University of Maribor
Faculty of Economics and Business

Letnik Volume 70 | Številka Number 3 | 2024

NG OE

NAŠE GOSPODARSTVO

Revija za transformacijsko dinamiko v ekonomiji in poslovanju

OUR ECONOMY

Journal of Transformative Dynamics in Economics and Business

NAŠE GOSPODARSTVO

Revija za transformacijsko dinamiko v ekonomiji in poslovanju

Letnik 70, št. 3, 2024

Izdajatelj
Sciendo v imenu Univerze v Mariboru,
Ekonomsko-poslovne fakultete

Naslov uredništva
Maribor, Razlagova 14, Slovenija, telefon: +386 2 22 90 112

E-pošta: nase.gospodarstvo@um.si
Spletna stran: https://sciendo.com/journal/NGOE

Revija je uvrščena v bibliografske baze podatkov EconLit, European Reference Index for the Humanities and the Social Sciences (ERIH PLUS), Directory of Open Access Journals (DOAJ), ProQuest, EBSCO, Ulrich's Periodicals Directory in številne druge.

OUR ECONOMY

Journal of Transformative Dynamics in Economics and Business

Vol. 70, No. 3, 2024

Published by
Sciendo on behalf of University of Maribor,
Faculty of Economics and Business

Editorial and administrative office address
Maribor, Razlagova 14, Slovenia, phone: +386 2 22 90 112

E-mail: our.economy@um.si
Webpage: https://sciendo.com/journal/NGOE

The journal is indexed/abstracted in EconLit, European Reference Index for the Humanities and the Social Sciences (ERIH PLUS), Directory of Open Access Journals (DOAJ), ProQuest, EBSCO, Ulrich's Periodicals Directory and in a number of other bibliographic databases.

Oblikovanje: Univerza v Mariboru, Univerzitetna založba, Marina Bajić
Letno izidejo štiri številke revije. Letna naročnina: 44,10 EUR (Slovenija) in 54,60 EUR (tujina).
ISSN 0547-3101
Revijo sofinancira Javna agencija za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije

Vsebina / Contents

Assessing Fiscal Sustainability with Panel Unit Root, Cointegration, and Granger Causality Tests: Evidence from the Broader Groups of Countries

Nejc Fir

University of Maribor Faculty of Economics and Business, Maribor, Slovenia
nejc.fir@um.si

ARTICLE INFO

Original Scientific Article

Article history:
Received April 2024
Revised September 2024
Accepted September 2024

JEL Classification
H61, H62, E62

Keywords:
Cointegration tests
Fiscal sustainability
Granger causality tests
Intertemporal budgetary constraint
Unit root tests

UDK: 336.1:338.2
DOI: 10.2478/ngoe-2024-0013

Cite this article as: Nejc, F. (2024). Assessing fiscal sustainability with panel unit root, cointegration, and granger causality tests: evidence from the broader group of countrie. *Naše gospodarstvo/Our Economy, 70*(3), *1-20*. DOI: 0.2478/ngoe-2024-0013

Abstract

The question of fiscal sustainability of countries has become one of the central topics in economic policy, especially in times of increasing public debts. One way to assess fiscal sustainability is to examine compliance with the intertemporal budget constraint, which involves testing the stationarity of government revenues and expenditures, the primary budget balance, and the first differences of public debt. Part of this approach includes testing cointegration and causality among different pairs of variables. Under this approach, the paper is focused on both first- and second-generation panel unit root tests, cointegration, and Granger causality test. This paper focuses on assessing the fiscal sustainability of four panels of countries divided by continents: Europe, Asia and Oceania, Africa, and Latin America, the Caribbean, and North America. It has been found that fiscal sustainability is present in all the broader groups of countries considered but in a weak form. Fiscal sustainability was confirmed when considering a constant in calculations, while deviations were observed among groups of countries when both a constant and trend were considered. The study serves as a starting point for a more extensive analysis of fiscal sustainability. For more accurate findings, it would be necessary to categorize countries into smaller and economically more homogeneous groups and analyze them using other fiscal sustainability methods as well.

Introduction

The issue of fiscal sustainability is gaining interest among researchers in recurring periods of economic crises as countries often rely on extensive government expenditures that are not balanced with either higher current or future government revenues. Such behavior results in increasing borrowing needs of governments, which leads to persistently higher public debt levels. Therefore, the study of fiscal sustainability is focused on two aspects. Firstly, the identification of factors that cause the inability to balance the budget balance and,

secondly, the negative effects of unsustainable public finance and public borrowing on the economy (Brady & Magazzino, 2018). Consequently, the key two variables that are studied under fiscal sustainability are primary budget balance and public debt (Krejdl, 2006).

