process - the issuer must clearly communicate its environmental sustainability goals to investors. Next, he needs to go through a procedure that will determine whether the projects qualify as green projects. Projects will also be assessed against other eligibility criteria and may be subject to additional procedures for final selection.
- Fund management - proceeds from green bonds must be credited to a special account or separately accounted for by the issuer.
- Reporting - providing up-to-date information on the use of funds, which is subject to annual updating until the funds are fully utilized and timely updating in case of significant changes.

Before issuance, the issuer prepares a Green Bond Policy in accordance with the main elements of green bonds. For a successful issue, issuers are recommended to engage an external consultant who will

help them properly prepare for an independent external assessment and complete all documentation (Doszhan, 2022). The issuance of green securities in Kazakhstan began in 2021, and the country entered the global system as an accredited member and promising partner of the global green bond market. The main result is the identification of current global trends in the development of green finance in Kazakhstan.

Green bonds are another debt instrument first implemented in Kazakhstan with the support of UNDP. Damu Fund issued its debut green bonds with the support of UNDP and the AIFC Green Finance Center (GFC) on August 11, 2020 at the Astana International Financial Center, for which it was awarded the international award "Pioneer of the Green Market" (Climate Bonds Award 2021). Over three years, sustainable development bonds worth 139.7 billion tenge have been registered on KASE, of which 85.8 billion tenge have been placed, which is less than 1% of corporate debt traded on the exchange. For comparison: the same global figure tends to 10%. To date, out of 11 ESG bonds registered on the Kazakhstan Stock Exchange, ten have been placed. Nine of them were successful, one placement did not take place.

The debut issues of ESG bonds on KASE from the Asian Development Bank (it now accounts for more than half of all sustainable bonds on the exchange) took place in November 2020. With the first issue, the issuer raised 3.9 billion tenge. The total demand for securities was represented by seven active applications, while the order book was oversubscribed almost 3 times: the total demand for subscription reached almost 11 billion tenge, which amounted to 283% of the supply volume. At the same time, another issue of ADB bonds was placed, already for 10.1 billion tenge. There were 12 active applications, seven of which were satisfied. The total demand for subscription reached 179.5% of the supply volume. Proceeds from ADB's green bond issue were used to finance two solar power plant projects in southern Kazakhstan.

In September 2021, the fourth placement of ESG bonds took place on KASE. This time from the Damu FRP. The fund raised KZT 1 billion through its debut five-year social bond issue to finance small and medium-sized businesses from the hardest-hit sectors of the economy during the COVID-19 pandemic. The securities were in slightly less demand than previous sustainable bond issues: demand for the issue was 150%, with five active participants. The coupon rate was 2.4% higher than the base rate at the time of placement. On February 21st , 2022, the Kazakhstan Stock Exchange held an initial placement of the next social bonds of the Asian Development Bank. The coupon rate on ADB bonds was 11%. Eight active bids took part in the auction; demand to supply was 140%. On February 24th , 2022, the regulator makes an extraordinary decision to increase the base rate to 13.5%, due to "the need to maintain price stability against the backdrop of a worsening geopolitical situation." The ESG bond market is freezing for a while, with no new placements taking place.

In September 2022, the Development Bank of Kazakhstan registered the issue of green bonds on the local market in the amount of 15 billion tenge, but there were no placements of securities - the bank is waiting for favorable conditions in the market. On October 20th 2022, trading in green bonds of the Asian Development Bank for 3.4 billion tenge took place. The yield on securities was at the level of the base rate of the National Bank of the Republic of Kazakhstan. This issue was the least popular among other ADB sustainable bond issues on KASE. Demand to supply was 100%; only one KASE member took part in the trades. For comparison: for two "volatile" bonds of the issuer in the second half of 2022, the demand for supply was 140 and 200%, respectively (Figure 3).

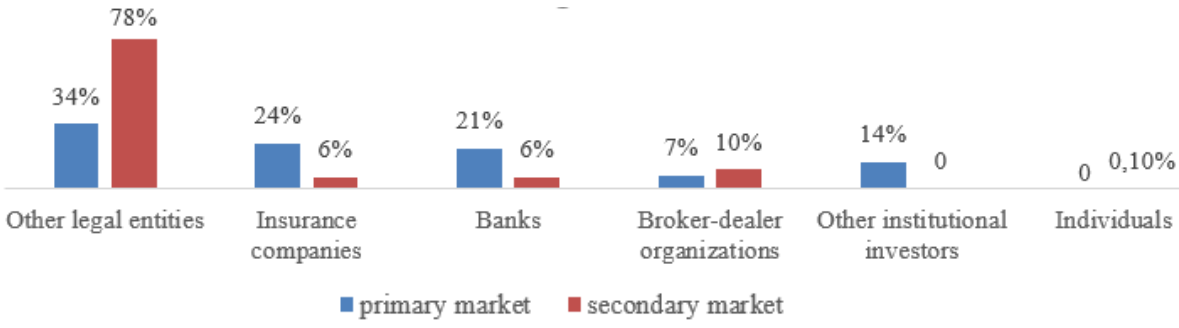

Figure 3. Purchasing ESG bonds

Source: Compiled by the authors according to https://kz.kursiv.media/

A particular ESG category is assigned to bonds based on the “open architecture” principle, when the issuer confirms compliance with one of the international ESG standards recognized by the Exchange. This structure gives issuers the flexibility to choose the most appropriate ESG standard to finance their sustainability projects. The ESG category assigned to bonds will reflect the relevant ESG standard and may include social, sustainability, blue bonds, transition bonds and other sustainability-linked bonds. The purpose of placing such green bonds is to provide loans to Kazakh enterprises implementing renewable energy projects. This is an area that is actively developing throughout the world, and “green” finance will show its effectiveness in Kazakhstan in the near future.

At the beginning of December 2022, the National Bank raises the rate to a record 16.75% since 2016 against the background of historically maximum inflation expectations. At the same time, a new instrument appears on the sustainable bond market - 15-year bonds with a floating coupon rate tied to the TONIA indicator, with a fixed margin of 3% from the national electric grid operator KEGOC. This was the first ESG placement not of a development institute, but of a company. The securities were registered within the second KEGOC bond program back in July 2021, and subsequently the bonds were reclassified as green (Figure 4).

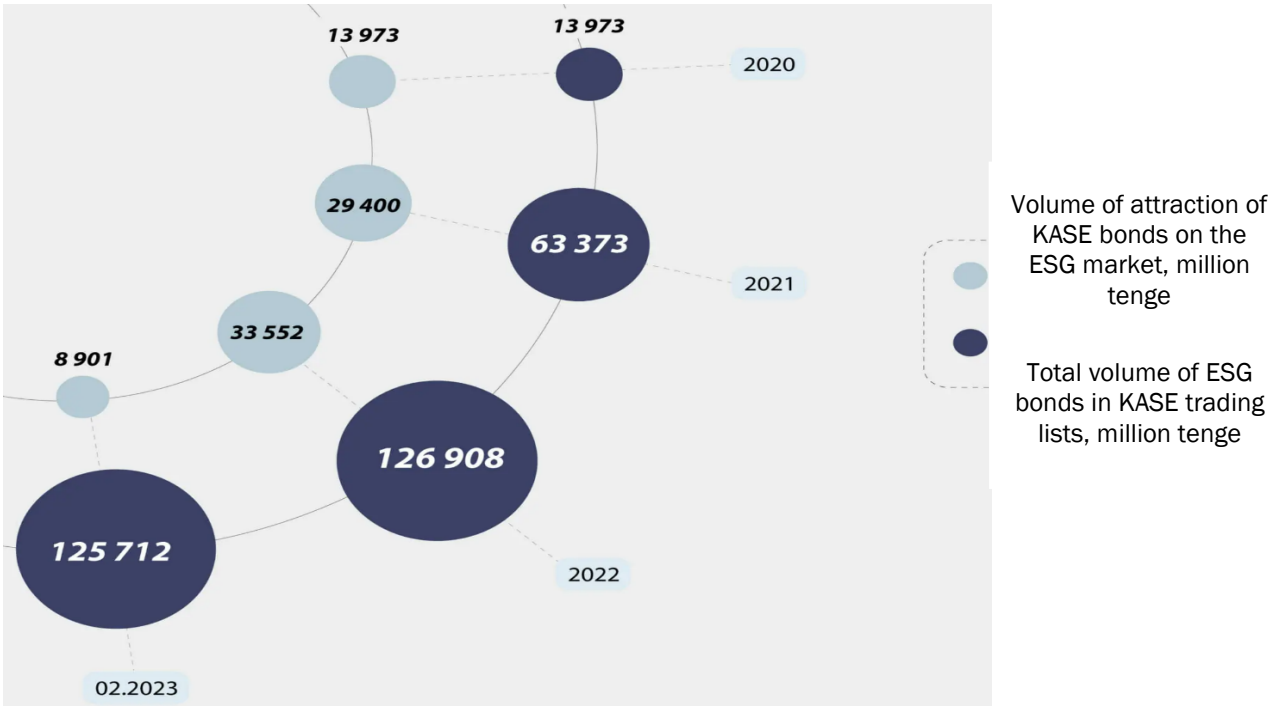

Figure 4. Green bond market in the Republic of Kazakhstan, million tenge

Source: Compiled by the authors according to https://kz.kursiv.media/

Financial institutions and private businesses are showing significant interest in green financial instruments. The green bond market is experiencing an excess of demand over supply. Figure 5 shows the dynamics of green finance indicators in Kazakhstan.