The issue of ensuring fiscal sustainability is a phenomenon that affects all groups of countries. Low-income countries and emerging economies face vulnerable access to capital markets, rising public debts, an expanding public sector, and vulnerability to cyclical changes or financial contagion. On the other hand, developed economies confront challenges in ensuring fiscal sustainability over a longer time period, as their social measures are of a long-term nature and often require high financial inputs while facing demographic challenges. With the development of methods for assessing the present value of debt, there has been increased interest in studying fiscal sustainability, as countries have begun to accumulate long-term liabilities that are not evident in budget balances or assessed with current budget surpluses. Four dimensions of fiscal sustainability are highlighted. The first dimension is solvency, which is often emphasized by researchers and means the government's ability to repay its obligations. The next dimension is economic growth, as fiscal policy must pursue measures that lead to sustainable and long-term economic growth while considering fiscal sustainability. The third dimension is stability, referring to the government's capacity to repay future obligations with existing tax burdens. The last dimension is equity, which represents the government's capacity to repay its obligations without transferring costs to future generations. All four discussed dimensions of fiscal sustainability are intertwined and are not separate units of study in the phenomenon of fiscal sustainability (Schick, 2005).

The ability of the government to sustain credible public finances and the capacity to deliver public services over the long run are outlined in the definition of fiscal sustainability. It takes strategic monitoring and forecasting of future revenues and obligations, environmental conditions, and other socio-economic trends to ensure long-term fiscal sustainability and effective budget planning (OECD, 2013). Demographic trends, sudden economic contractions, and limited fiscal spaces pose challenges for countries in maintaining fiscal sustainability. Budget revenues must be carefully planned to ensure solvency without increasing the tax burden that falls on economic entities. The function of fiscal sustainability is also to ensure intergenerational equity, as excessive shifting of obligations to the future causes a limited range of public services in the future. Fair fiscal policy must pursue conditions of fiscal sustainability in such a way that budget revenues meet fiscal capacities in the present and limit the transfer of the tax burden to future generations (OECD, 2009).

The country's public finances are described as sustainable when the present value of future budget surpluses is equalized with the current level of public debt. This condition is also described as the intertemporal budget constraint, under which the government can manage its public debt. Therefore, any public debt rollover does not cause excessive accumulation and does not pose an insolvency risk (Krejdl, 2006). The fulfillment of public sustainability conditions can improve a country's position on financial markets with more favorable conditions for issuing government bonds, as it reflects a lower probability of sovereign risk (Chen, 2014).

In this study, we examined the fiscal sustainability of countries in four panels divided by continents: Europe, Asia and Oceania, Africa, and Latin America, the Caribbean, and North America. The paper is structured as follows. We first reviewed the theory and empirical evidence in Section 2, which allowed us to determine the appropriate methodological approach and select the data set that is described in Section 3. In Section 4 we have presented the results, where we first presented descriptive statistics, then proceeded to present the first-generation unit root tests and Pesaran's second-generation unit root test. Testing fiscal sustainability with the unit root tests is the first methodological step, therefore, we have proceeded with testing the cointegration on various pairs of variables using Pedroni's test and Granger causality with the Dumitrescu-Hurlin test.

The main aim of the study is to detect the fiscal sustainability in the examined group of countries. The study contributes to the literature on the assessment of fiscal sustainability with a standard approach using panel unit root and cointegration tests with the inclusion of recent periods. Examination of a broader group of countries covers a significant number of countries that are usually left out in studies of smaller groups of countries, even if that contributes to more homogenous panels.

Theoretical Background and Literature Review

The main focus when studying fiscal sustainability is placed on the primary budget balance and public

balance. These two key fiscal variables mainly describe the fiscal conditions of a country (Croce & Juan-Ramón, 2003). The study of fiscal sustainability follows the arithmetic of the budget balance, where the relationship between government expenditures and government revenues is described. The budget deficit presents a situation where the government revenues insufficiently cover all government expenditures and interest from previously issued public debt, and other contingent liabilities, therefore, posing a risk of unsustainable public finances. The issue of budget deficit arises with its financing, as deficits are financed through the issuance of government bonds that accumulate public debt over time (Case et al., 2012, p. 179).

It is also important to observe the primary budget balance, as it excludes interest expenses on public debt. If the primary budget balance is in deficit, i.e., budgetary expenditures exceed budgetary revenues, or if the surplus of the primary budget balance is smaller than the real interest repayments on public debt, the country will find itself in a budget deficit. The reasons for a deficit in the primary budget balance can vary. The most common reasons are the need for countercyclical fiscal policy, wars, and natural disasters, structural reforms of the economy, delays in public financial consolidation, external shocks, and various economic-psychological factors (Guellec & Wunsch-Vincent, 2009; Döring & Oehmke, 2019). Fall et al. (2015) summarize the following political-economic factors as reasons for budgetary indiscipline:

- The lack of information about the conduct of fiscal policy leads to situations where politicians exploit the public's ignorance about the state of the public budget, therefore, the political cycle has a significant impact on the budget balance;
- The competition of political parties for election causes an increase in the scope of budget expenditures as a percentage of GDP, in order to ensure a relatively larger scale of public goods and services. Public borrowing represents a convenient tool for financing such political programs;
- Rent-seeking by various groups, who wish to gain budgetary benefits through lobbying without providing equivalent value, causes additional negative pressures on the unbalance of the budget;
- The pursuit of intergenerational solidarity causes the necessary increases in budget revenues to be deferred to the future, thereby transferring the burden of costs for servicing a relatively higher public debt and the current budget deficit onto future generations;
- Governments inadequately pursue the counter-cyclical orientation of fiscal policy and act in accordance with the business cycle, as there is often fiscal indiscipline in times of favorable macroeconomic conditions.

In the empirical literature review, we focused on referential studies of fiscal sustainability that incorporated the methodology for testing fiscal sustainability through panel unit root tests and cointegration, along with the assessment of the fiscal reaction function. The objective was to encompass studies that investigated different groups of countries, which are part of the broader panels of countries under study.

Chen (2014) analyzed the fiscal sustainability of the G7 group of countries and selected European countries using quarterly data from the first quarter of 1980 to the fourth quarter of 2012. By testing for the presence of a unit root in the public debt-to-GDP ratio variable, the author found that a unit root is present in the sample under study, indicating a violation of the fiscal sustainability condition. The public debt-to-GDP ratio shows time series stationarity for Canada, Germany, the USA, and Italy when calculations take into account a nonlinear trend in the long-term and asymmetric data adjustment. Brady & Magazzino (2019) investigated the stationarity and cointegration of budget revenues and expenditures in the case of Italy, examining the long-term characteristics of both fiscal variables between 1862 and 2013. It was found that a unit root is present throughout the entire period, which rejects the condition of fiscal sustainability, although weak cointegration can be detected, suggesting the weak presence of fiscal sustainability. The authors divided the entire observed period into different sub-periods and found that fiscal sustainability can be confirmed for the sub-period between 1862 and 1913, while fiscal sustainability cannot be confirmed for the period 1947-2013.

Magazzino (2022) studied the fiscal sustainability of a group of six countries included in the Gulf Cooperation Council during the period 1990-2017. Using Pesaran's unit root test and Pedroni's cointegration test, the author rejected the fiscal sustainability of the group of countries under consideration. Bahrain and Qatar stand out among the studied countries, with a unit root process present in all fiscal variables, as well as an absence of cointegration between budget revenues and expenditures, and between the primary budget balance and public debt. The same applies to Saudi Arabia and Oman, which do not show a long-term relationship between budget

revenues and expenditures. In the group of countries under consideration, a strong impact of changes in oil prices on budget revenues can be detected, which can explain the deviation from the conditions of fiscal sustainability.

Campo-Robledo & Melo-Velandia (2015) examined the fiscal sustainability of a group of eight Latin American countries over the period 1960-2009, using the Carrion-i-Silvestre et al. (2005) second-generation unit root test and the Westerlund (2006) cointegration test. The authors confirmed the fiscal sustainability of the Latin American countries group, although both budget expenditures and budget revenues did not reject the presence of a unit root. The fiscal sustainability of the countries under study could be confirmed through the cointegration between budget revenues and expenditures, even though the cointegration link is weak. Chile, Panama, and Uruguay have the relatively highest level of fiscal sustainability among the countries studied, while Colombia, Paraguay, Argentina, Ecuador, and Peru exhibited a relatively lower level of fiscal sustainability, having experienced numerous debt crises during the study period.