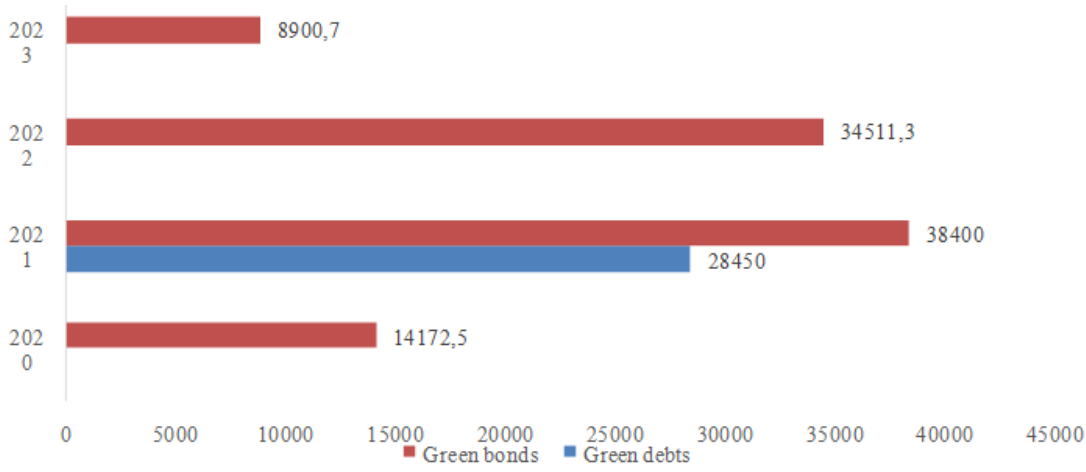

Figure 5. Volumes of green financing in Kazakhstan

Source: https://kase.kz/files/reports/KASE_meeting_2021_rus.pdf

Demand to offer for green bonds amounted to 70.2%, two active bids participated in the auction. The initially announced placement volume for the issue amounted to 23 billion tenge, 16.1 billion tenge was raised. The funds are aimed at implementing two projects related to the construction of the necessary network infrastructure (construction of a solar power plant; projects in the field of energy efficiency and development of renewable energy sources, which have ESG and SDG elements) are also being implemented (Figure 6).

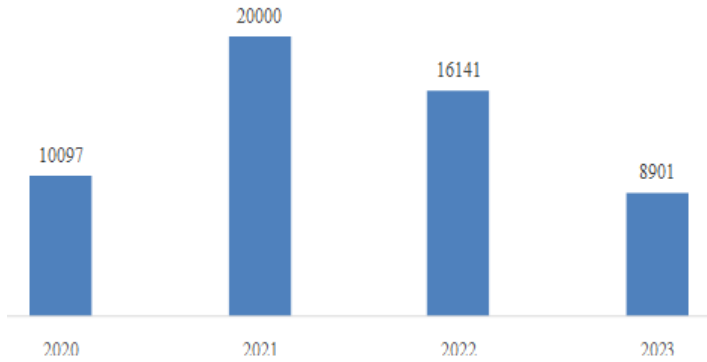

Figure 6. ESG bonds on KASE, million tenge

Source: https://kase.kz/files/reports/KASE_meeting_2021_rus.pdf

The dynamics of the global ESG bond market in 2023 will depend on the depth of the recession in a number of developed countries and interest rates of central banks, ACRA notes. According to Crédit Agricole CIB ESG FixedIncome Research, global sustainable bond issuance could rise by 30% this year compared to last year. At the same time, new instruments and Asian markets may become drivers for the market. If we conduct a comparative analysis of the state of the green bond market in the world based on two parameters Climate Bonds Initiative Green Bond Database (GBDB), Social and Sustainability Bond Database (CBDB), we will see that Kazakhstan's share in the ESG sector is very small, as shown in Figure 7.

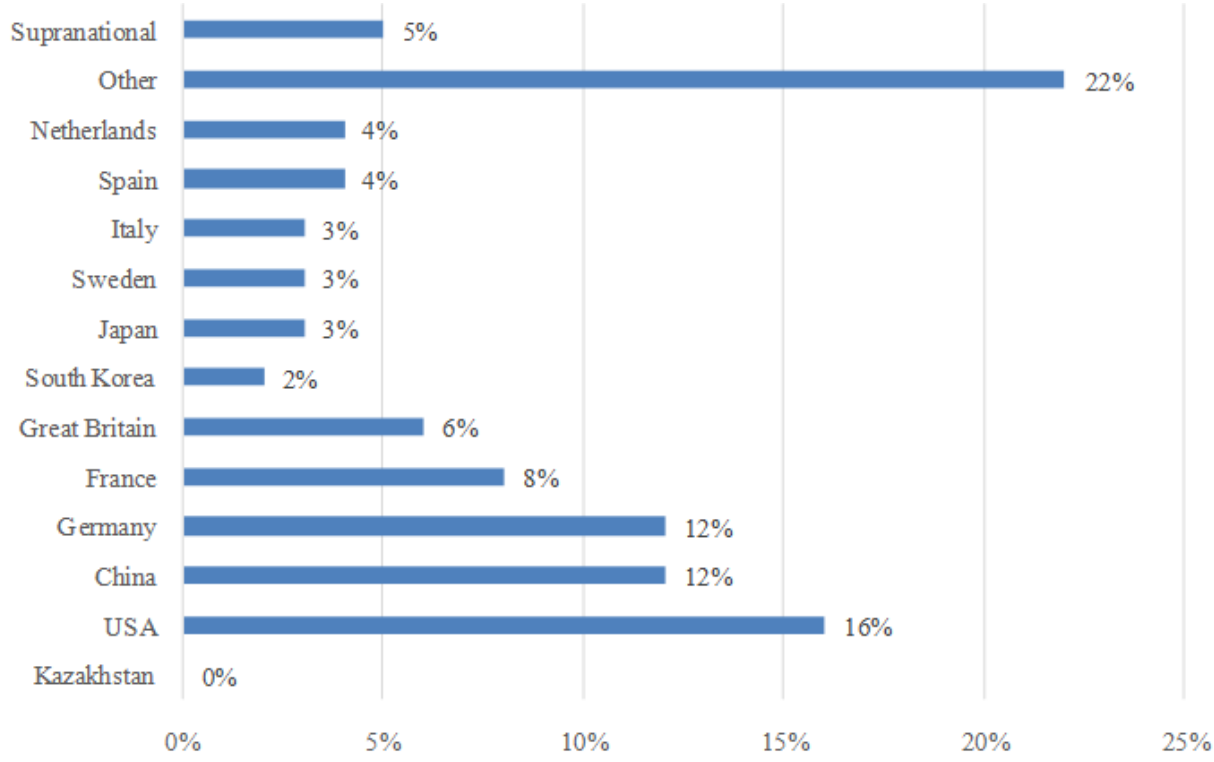

Figure 7. Annual green bond issuance volume in 2021

Source: https://www.climatebonds.net/resources/2022?field_report_type_tid=1154&field_report_language_tid=590

In 2021, the volume of placements amounted to 578.4 billion dollars, at the end of the first half of 2022 - 211 billion dollars. As of the end of the first half of 2022, the cumulative volume of green bonds issued since 2014 in the world exceeded 1.8 trillion US dollars (Figure 8).

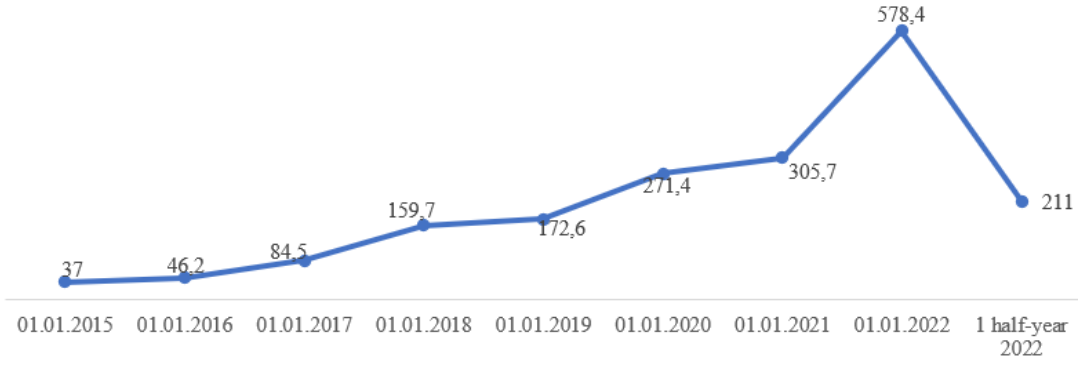

Figure 8. Volume of green bond issues in the world, billion dollars

Source: https://bondguide.moex.com/

3. APPLICATION FUNCTIONALITY

In foreign financial markets, the driver for the development of green financial instruments, as a rule, is increased demand for them from investors. Preference for green issues over similar non-green issues results in a greenium discount. In Kazakhstan, the green finance market is only at the initial stage; the

prospects for the emergence of a stable greenium depend on the subsequent actions of government authorities and other participants in this financial market. Table 3 provides information on green loans in Kazakhstan. In September 2021, the Eurasian Development Bank approved the first green loan in Kazakhstan with the full support of the CSF, within the framework of which internal documents of Batys Transit JSC were developed, including a policy in the field of green financing. The funds raised under the signed loan agreement were used by the borrower to finance the project "Construction and operation of street lighting networks in Atyrau (Environmental Code).