Similarly, Westerlund & Prohl (2010) confirmed the presence of fiscal sustainability for eight developed OECD countries between the first quarter of 1997 and the fourth quarter of 2005 using a similar approach. Beqiraj et al. (2018), who studied the fiscal sustainability of 21 OECD countries between 1991 and 2015, tested for stationarity with Pesaran's second-generation unit root test and cointegration of various fiscal variables. The fiscal variables studied are not among the conventional variables in analyses of countries' fiscal sustainability, as, besides the public debt-to-GDP ratio, variables like the cyclically adjusted primary budget balance and the ratio of public debt to potential GDP were tested. The authors found that fiscal sustainability could not be confirmed in the group of countries studied. Sandica (2013) found the presence of a unit root in both budget expenditures and revenues in a panel of the Czech Republic, Hungary, Poland, and Romania between the first quarter of 2000 and the fourth quarter of 2011, and confirmed cointegration between these variables, indicating fiscal sustainability in the countries under study. Krajewski et al. (2016) for 10 Central and Eastern European countries between 1990 and 2012, using first-generation unit root tests, found that public debt is integrated of order one, while the variables of budget expenditures and revenues are cointegrated. These findings confirm fiscal sustainability on the panel of countries under study, which was also confirmed by estimating the fiscal reaction function using the Bohn (2007) method.

Baharumshah & Lau (2007) studied the fiscal sustainability of five East Asian countries between the first quarter of 1975 and the second quarter of 2003. Through first-generation unit root tests and cointegration, they confirmed the fiscal sustainability of the countries under study. Strong cointegration between real budget revenues and expenditures was confirmed for South Korea, Thailand, and Singapore, unlike Malaysia and the Philippines, which have relatively low cointegration vectors between real budget revenues and expenditures. The panel of South Asian countries, including India, Pakistan, Bangladesh, Sri Lanka, and Nepal, was studied by Shastri et al. (2018) for the period between 1985 and 2014. Using Pedroni's unit root test and Westerlund's cointegration test, they confirmed the long-term relationship between budget revenues and expenditures, indicating the presence of fiscal sustainability in the countries under study. Shastri et al. (2018) supported their findings with calculations of the fiscal reaction function but noted a low degree of fiscal sustainability in the long term. Rajakaruna & Suardi (2022) reached similar conclusions with the estimation of the fiscal reaction function for Sri Lanka, India, and Pakistan. A positive sign in the impact of public debt on the primary budget balance confirms the condition of fiscal sustainability, which, however, is not a sufficient condition, as additional tests rejected the presence of long-term fiscal sustainability.

Adams et al. (2010) studied the fiscal sustainability of 49 Asian and Pacific countries, members of the Asian Development Bank, between 1990 and 2008. The authors, with estimates of fiscal reaction functions and various supporting stress tests of alternative scenarios, confirmed the fiscal sustainability of the countries under study. Findings were reinforced with calculations for individual Asian regions and selected countries.

When studying fiscal sustainability, researchers often face data availability issues, leading to a limited set of countries that allows for analyzing over a longer period. Afonso & Jalles (2014) tested fiscal sustainability in 19 selected countries between 1880 and 2009. They confirmed the stationarity of the first difference of public debt for most of the countries under study, with only Spain and Japan standing out for rejecting long-term fiscal sustainability. The results of unit root tests and cointegration of budget expenditures and revenues showed consistent findings both in the study of individual countries and the entire panel.

Nzimande & Ngalava (2019) studied a group of 13 countries of the Southern African Development Community for the period 1980-2014, testing for the presence of a unit root with Pesaran's test and cointegration with Westerlund's test on the variables of budget expenditures and revenues. The authors did not reject the null hypothesis of the presence of a unit root, as the variables of budget expenditures and revenues are integrated of order one. Nevertheless, cointegration between the two fiscal variables could be confirmed, hence Nzimande & Ngalava (2019) confirmed the presence of fiscal sustainability in the countries under study. Khadan (2019) examined the fiscal sustainability of 10 Caribbean countries during the period 1991-1997. With unit root tests, cointegration, and fiscal sustainability function tests, the author confirmed weak fiscal sustainability. This status was affirmed by cointegration tests, which were also supported by the fiscal reaction function.

Afonso & Rault (2010) investigated 15 European Union countries between 1970 and 2006 using first- and second-generation unit root tests, and by checking the cointegration of budget expenditures and revenues, as well as real public debt and the primary budget balance. They found that the solvency condition was met, as the stock of real public debt is integrated of order zero. The results of unit root tests on budget expenditures and revenues were consistent, as both first- and second-generation tests confirmed the integration of both variables at order one. With Pedroni's and Westerlund's cointegration tests, cointegration between budget expenditures and revenues was confirmed, which means fiscal sustainability was affirmed in the selected European Union countries. In the study of individual countries, it was determined that Austria, Finland, France, Germany, the Netherlands, the United Kingdom, and Sweden meet the conditions of fiscal sustainability.

In their study of 19 European Union countries between 1996 and 2020, Afonso and Coelho (2022) also confirmed the solvency condition, as the first difference of the stock of real public debt showed stationarity using Pesaran's unit root test. Long-term cointegration links between budget revenues and expenditures, the primary budget balance as a percentage of GDP, public debt as a percentage of GDP, and public debt as a percentage of GDP with the primary budget balance as a percentage of GDP lagged by one time unit were also confirmed. Using Dumitrescu and Hurlin's panel Granger causality test, Afonso & Coelho (2022) found the following relationships: budget expenditures as a percentage of GDP influence budget revenues as a percentage of GDP, lagged public debt as a percentage of GDP by one year affects the primary budget deficit as a percentage of GDP, lagged primary budget deficit as a percentage of GDP by one year affect public debt as a percentage of GDP, while budget revenues as a percentage of GDP do not influence budget expenditures as a percentage of GDP. The authors confirmed the fiscal sustainability of the countries under study with the fiscal reaction function test. They also found that fiscal rules and the overall budget as a percentage of GDP positively influence fiscal sustainability, while trade openness as a percentage of GDP, the current account balance as a percentage of GDP, and government efficiency negatively affect the primary budget balance.

Covered studies in the literature review reveal diverse findings on the state of fiscal sustainability in analyzed countries using unit panel unit root and cointegration tests. For panels as a whole in the existing literature it is common to confirm the presence of weak fiscal sustainability. Furthermore, between the countries in the examined panel, we can find heterogeneous results on fiscal sustainability among them. In the present article, we complement the literature on the assessment of fiscal sustainability with a methodological approach of using unit root and cointegration tests.

Methodology and Data Set Decription

The field of research on the fiscal sustainability of countries is related to the solvency of the public budget, which refers to meeting the intertemporal budget constraint. The fundamental variables studied in fiscal sustainability are public debt and primary budget balance (Bohn, 2007). The empirical literature distinguishes two standard approaches for verifying the solvency of the public budget. The first approach focuses on examining the characteristics of time series of fiscal and macroeconomic variables. This approach involves testing the stationarity and cointegration of various fiscal variables. However, this verification does not allow for firm conclusions about fiscal sustainability due to assumptions about the characteristics of fiscal variable time series. Therefore, a second approach emerged in the empirical literature, established by Bohn (1998; 2005; 2007) for testing the solvency of the public budget by estimating the fiscal reaction function. Bohn's method of testing fiscal sustainability involves estimating the marginal responsiveness of the budget surplus to various fiscal, macroeconomic, and other variables. With this approach, fiscal sustainability can be confirmed based on the positive marginal responsiveness of the budget balance to changes in public debt and other studied variables (Cho & Lee, 2022).

The approach to assessing fiscal sustainability by testing the stationarity of public debt and the cointegration of budget expenditures and revenues was established in the empirical literature by Hamilton & Flavin (1986) and Trehan & Walsh (1991). Time series are stationary when the mean and variance in the time unit are not changing in the time. While covariance between two time units is dependent only on the time lag between values of variables in these two time units and not from the actual period, from which the covariance is calculated. For the case of fiscal sustainability, the same order of integration for various fiscal variables is important, as discrepancy would present us with the different dynamics of fiscal variables and would lead us to the conclusion of assuming fiscal unsustainability.

The theory of fiscal sustainability can be explained by an equation that represents the budget constraint, which determines budget flows (Westerlund & Prohl, 2010):

$$G_t + (1 + \mathrm{r}_t)D_{t-1} = R_t + D_t \quad (1)$$

In Equation 1, G denotes budget expenditures, R represents budget revenues, D is public debt, and r represents the real interest rate paid on public debt. The verification of fiscal sustainability stems from testing the present value of the budget constraint (PVBC), which can be written with the following equation (Afonso, 2005):

$$D_{t-1} = \sum_{s=0}^{\infty} \frac{1}{(1+r)^{s+1}}(R_{t+s} - G_{t+s}) + \lim_{s\to\infty} \frac{D_{t+s}}{(1+r)^{s+1}} \quad (2)$$