Table 3. Green loans in Kazakhstan

Issuer/ creditor	*Category*	*Volume, thousand tenge*	*Release date*	*Green loan recipient*	*Target*
Halyk Bank	Green loan	7900000	30.11.21	JSC "Kaz Green" Energy"	Construction of a 5 MW power plant in Karaganda region, Zhezkazgan
Development Bank Kazakhstan	Green loan	16950000	22.11.21-22.11.35		-
Eurasian Development Bank	Green loan	3600000	20.09.21	OJSC Batys Transit"	Construction and operation of street lighting networks in Atyrau

Source: https://gfc.aifc.kz/ru/

The adopted Environmental Code of the Republic of Kazakhstan, which came into force on July 1, 2021, introduces a taxonomy of green projects, provides a legislative definition of green financing, and specific tools for economic stimulation of activities aimed at environmental protection (Law of the Republic of Kazakhstan, "On the securities market"). In December 2021, a taxonomy of green projects to be financed through green bonds and loans was adopted. The taxonomy provides clear definitions of the types and technologies of green projects so that all market participants (banks, funds, investors, supervisors, users) have the same basis for defining their tasks, programs and financial products, for example the conditions for issuing green loans. In accordance with the Law of the Republic of Kazakhstan "On the Securities Market", the bond market in 2022 saw a record number of concluded transactions - 18,481, with a continuing downward trend in the average volume of one transaction. The average daily trading volume amounted to 10.2 billion tenge (on the secondary market - 4.1 billion tenge), the average daily number of transactions - 75 (on the secondary market - 67), the average volume of one transaction - 134.7 million tenge (on the secondary market - 60.4 million tenge (Table 4).

Table 4. Main indicators of trading on the bond market

Indicator	*2018*	*2019*	*2020*	*2021*	*2022*
Trading volume, billion tenge, incl.	2309,4	2715,6	2691,2	1980,8	2488,8
– primary market	1858,2	1953,7	2239,4	1143,7	1492,2
– secondary market	451,2	761,9	451,8	837,0	996,7
Number of transactions, pcs.	2203	2704	3203	8839	18481
– primary market	137	363	1033	980	1978
– secondary market	2066	2341	2170	7859	16503
Average number of transactions per day, pcs.	9	11	13	36	75
Average volume of one transaction, million tenge	1048,3	1004,3	840,2	224,1	134,7

Source: https://kase.kz/

In the context of the main categories of investors in the primary corporate bond market, the share of banks was 27.0%, broker-dealer organizations – 2.9%, other institutional investors – 11.1%, other legal entities – 58.1%, individuals – 0 ,8 %. The share of participation of non-residents was 3.5%. Let's consider the forecast values of trading volume on the bond market of the Republic of Kazakhstan, including green bonds for 2023-2026 (Figure 8).

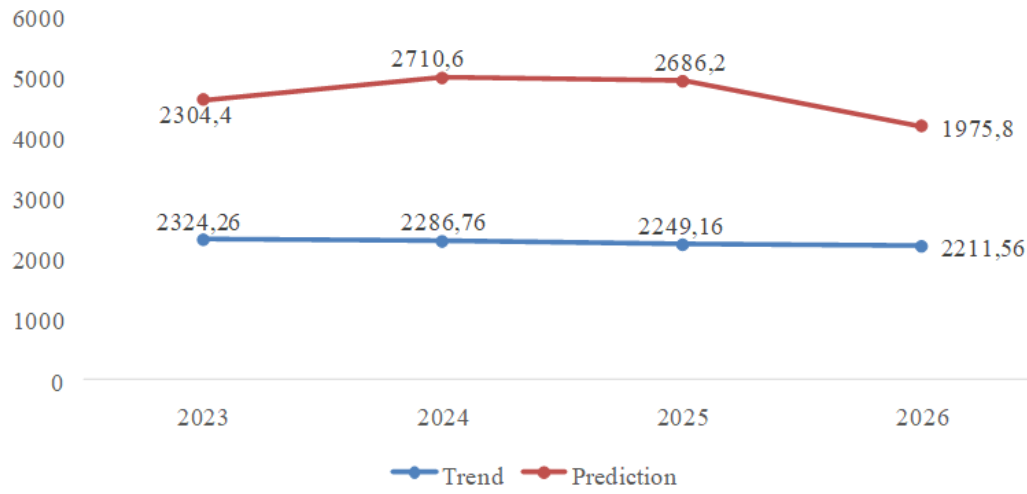

Figure 9. Forecast values of trading volume on the bond market of the Republic of Kazakhstan, including green bonds, billion tenge

Source: Compiled by the authors

The results of the regression analysis are presented in Table 5. To stimulate the growth of the bond market, including green bonds, it is important to develop transparent and attractive investment terms, actively communicate the benefits to investors and support issuers implementing green projects. Developing a green bond market may also require collaboration with international investors and financial institutions.

Table 5. Regression analysis results

CONCLUSION								
Regression statistics								
Multiple R	0,1956533							
R-squared	0,0382802							
Normalized R-squaredт	-0,2822931							
Standard error	344,08396							
Observations	5							
Analysis ofvariance								
	df	*SS*	*MS*	*F*	*Significanceof F*			
Regression	1	14137,6	14137,6	0,119412	0,752485			
Residual	3	355181,3	118393,7707					
Total	4	369318,9						
	Coef ficients	*Standard error*	*t-statistic*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Y-section	78389,16	219794	0,356648259	0,744965	-621094	777871,9	-621094	777871,9
Variable X 1	-37,6	108,8089	-0,345559963	0,752485	-383,878	308,6785	-383,878	308,6785

Source: own

The slight increase in forecast trading volumes on the bond market, including green bonds, may be due to several factors:

- Lack of investor awareness and awareness - Investors may not be sufficiently aware of the benefits of green bonds, and therefore may not show sufficient interest in this instrument.
- Lack of regulatory incentives - in some cases, insufficient development of green regulation and government incentives can slow down the development of the green bond market. Effective regulation and tax incentives can help attract investors.
- Lack of supply of green bonds - if issuers (corporations, government, etc.) do not offer enough green bonds to the market, this can limit trading growth. It is important that issuers actively implement green projects and issue bonds to finance them.
- Global economic and financial conditions, such as changes in interest rates, global financial crises or geopolitical events, may influence investors' decision to participate in the bond market.
- Economic instabilities in a country or region may reduce investor interest in long-term investments, including bonds.
- Corporate and banking problems - problems with borrowers (corporations or banks) issuing bonds can impair creditworthiness and, as a result, investor interest.
- Competition with other financial instruments - investors may prefer other financial instruments, such as shares or deposits, instead of bonds, especially if they expect higher returns.

CONCLUSION

The use of advanced technologies and artificial intelligence (AI) to predict the green bond market in Kazakhstan can play an important role in promoting sustainable financial instruments and environmental goals. Artificial intelligence can be used to process and analyze a variety of data on the state of the environment, environmental trends and climate change, allowing to assess the impact of environmental factors on the green bond market and predict potential risks and opportunities.

The effective use of artificial intelligence to predict the green bond market helps attract investment in environmentally significant projects, promotes sustainable development and contributes to the achievement of Kazakhstan's environmental goals, thereby enabling investors to invest financial resources in promising green bond investment projects.

The development of the green bond market with the use of artificial intelligence contributes to sustainable development, providing a balance between financial gain and environmental care.In general, the effective use of artificial intelligence in forecasting the green bond market provides a strategic opportunity for Kazakhstan to achieve its environmental goals and attract investment in projects that promote sustainable development.

ACKNOWLEDGMENTS

This research has been funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19677311)

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ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Dan, T.B., Thach, N.N. (2024), "Which Solow Model – Homogeneous Technology-, Heterogeneous Technology-, or Human Capital-Augmented – Best Explains OECD Growth? Fresh Evidence from Bayesian Monte Carlo Simulations", *Montenegrin Journal of Economics*, Vol. 20, No. 2, pp. 251-265.

Which Solow Model – Homogeneous Technology-, Heterogeneous Technology-, or Human Capital-Augmented – Best Explains OECD Growth? Fresh Evidence from Bayesian Monte Carlo Simulations

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ARTICLE INFO

Received October 25, 2023
Revised from November 24, 2023
Accepted december 24, 2023
Available online April 15, 2024

JEL classification: C11, E22, O47

DOI: 10.14254/1800-5845/2024.20-2.20

Keywords:

MCMC simulations,
canonical Solow model,
augmented Solow model,
homogeneous technology,
heterogeneous technology,
multicollinearity,
OECD.

ABSTRACT

The Solow growth model significantly impacts growth econometrics. However, its primary issue arises when applied to OECD samples. While incorporating human capital accumulation improves the model's goodness-of-fit, it remains low for this subset. Furthermore, augmenting the model with various technology variables leads to different results. In light of doubts regarding multicollinearity within the frequentist framework, this study aims to determine which modified model specification well explores the OECD growth pattern. By employing Monte Carlo simulation within the Bayesian panel non-linear framework, our findings suggest that the human capital-augmented Solow growth model with homogeneous technology best elucidates economic growth in OECD countries, aligning with the productivity convergence hypothesis.

INTRODUCTION

Understanding economic growth, one of the oldest and most significant research agendas, is crucial for the well-being of future generations. That is why growth economists endeavor to explain the process of economic growth and cross-country differences in average income. The most basic but popular growth model, Solow model (Solow, 1956), representative of the first period of modern growth theory, posits that economic growth through physical capital accumulation is constrained by diminishing returns over time, leading to a steady state. At the steady state, per capita income increases at the speed of exogenous technical progress. The main critique of the Solow model is its low explanatory power for the set of OECD countries, where the capital share in income is high (MRW, 1992). Many subsequent studies have attempt-

ted to enhance the canonical Solow model by incorporating various explanatory variables (MRW, 1992; Knowles and Owen, 1995; Park and Prat, 1996; Felipe and McCombie, 2005; Abu-Qarn, 2019). MRW (1992) introduced human capital as an independent predictor in the model, while others augmented it with technology variables (Islam, 1995; Nonneman and Vanhoudt, 1996; Lee et al., 1997; Felipe and McCombie, 2005; Abu-Qarn, 2019).

Nevertheless, including new independent variables in the frequentist analyses poses challenges due to highly correlated predictors. The intricate relationship between fixed investment and technology is influenced by various factors such as positive correlation and reverse causality (Lucas, 1988; Romer, 1990; MRW, 1992; Islam, 1995; Jones, 1995; Acemoglu, 2008; Jing Liu et al., 2022). Physical investments enhance the adoption of new technologies and innovations, resulting in faster technology advancement. On the other hand, higher technology growth can prompt increased investment as firms seek to remain competitive by adopting the latest technologies. Similarly, the relationship between human capital, savings, and population is complex (MRW, 1992)—more savings or lower population growth causes higher human capital via more significant income. Hence, including all these independent variables in a single growth model can potentially cause multicollinearity, leading to severe statistical issues (Jaya et al., 2019; Pesaran and Smith, 2019). Multicollinearity makes it difficult or even impossible to isolate the independent impacts of the predictors on the dependent variable. Furthermore, the coefficient estimates of correlated variables become biased and difficult to interpret accurately, while the standard errors can be inflated, potentially leading to misleading statistical significance tests.

To mitigate multicollinearity, one approach is to use ordinary techniques such as variable selection or dimension reduction methods to eliminate one of the correlated variables. Alternatively, if the theoretical importance of all the independent variables is significant and one wishes to include them in the model, Bayesian methods that can handle multicollinearity effectively need to be explored. Bayesian methods offer some advantages in dealing with multicollinearity compared to traditional frequentist methods (Block et al., 2011; Jaya et al., 2019; Pesaran and Smith, 2019). Bayesian methods provide a more flexible and principled framework for modeling complicated relationships among variables. Here are some ways the Bayesian approach can help overcome multicollinearity issues:

(i) Prior specification: In Bayesian analysis, one can include informative priors that express our beliefs about the relationships between variables before observing the data. One can guide the model towards plausible parameter estimates by incorporating specific prior knowledge, even when multicollinearity is present. Informative priors can help stabilize the estimation process and provide more realistic parameter estimates.

(ii) Sampling-based estimation: Bayesian inferences rely on Markov Chain Monte Carlo (MCMC) techniques to obtain the posterior distribution of parameters. These techniques allow for efficient sampling from the joint posterior distribution, which can be helpful when dealing with multicollinearity, especially in high-dimensional settings.

(iii) Prioritizing parameter uncertainty: Bayesian inference naturally provides a posterior distribution for each parameter, including variance and covariance estimates. This means that instead of point estimates, one gets a range of likely values, which helps understand the uncertainty around the parameter estimates, mainly when multicollinearity is present.

(iv) Non-linear models: Bayesian methods are more amenable to handling non-linear relationships between variables. When multicollinearity arises due to interactions between variables, Bayesian modeling can easily incorporate these non-linear effects, allowing for a more flexible representation of the underlying relationships.

With all the above arguments in mind, the research focuses on determining which of the following models – the canonical or human capital-augmented Solow models augmented by homogeneous and heterogeneous technology – best accounts for income disparity across OECD countries. A Bayesian non-linear framework through MCMC simulations is applied to an OECD panel to achieve this goal. The assumption of fixed technological progress, depreciation rates, and country-specific rates for these variables will be incorporated into the canonical and augmented Solow models. Our research contributes to the growth area in the following ways: first, the adoption of thoughtful Bayesian estimation allows for coding the interactions among variables, disentangling individual effects of the predictor variables on the response; the

research concludes that the Solow model augmented with country-specific human capital accumulation and identical technology performs best in depicting the economic growth of OECD countries; second, the study demonstrates the advantages of the Bayesian approach over frequentist inference in handling complex growth models.

1. CANONICAL SOLOW GROWTH MODEL, MRW SPECIFICATION, AND RELATED EMPIRICS

1.1 MRW specification of canonical Solow model

The canonic Solow growth model includes labor-augmenting technical progress as an exogenous variable, known as Harrod-neutral technical progress. The Cobb-Douglas production function is utilized:

$$Q_{it} = AK_{it}^{\alpha}(LE)_{it}^{1-\alpha}. \qquad (1)$$

where $Q, K,$ and L are income, physical capital, and raw labor, respectively. E is labor-augmenting technical progress; LE is effective labor; α is income elasticity concerning physical capital $(0 < \alpha < 1)$; and i, t are country and time, respectively.

Suppose that labor-augmenting technical progress has a rate of g. In this scenario, the effect of technical progress on production is similar to that of raw labor. For instance, if the growth rate of labor productivity (*E*) is 0.02, it means that in period t, 100 workers would produce the same output as 102 workers did in the previous period (t-1).

Additionally, if the population (*L*) and labor productivity (*E*) grow at a rate of n and g, respectively, effective labor (*LE*) would increase at a higher rate, specifically $(n + g)$, which exceeds the growth rate of raw labor (*L*). This indicates that the combined effect of population growth and labor productivity growth results in a higher growth rate of effective labor, leading to a more significant impact on production.

In the Solow model, augmented with Harrod-neutral technical progress, k^E there is a ratio between physical capital and effective labor ($k^E = \frac{K}{LE}$), and q^E is the income per unit of effective labor ($q^E = \frac{Q}{LE}$). Applying $LE_{it} = L_{it}E_{it}$ leads to:

$$q_{it} = q_{it}^E E_{it} = q_{it}^E e^{gt}. \qquad (2)$$

$$k_{it} = k_{it}^E E_{it} = k_{it}^E e^{gt}. \qquad (3)$$

Dividing (1) by $LE,$ we obtain:

$$q_{it}^E = A(k_{it}^E)^{\alpha}. \qquad (4)$$

Hence, the fundamental growth equation is rewritten:

$$\Delta k_{it}^E = sq_{it}^E - (n + g + \delta)k_{it}^E. \qquad (5)$$

Or

$$\Delta k_{it}^E = sA(k_{it}^E)^{\alpha} - (n + g + \delta)k_{it}^E. \qquad (6)$$

where Δk_{it}^E represents the increment of physical capital, and the variables $s, \delta, n,$ and g represent the fraction of savings (physical investment) in income, depreciation rate, growth rate of population, and technology growth rate, respectively.

The right-hand side of (6) consists of two terms: the first term represents investment per unit of effective labor, and the second term represents "break-end investment" – an amount of investment that compensates for the depreciated part of the capital stock – along with the growth rate of effective labor $(n + d)$. As a result, when investment per unit of effective labor matches the "break-end investment," k^E

increases. Conversely, if they do not match, k^E decreases. This interplay between investment and effective labor drives changes in k^E over time.

The model reaches the steady state when $\Delta k_{it}^E = 0$. Transforming (2) and (3), we obtain:

$$k^* = \left(\frac{sA}{n+g+\delta)}\right)^{\frac{1}{1-\alpha}} e^{gt}. \quad (7)$$

$$q^* = A^{\frac{1}{1-\alpha}} \left(\frac{s}{n+g+\delta)}\right)^{\frac{\alpha}{1-\alpha}} e^{gt}. \quad (8)$$

where k^* and q^* are per capita capital and income at the steady state, respectively. We take logarithms to obtain:

$$lnq = a + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}(n+g+\delta) \quad (9)$$

At the steady state, (8) indicates that per capita income gains continuous growth at a speed of g. This sustained growth is primarily attributed to the impact of labor-augmenting technical progress, which counteracts the law of diminishing returns to capital, a factor that could otherwise hinder per capita income growth. The gradual accumulation of raw labor, coupled with technological advancements, allows effective labor to expand in tandem with physical capital, leading to an increase in the ratio between capital and labor at a rate of g. As a result, both capital and income experience growth at a combined rate of $(n+g)$, while the ratio between capital and labor and per capita income rise at a rate of g. The steady-state reflects a dynamic equilibrium where various factors work harmoniously to sustain economic growth.

When MRW (1992) introduced human capital stock (H) into the production function, (1) becomes:

$$Q_{it} = K_{it}^{\alpha} H_{it}^{\beta} (A_{it}L_{it})^{1-\alpha-\beta} \quad (10)$$

where β is income elasticity concerning human capital $(0 < \beta < 1)$, MRW hold the assumption of decreasing returns to all capital: $\alpha + \beta < 1$.

Transforming (10) and taking logarithms, we obtain:

$$lnq = a + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) - \frac{\alpha+\beta}{1-\alpha-\beta}(n+g+\delta) \quad (11)$$

where s_k and s_h are the share of physical and human capital investment in income, respectively.