The intertemporal budget constraint is met if the second term of the equation tends towards zero in the limit to infinity. At that point, the highest growth rate of public debt is constrained by the real interest rate, which in the literature is termed as the absence of a Ponzi game or the transversality condition. Governments must balance any increase in the present value of public debt with an increase in the surplus of the primary budget balance. Testing the absence of a Ponzi game can be done by verifying the stationarity of the first difference of public debt, while fiscal sustainability can also be assessed by testing the cointegration between budget revenues and expenditures. The process of assessing fiscal sustainability is conducted in the following steps (Afonso, 2005):

- First, unit root tests are conducted on the variables of budget expenditures and budget revenues. If the budget revenues are integrated of order zero and the budget expenditures have first-order integration, or if the budget expenditures are integrated of order zero and the budget revenues have first-order integration, then we cannot confirm fiscal sustainability. If both budget revenues and budget expenditures are integrated of order zero, then such a result represents confirmed fiscal sustainability. In the case of first-order integration for both budget expenditures and budget revenues, a further cointegration test between budget revenues and budget expenditures is required.
- If budget revenues and budget expenditures are not cointegrated, then fiscal sustainability is not present. Despite the absence of cointegration between budget revenues and budget expenditures, such a connection does not pose a problem for fiscal sustainability if the budget revenues are higher than budget expenditures. In the case of cointegration between budget revenues and budget expenditures, it is necessary to check the value of the cointegration vector to assess fiscal sustainability.
- If the cointegration vector between budget expenditures and budget revenues equals 1, then there is fiscal sustainability with a constrained ratio between public debt and GDP. Fiscal sustainability is also present in the case of a cointegration vector that is less than 1, but in such a case, we have fiscal sustainability without a constrained ratio between public debt and GDP. If the cointegration vector between budget expenditures and budget revenues is greater than 1, then we cannot confirm fiscal sustainability.

However, it is necessary to be aware that verifying fiscal sustainability solely through the first approach, which consists of examining the characteristics of time series, can lead to misleading conclusions. Numerous unit root tests can show different results regarding the stationarity of fiscal variables, and such an examination of fiscal sustainability involves an excessive focus on past dynamics, which cannot guarantee the future dynamics of fiscal variables. Verifying fiscal sustainability with unit root and cointegration tests does not allow us to study and identify the various factors affecting fiscal sustainability, providing limited informational value about the formulated fiscal policy. A sensible complement is the second approach to verifying fiscal sustainability according to Bohn's method, which allows checking the impact of public debt, macroeconomic, and other variables on the primary budget balance with a regression model (Can, 2023).

In this research, we will limit ourselves to the approach of testing the stationarity and cointegration of various fiscal variables, taking into account the mentioned limitations of this approach.

The data for the analysis of fiscal sustainability were collected from the IMF database (2023), designed by Mauro et al. (2015). In line with the research of Afonso & Coelho (2022) and other studies presented in the literature review, data were collected for budget revenues, budget expenditures, the primary budget balance, and public debt. All the variables under study are expressed as a percentage of GDP. Annual data for all countries were obtained from the database, and then the selection of countries was based on the availability of data for the period between 1995 and 2021, which represents our study period. For the feasibility of empirical tests, we aimed to create balanced panels, so that countries included in the analysis had available data for the observed period between 1995-2021. 127 countries were divided into the following four groups based on geographical location:

- Europe – 30 countries and 27 years, resulting in 810 observations;
- Asia and Oceania – 37 countries and 27 years, resulting in 999 observations;
- Africa – 32 countries and 27 years, resulting in 864 observations;
- Latin America, the Caribbean, and North America – 28 countries and 27 years, resulting in 756 observations.

The division of countries into groups is shown in Appendix 1, where the four presented groups of countries make up separate panel data that we analyzed in the study. In these groups of countries, we tested the hypothesis stating: Fiscal sustainability is present in the studied groups of countries between 1995 and 2021.

Results

In this chapter, we first presented the descriptive statistics of the fiscal variables studied in the research. This is followed by the first-generation unit root tests of Levin, Lin & Chu, and Im, Pesaran & Shin, which we used to test the stationarity of budget revenues and expenditures, the primary budget balance, and the first difference of public debt. We then checked for the presence of a unit root on the same variables using Pesaran's test, as this second-generation unit root test accounts for cross-sectional dependence. Conclusions about the presence of fiscal sustainability in the groups of countries under study were made after conducting Pedroni's cointegration test and Dumitrescu and Hurlin's Granger causality test.