1.2 Related empirics

MRW (1992) conducted one of the most influential works revitalizing the canonical Solow growth model. Their study focused on specifying the Solow model and testing its predictions. To estimate their regression, making an identifying restricted assumption of homogeneous technology across countries (g+δ=0.05), the authors employed a simple frequentist technique (Ordinary Least Squares) with data spanning from 1960 to 1985 for three distinct subsets of countries: the first dataset comprised 98 countries, the second included 75 countries, and the third was limited to 22 OECD countries. The outcomes of their analysis were mixed. The Solow model elucidated more than half of the income per capita variation among diverse countries, except for a specific subset – the OECD economies. The outcomes were satisfactory in the initial two subsamples, showing an R-squared value of 0.59 and implying an elasticity of physical capital (α) of 0.6. Nevertheless, the results for the OECD subsample were considerably less fulfilling. The estimated coefficient of $\ln(n+0.05)$ was found to be statistically insignificant despite having the correct negative sign. Furthermore, the R-squared value for the OECD countries was extremely low, amounting to only 0.06. These findings highlighted potential limitations of the standard Solow model when applied to the OECD economies. To improve the Solow model's explanatory power, MRW (1992) chose to include human capital in the analysis, due to which, for the OECD subsample, R-squared increases from 0.06 to 0.24, a low for a well-specified model level, while implied α decreases from 0.36 to 0.14 and implied β obtains a value of 0.37. Suggesting that multicollinearity is implicit in their augmented model, MRW (1992) stated:

"*Human-capital accumulation may be correlated with saving rates and population growth rates; this would imply that omitting human-capital accumulation biases the estimated coefficients on saving and population growth*."

Furthermore, the debate surrounding cross-country income disparities among OECD countries has prompted growth economists to reconsider the old approach, assuming that the term "A" (representing total factor productivity, TFP) is the same across all countries. Jorgenson (1995) recommended not specifying homogeneous technology variables in growth models, suggesting that this assumption may need to capture the reality of technological differences between nations accurately. Islam (1995) further emphasizes that assuming homogeneous technology can lead to an omitted variable bias. The growth model may fail to capture crucial factors influencing income differences by overlooking the variations in technology levels across countries. Prescott (1998) offers a different perspective, arguing that differences in savings rates might not be as significant as TFP when explaining income disparities. He proposes that the focus should shift towards developing a TFP theory to understand better the sources of economic growth and variations in income levels. Numerous subsequent studies (Islam, 1995; Lee et al., 1997; Felipe and McCombie, 2005; Abu-Qarn, 2019) have explored variations in technology levels and rates across countries and replicated the Solow model employing various frequentist methods. However, the empirical results obtained from these studies have been mixed, leading to divergent conclusions. Notably, adopting a panel approach, Islam (1995) found that the fit of the Solow model considerably improved for the OECD subset and concluded: "The present paper advocates and implements a panel data approach to deal with this issue. The panel data framework makes it possible to allow for differences of the above-mentioned type in the form of unobservable individual "country effects"." Similarly, Felipe and McCombie (2005) found a significant improvement in the model's explanatory power when taking into account variations in technology across OECD countries. By contrast, Abu-Qarn (2019) revealed that incorporating heterogeneous technology did not produce a better model fit for three data samples, including OECD countries. However, similar to MRW (1992), adding the human capital variable notably improved the goodness-of-fit. This discrepancy in the mentioned findings highlights the complicated connections between population, savings, human capital, technology, and income. By our suggestion, the primary reason for the contradictory findings is that incorporating heterogeneous technology or human capital into the Solow model creates a close association between physical investment and productivity variables, as well as between human capital investment and savings and population. These dimensions are strongly correlated in general. The high correlation between these variables can create difficulties for frequentist methods in the mentioned studies. This correlation may lead to issues such as multicollinearity, making it challenging to disentangle the independent effects of the predictors on income.

In summary, empirical investigations incorporating human capital and technology variations across OECD countries in the Solow growth model have yielded conflicting outcomes. Some studies show improved explanatory power with the inclusion of differences in technology, while others indicate limited improvement. The high correlation between population growth, physical and human capital investment, and technology poses challenges for frequentist methods. The current study implements Bayesian non-linear estimation with specific priors on a panel of OECD countries to address this significant challenge when incorporating country-specific human capital, technology, and depreciation rates. By selecting specific priors, Bayesian analysis offers a more flexible approach to handle multicollinearity and allows for a better understanding of parameter uncertainties and non-linear relationships in a growth model. As a result, the study will provide more reliable and robust evidence on the best version of the Solow growth model.

2. BAYESIAN MCMC SIMULATIONS AND DATA

2.1 Bayesian MCMC simulations

Since the 1990s, the application of Bayesian approaches in various fields, from genetics to macroeconomics, has sparked a revolution in data analysis. However, growth econometrics has been relatively absent from using Bayesian methods. In this article, we aim to introduce growth researchers to the thoughtful (with specific informative priors) Bayesian methodology as an effective tool to tackle model uncertainty

arising from statistical issues. By doing so, we can address some of the limitations of the frequentist approach and benefit from a more flexible and intuitive framework for handling uncertainty. The most significant advantage of Bayesian analysis is its ability to incorporate specific prior information or beliefs about the parameters of interest. Unlike the frequentist approach, which does not formally include prior information, Bayesian analysis can utilize this additional knowledge, resulting in more efficient estimation from the available data. By producing a posterior distribution of the parameters, Bayesian analysis enables researchers to express uncertainty in parameter estimates and make probabilistic statements about the parameter values. On the contrary, frequentist methods often rely on point estimates and confidence intervals, which may not fully capture the extent of uncertainty. So, Bayesian analysis is well-suited for handling model complexity and hierarchies, making it a valuable tool for dealing with high-dimensional data and intricate relationships between variables. Bayesian analysis proves to be effective in dealing with multicollinearity, a common issue in regression analysis, by incorporating specific prior information and providing a full posterior distribution of the parameters. In contrast, frequentist methods may struggle with such complexity and can lead to issues like overfitting or underfitting. In frequentist regression, multicollinearity can result in unstable coefficient estimates and inflated standard errors (Block et al., 2011; Jaya et al., 2019; Pesaran and Smith, 2019; Thach et al., 2019).

The study employs MCMC simulations within a Bayesian non-linear regression model with specific priors on the elasticity parameters (α, β) to assess the canonical Solow model and its augmented versions. In the canonical and human capital-augmented Solow models, we incorporate constant exogenous technology variables along with heterogeneous technology and depreciation rates. Thus, we need to evaluate four Solow models: two canonical Solow models and two human capital-augmented Solow models with homogeneous and heterogeneous technology variables. To estimate the Bayesian growth models based on equation (11), we suppose that all the OECD countries in the sample have reached their steady state.

To assess the canonical Solow model, the study adopts the assumptions of MRW (1992), with a technology growth rate of 0.02 and a depreciation rate of 0.03. Various assumptions regarding technology and depreciation rates are applied to both the canonical and augmented versions of the Solow model. For comparison and selection among the four Bayesian models, Bayesian information criteria such as Deviance Information Criterion (DIC), log of marginal likelihood (log(ML)), Bayes factor measured in log metric (log(BF)), and posterior probabilities of models (P(M/y)) are analyzed. A Bayesian model performs better if the DIC is smaller while the remaining statistics are larger. Furthermore, visual tools such as observed vs. fitted plots, residual vs. fitted plots, and predictive interval plots are employed to compare the goodness-of-fit between the best Bayesian and frequentist growth models. In conjunction with the graphical tools, we utilize standard metrics such as Mean Squared Error (MSE), (Root Mean Squared Error) (RMSE), and Mean Absolute Error (MAE). The smaller the metric value is, the more precise the model predictions become.

DIC is calculated as:

$$DIC = D(\bar{\theta}) + 2p_D \quad (12)$$

where $D(\bar{\theta})$ is the posterior mean deviance, and p_D is the effective number of parameters in a model.

Log(ML) is measured by:

$$\log\ P(y) = log \int p(y|\theta)p(\theta)d\theta \quad (13)$$

where $P(y)$ is the marginal likelihood of the data y, $p(y|\theta)$ is the likelihood function, and $p(\theta)$ is the prior distribution of the parameters θ. Note that the integral is taken over the parameter space θ.

As the ratio of the marginal likelihoods under two competing models, M_1 and M_2, BF is calculated as:

$$BF = \frac{p(y|M_1)}{p(y|M_2)} \quad (14)$$

where $p(y|M_1)$ and $p(y|M_2)$ are the marginal likelihoods of the data under models M_1 and M_2, respectively.

As the average of the absolute differences between the observed values and the predicted values, MAE is calculated as:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - \hat{y}_i| \quad (15)$$

where n is the number of observations (data points), y_i is the actual (observed) value for observation i, and $\hat{y}_i$ is the predicted value for observation i.

MSE and RMSE measure the average squared difference between the predicted and the observed values. MSE is measured by:

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \quad (16)$$

RMSE is the square root of the MSE:

$$RMSE = \sqrt{MSE} \quad (17)$$

We set a default configuration for the MCMC sample during our simulation process. We discard the initial 2,500 burn-in iterations to ensure the stability and convergence of the algorithm. Additionally, to effectively assess MCMC convergence in a high-dimensional regression setting, we use a thinning rate of 50. This allows us to reduce the number of iterations while retaining the sample's representativeness. Consequently, 502,451 iterations are executed within the MCMC algorithm, providing robust and reliable analysis.

2.2 Data

Our investigation utilizes a panel dataset encompassing 28 OECD countries from 1970 to 2019. The dataset is designed to explore the connections between various fundamental inputs and their impact on aggregate income. The dataset comprises essential variables: physical investment share in GDP (s_k), human capital investment share in GDP (s_h), population growth rate (n), productivity (TFP) growth rate (g), depreciation rate (δ), and per capita income (q). To set a specific informative prior for the elasticity parameters (α, β), we restrict its possible values between 0 and 0.5, adopting a uniform(0,0.5) prior distribution. This mildly informative prior choice aims to introduce a regularization effect on the posterior distribution, enhancing the stability and reliability of the parameter estimates. To check estimation robustness, we run one more simulation with a uniform(0,1) prior for parameters α, β.

Data on per capita income, TFP, depreciation rate, and population are sourced from version 10.01 of the Penn World Tables. At the same time, information on the physical and human capital investment share in GDP is gathered from the World Bank's World Development Indicators. By employing a thoughtful Bayesian estimation with informative prior settings relying on these comprehensive datasets, the study gains more profound insights into the linkages between the crucial variables and their implications for economic growth in the OECD economies.

3. BAYESIAN SIMULATION OUTCOMES AND INTERPRETATION

3.1 Convergence diagnosis

Before performing Bayesian inferences, it is necessary to inspect the convergence of MCMC chains to ensure the robustness of the Bayesian analysis. Our investigation has carried out thorough diagnostic tests to assess the convergence of the MCMC chains in relation to our models. The results for the best-fitting Bayesian model, recorded in Appendix A, indicate reasonable diagnostic graphs. Specifically, the trace plots show no discernible trends and rapidly approach constant mean and variance values, indicating favorable convergence. Additionally, the autocorrelation plots exhibit acceptable patterns, and the histograms resemble the shape of probability distributions (Appendices B and C). Overall, the MCMC chains of our model demonstrate good mixing, suggesting no serious convergence issues. It can be confidently concluded that the MCMC chains have effectively converged to the target distribution. This provides a solid

foundation for performing Bayesian inferences and drawing reliable conclusions about the parameters and relationships in the model.

3.2 Goodness-of-fit comparison between homogeneous technology-, heterogeneous technology-, human capital-augmented Solow growth models

Table 1 demonstrates the performance of the four Solow growth models estimated performing MCMC simulations. According to the Bayesian information criteria estimates, the Solow model augmented with human capital and homogeneous technology is most preferable for the OECD sample. The finding is consistent mainly with MRW (1992). The main reason for this finding is productivity convergence arising in the advanced world (Bernard and Jones, 1996; Sadik, 2008; Mendez, 2020). The productivity convergence hypothesis posits that adopting technologies within groups of industrialized countries is more likely and faster due to the low costs of importing them from a few centers. The estimated values of constant, α, and β for this model do not differ considerably from those of the canonical and human capital-augmented Solow models with heterogeneous technology. The estimated value of the constant is around 10, while those of α and β are approximately 0.01 and 0.02, respectively. However, the canonical Solow model stands apart, with estimated values of the constant and α equal to 8.06 and 0.26, respectively. Notably, augmentation with human capital improves the Solow model's goodness-of-fit, aligning with previous studies (MRW, 1992; Abu-Qarn, 2019). Conversely, by adding country-specific technology variables, the Solow model produces conflicting results: the model fit increases in Islam (1995) and Felipe and McCombie (2005) but decreases in Abu-Qarn (2019) and our study. Regarding the estimated values for α, the results from our human capital-augmented Solow models are similar to those by Abu-Qarn (2019) but much lower compared to MRW (1992) and Islam (1995). It is noteworthy that our estimated values of β are much lower compared to MRW (1992), Islam (1995), and Abu-Qarn (2019).

Table 1. Posterior summary of the canonical and human capital-augmented Solow models

Bayesian models	*Canonical Solow growth models*		*Human capital-augmented Solow growth models*	
Technology variables	*homogeneous technology*	*heterogeneous technology*	*homogeneous technology*	*heterogeneous technology*
Specification of technology and depreciation rates	$g = 0.02,$ $\delta = 0.03$	$g = tfp,$ $\delta = delta$	$g = 0.02,$ $\delta = 0.03$	$g = tfp,$ $\delta = delta$
Number of OECD countries	28	28	28	28
MCMC sample size	10000	10000	10000	10000
Constant	8.060	10.107	10.229	10.307
Implied α	0.263 (0.006)* [0.201,0.292]**	0.033 (0.004) [0.002,0.091]	0.013 (0.002) [0.000,0.045]	0.013 (0.001) [0.000,0.044]
Implied β			0.017 (0.005) [0.001,0.066]	0.021 (0.003) [0.001,0.068]
DIC	2703.028	2752.757	1123.334	1124.512
Log(ML)	-1364.732	-1390.287	-576.6644	-576.7437
Log(BF)	.	-25.55514	788.0674	787.9881
P(M/y)	0.0000	0.0000	0.5198	0.4802
Error variance	0.303	0.313	0.215	0.215

Note: *denotes Markov chain standard error (MCSE), ** denotes PPI (Posterior Probability Interval) representing a 95% probability that a mean coefficient lies between two values in the population.

Source: Calculations by the author

3.3 Goodness-of-fit comparison between frequentist and Bayesian growth models

This subsection compares the performance of frequentist and Bayesian inferences in estimating the human capital-augmented Solow growth model with homogeneous technology. This task is carried out via observed vs. fitted plots, residual plots, and predictive interval plots. As evident from the first type of diagnostic plots (Figure 1a), notable differences emerge between the predictive performance of the Bayesian and frequentist models. The yellow (Bayesian) points align more closely with the diagonal line (y = x) compared to the blue (frequentist) ones. This indicates that the Bayesian model's predicted values match the observed values better than the frequentist model.

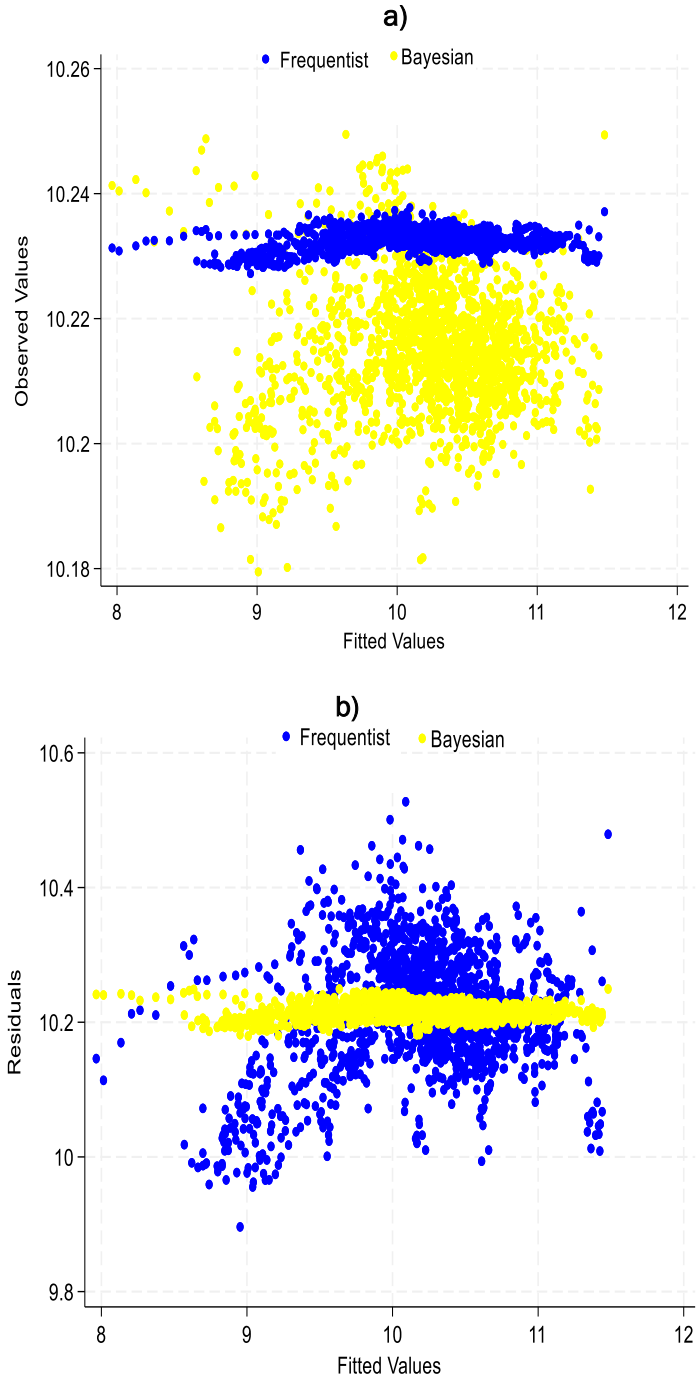

Figure 1. Bayesian vs. frequentist: a) Observed vs. fitted plot, b) Residual plot

Source: own

Furthermore, the second type of plot (Figure 1b) exhibits that, compared to the frequentist residual (blue) plot, the residuals of the Bayesian (yellow) plot are more evenly spread across the range of predicted values, which indicates that the Bayesian model's predictions are unbiased and have no systematic errors.