Descriptive Statistics

Before we begin presenting the calculations of unit roots, cointegration, and Granger causality, we can examine the descriptive statistics of individual groups of countries, where special attention was paid to the arithmetic mean and standard deviation. In Table 1, we can observe that, during the study period, the group of European countries recorded the highest value of the arithmetic mean in budget revenues, budget expenditures, and public debt.

For budget revenues and budget expenditures, this difference is relatively high, as European countries have more than a 10 percentage point higher share of budget expenditures and revenues as a percentage of GDP than the group of countries from Asia and Oceania, which has the second-highest arithmetic mean value of these two fiscal variables. The arithmetic mean of public debt as a percentage of GDP for European countries compared to other groups is not significantly higher, as African countries have a lower arithmetic mean value of public debt as a percentage of GDP by 1.2 percentage points. The highest average value of the primary budget balance as a percentage of GDP is recorded by the group of countries from Asia and Oceania, which, like European countries and the group of countries from Latin America, the Caribbean, and North America, have an average primary budget balance as a percentage of GDP in surplus. Only the group of countries from Asia and Oceania has an average value of the primary budget balance as a percentage of GDP in deficit. The lowest average value of budget revenues and budget expenditures as a percentage of GDP can be found in the group of African countries, while the group of countries from Asia and Oceania recorded the lowest average value of public debt as a percentage of GDP during the study period.

The highest standard deviation of the variables of budget revenues, budget expenditures, and the primary budget balance was recorded in the group of countries from Asia and Oceania, indicating that this group of countries had the highest variability around the average for these variables. This suggests relatively the most volatile and diverse fiscal policy among the countries studied. Public debt as a percentage of GDP had the highest standard deviation in the group of African countries. On the other hand, the group of countries from Latin America, the Caribbean, and North America had the relatively lowest standard deviation for the variables of budget revenues and the primary budget balance, while the relatively

lowest value of the standard deviation for budget expenditures and public debt was recorded in the group of European countries.

Table 1
Descriptive statistics of examined fiscal variables

Europe	*Government revenue (% of GDP)*	*Government expenditure (% of GDP)*	*Primary budget balance (% of GDP)*	*Public debt (% of GDP)*
Mean	42.73741	44.86787	0.479833	59.67061
Median	42.67662	45.36931	0.213939	53.73911
Maximum value	59.67470	66.82280	20.57039	212.4489
Minimum value	22.29026	24.26086	-28.17485	3.764939
Standard deviation	7.140171	7.092167	4.077183	34.20736
Asia and Oceania	*Government revenue (% of GDP)*	*Government expenditure (% of GDP)*	*Primary budget balance (% of GDP)*	*Public debt (% of GDP)*
Mean	30.95163	32.22020	0.723899	47.44849
Median	26.64701	30.28318	-0.233833	39.64523
Maximum value	153.3713	137.3595	47.76756	262.4920
Minimum value	3.487907	8.392471	-24.52537	1.561886
Standard deviation	18.31017	16.29593	7.108267	35.20019
Africa	*Government revenue (% of GDP)*	*Government expenditure (% of GDP)*	*Primary budget balance (% of GDP)*	*Public debt (% of GDP)*
Mean	21.01225	23.47001	-0.715881	58.55503
Median	18.40130	21.53123	-1.221664	48.98661
Maximum value	62.66851	141.5014	31.24285	263.3720
Minimum value	2.764126	7.380385	-117.6795	0.488086
Standard deviation	9.646273	10.66361	6.409674	40.20173
Latin America, the Caribbean, and North America	*Government revenue (% of GDP)*	*Government expenditure (% of GDP)*	*Primary budget balance (% of GDP)*	*Public debt (% of GDP)*
Mean	22.76766	25.30024	0.103356	55.23910
Median	22.76704	25.02865	0.063303	46.78176
Maximum value	60.12687	67.93982	14.41452	319.0883
Minimum value	4.300100	9.311014	-30.27498	3.901890
Standard deviation	6.947125	7.336462	3.917408	34.31300

Source: Authors' calculation

First-Generation Panel Unit Root Tests

First-generation unit root tests that account for cross-sectional independence are the first step in verifying fiscal sustainability under the considered approach. Special attention needs to be paid to the first difference of public debt, which, by testing for the presence of a unit root, allows for the verification of the solvency condition in the groups of countries under study when the unit root process of the first difference of public debt is rejected. Checking for the presence of a unit root in the time series of budget expenditures and revenues will provide initial findings regarding fiscal sustainability before testing for cointegration. Table 2 shows the results of the LLC unit root test, which assumes a common unit root process, while Table 3 presents the results of the IPS unit root test, which assumes an individual unit root process. Both tests assume the presence of a unit root process. The calculations included automatic lag selection based on the Schwarz Information Criterion, and spectral estimation was based on the Newey-West selection of bandwidth using Bartlett's kernel, assuming asymptotically normal distribution. Rejecting the null hypothesis of both tests, which means rejecting the presence of a unit root and confirming stationarity, we can only assert that stationarity is present in at least one member of the panel. Thus, rejection of the null hypothesis does not provide information on which countries or how many countries exhibit stationarity for the variable under consideration (Afonso & Rault, 2010).