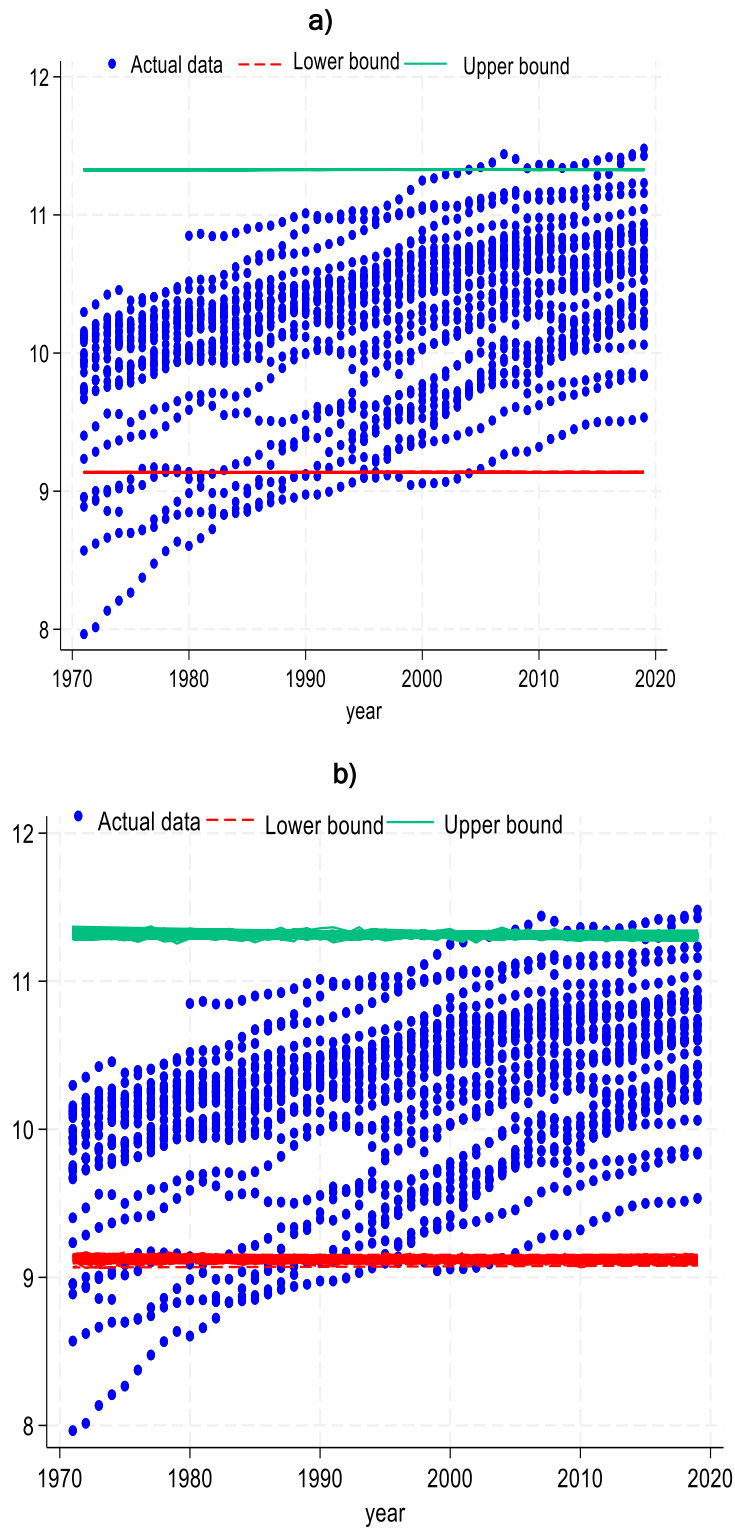

Figure 2. Actual data (GDP per capita) within predictive intervals: a) Frequentist model, b) Bayesian model

Source: own

Figure 2 compares the number of observations (actual data) of the variable GDP per capita within the predictive intervals between the Bayesian and frequentist human capital-augmented Solow models with homogeneous technology. A closer examination of the diagrams reveals only minimal disparity. However, the numeric results presented in Table 2, with values of 0.948 and 0.951 against 0.935, clearly indicate an advantage of the Bayesian models over the frequentist one. Moreover, other metrics such as MSE, RMSE, and MAE also favor the Bayesian models over the frequentist one. Based on these findings, we can conclude that the Bayesian approach outperforms the frequentist approach, particularly in addressing multicollinearity inherent in complex growth models.

Table 2. Comparing the frequentist and Bayesian augmented Solow growth models

Human capital-augmented Solow growth models	*Bayesian approach*		*Frequentist approach*
Prior for α, β	Uniform(0,0.5)	Uniform(0,1)	
Specification of technology and depreciation rates	$g = 0.02,$ $\delta = 0.03$	$g = 0.02,$ $\delta = 0.03$	$g = 0.02,$ $\delta = 0.03$
Number of OECD countries	28	28	28
Constant	10.229	10.287	10.472
Implied α	0.013	0.010	0.005
Implied β	0.017	0.012	0.006
MSE	0.303	0.303	0.312
RMSE	0.550	0.550	0.559
MAE	0.436	0.431	0.437
Percentage of observations within predictive intervals	0.948	0.951	0.935

Source: Calculations by the author

Furthermore, Table 2 shows that varying hyperparameters of the uniform prior do not alter the estimates of the elasticities α and β. Additionally, we observe no significant distinction in the estimated values of the constant, α, and β between the Bayesian and frequentist models.

CONCLUSION

Departing from the canonical Solow growth model, which poorly explains economic growth in the OECD countries, numerous studies have attempted to incorporate human capital and technology variables into the model. Nonetheless, the findings have been inconclusive and sometimes contradictory. The primary reason for the mixed results may be the issue of multicollinearity arising from the high correlation between population growth, human and physical capital investment, and technological progress. This statistical challenge is one that traditional frequentist methods struggle to handle effectively. In contrast, the Bayesian approach offers a more flexible and robust solution to address this correlation problem. Our study involved a sequence of MCMC simulations within a Bayesian non-linear framework, analyzing a panel dataset encompassing 28 OECD economies. The results indicate that the Solow growth model, when supplemented with heterogeneous human capital, homogeneous technology, and homogeneous depreciation rates, best explores the OECD growth pattern, which aligns with the productivity convergence hypothesis.

Based on the research findings, the study proposes the adoption of the augmented Solow model estimation results using the thoughtful Bayesian approach as a reliable empirical foundation for informing growth policies. Policymakers can gain a more accurate understanding of the dynamics of economic growth and make informed decisions to promote sustainable development and prosperity in the OECD context.

As with any empirical research, our study has limitations that should be acknowledged. One limitation is the potential for omitted variable bias, as there might be other unobserved factors influencing economic growth that should have been accounted for in our model. Additionally, the OECD sample may not fully

represent the diverse global economic landscape, which could affect the generalizability of our findings. Despite these limitations, our study contributes to understanding economic growth dynamics by showcasing the benefits of adopting a thoughtful Bayesian approach and considering the effects of heterogeneous factors in the Solow growth model. Further research and exploration of more comprehensive datasets could enhance the accuracy and scope of our findings.

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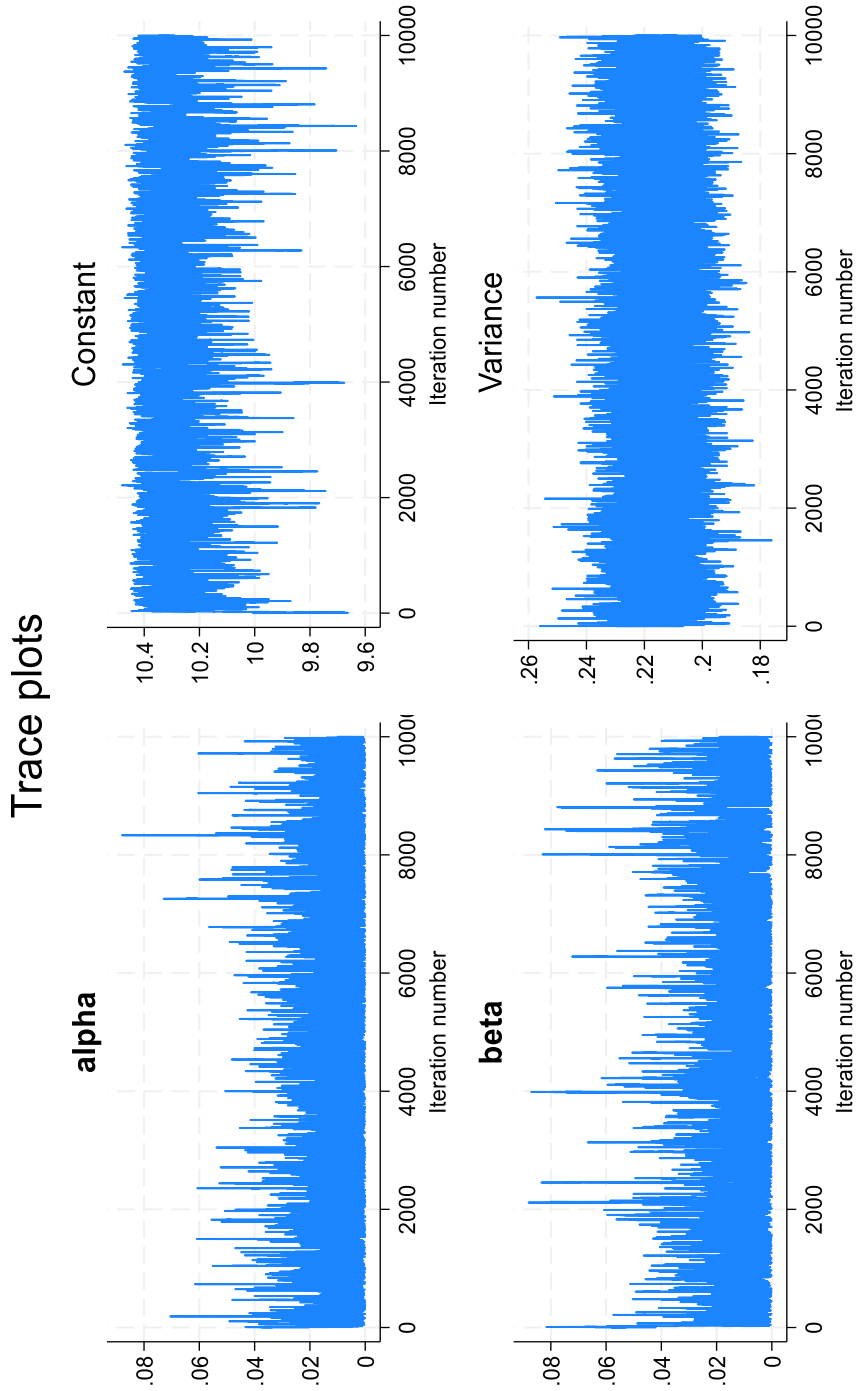
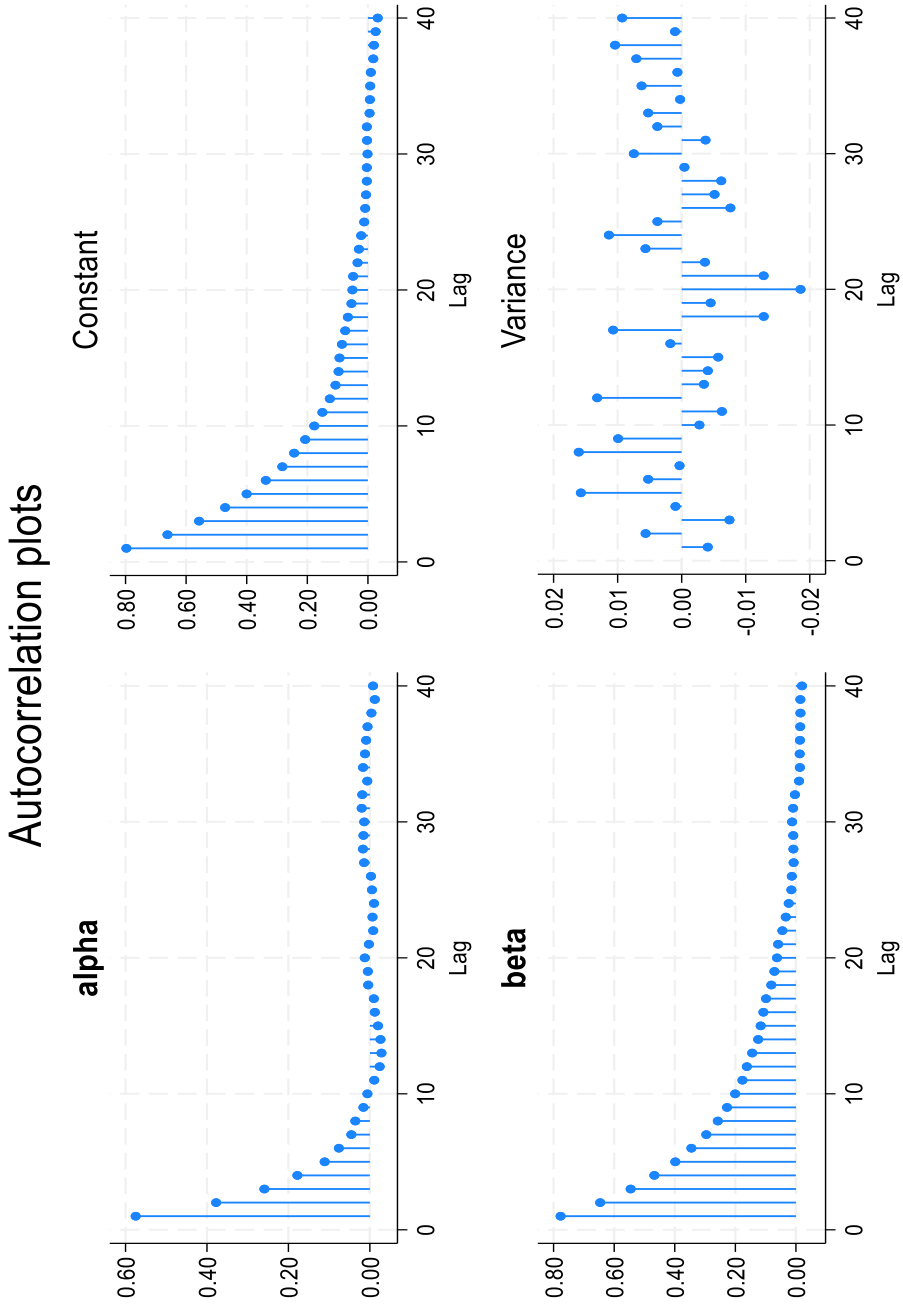
APPENDICES

A: Human capital-augmented Solow model



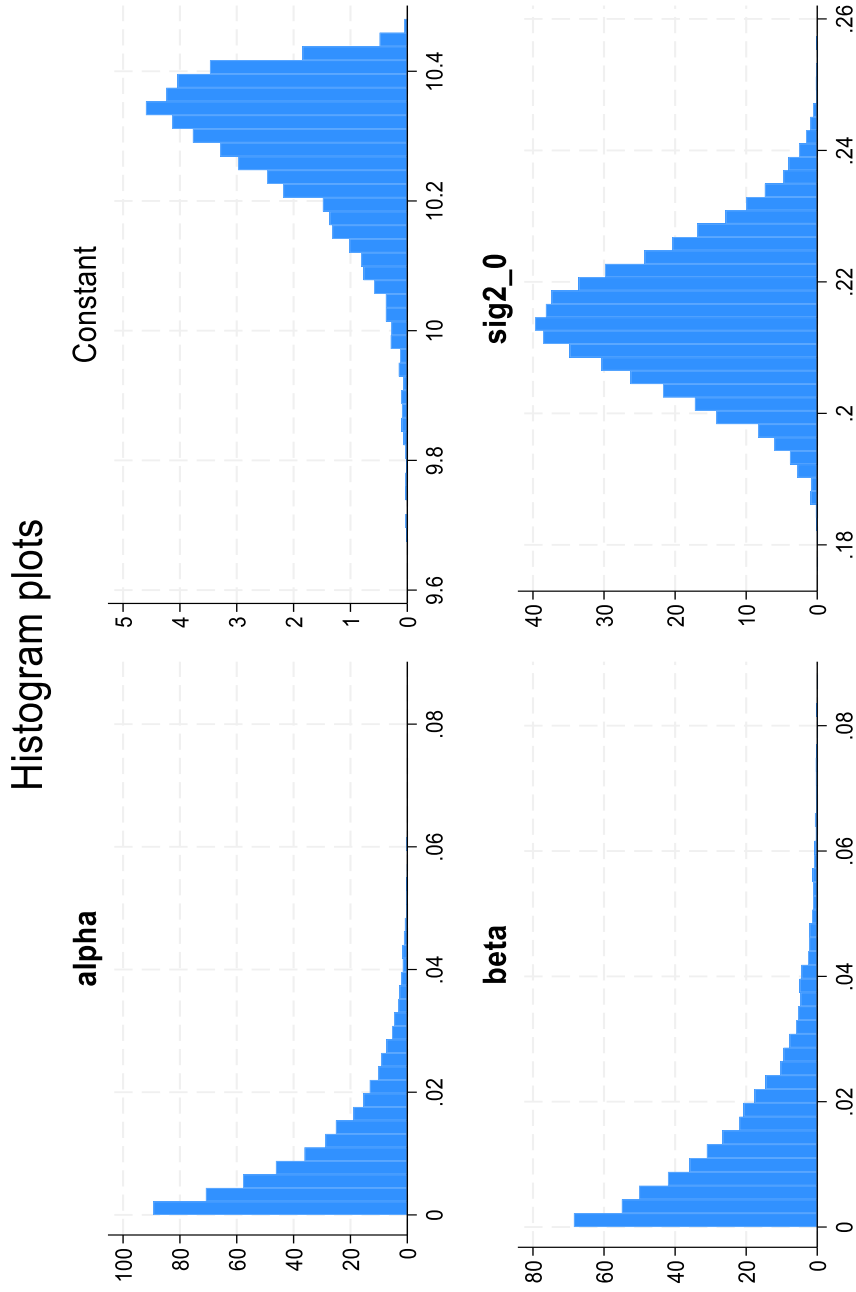
Source: Calculations by the author

B: Human capital-augmented Solow model



Source: Calculations by the author

C: Human capital-augmented Solow model



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e.g. Draskovic, V. (2007), "Specificities and problems of Montenegrin transition", working paper, No. ..., Leeds University Business School, TIGER, Warsaw, September.

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e.g. Miller, M. C. (1997), "The Crushing Power of Big Publishing", *The Nation*, 17 March, p. 10.

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