Table 2
Results of the Levin, Lin & Chu panel unit root test

	Europe	*Asia and Oceania*	*Africa*	*Latin America, the Caribbean, and North America*
Constant				
Government revenue (% of GDP)	-1.48554*	-0.99788	-4.02057***	-2.76902***
Government expenditure (% of GDP)	-5.96116***	-1.95857**	-3.21325***	1.04700
Primary budget balance (% of GDP)	-4.63160***	-5.51647***	-9.35805***	-4.20592***
First Difference of the Public debt (% of GDP)	-14.6232***	-16.4158***	-16.3197***	-2.72034***
Constant and trend				
Government revenue (% of GDP)	0.59797	-5.48746***	-4.47286***	-3.55502***
Government expenditure (% of GDP)	-4.46873***	-2.17942**	-5.46798***	-1.71347**
Primary budget balance (% of GDP)	-4.18343***	-5.32131***	-11.3642***	-3.63310***
First Difference of the Public debt (% of GDP)	-13.9821***	-15.0000***	-12.5220***	-11.2574***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level
Source: Author's calculation

When considering the group of European countries, it can be determined that both first-generation unit root tests confirm the stationarity of the first difference of public debt both with a constant and with a constant and trend. The same applies to the variables of budget expenditures and the primary budget balance. For the variable of budget revenues, the presence of a unit trend cannot be rejected with a constant and trend using the LLC and IPS tests, while budget revenues are stationary at a 1% risk of rejecting the null hypothesis with the IPS test and show stationarity at 10% in the case of the LLC test. In accordance with the empirical literature, fiscal sustainability for the group of European countries can indeed be confirmed, but there is some deviation in rejecting the unit root for budget revenues with the LLC test. In this case, it is necessary to compare the results with Pesaran's unit root test, which is presented in the following subsection.

Similarly, for the group of Asia and Oceania countries, the solvency condition can be confirmed, as the first difference of public debt is stationary at less than a 1% risk. According to the results of the LLC test, budget revenues have a unit root present at the constant, while they are stationary at less than a 1% level of significance when considering both constant and trend. On the other hand, the IPS test rejects the presence of a unit root in budget revenues both at the constant and with the constant and trend. Budget expenditures and the primary budget balance show stationarity, as both the LLC and IPS tests for these variables in the Asia and Oceania sample, indicate the absence of a unit root at least at a 5% level of significance. Similarly to European countries, it is not possible to conclusively assert fiscal sustainability for the group of Asia and Oceania countries using first-generation unit root tests, as the variable of budget revenues in the LLC test showed the presence of a unit root at the constant.

African countries have demonstrated the highest level of fiscal sustainability among all four groups of countries considered, according to the LLC and IPS tests. We can observe that the solvency condition is met with the integration of the first difference of public debt at the order of zero, while the variables of budget revenues and expenditures and the primary budget balance are stationary both at the constant and with the constant and trend. The absence of a unit root in the variables of budget revenues and expenditures is an important indicator of fiscal sustainability, which needs to be further confirmed with additional tests.

Table 3
Results of the Im, Pesaran & Shin panel unit root test

	Europe	*Asia and Oceania*	*Africa*	*Latin America, the Caribbean, and North America*
Constant				
Government revenue (% of GDP)	-2.37418***	-2.25532**	-4.18798***	-2.32613**
Government expenditure (% of GDP)	-7.93940***	-2.53763***	-2.88627***	-0.02365
Primary budget balance (% of GDP)	-6.53505***	-6.48067***	-10.1247***	-6.09916***
First Difference of the Public debt (% of GDP)	-15.1903***	-16.2201***	-16.3579***	-11.3466***
Constant and trend				
Government revenue (% of GDP)	-0.82741	-4.30719***	-5.86603***	-3.03362***
Government expenditure (% of GDP)	-5.04862***	-3.87034***	-6.27277***	-2.32041**
Primary budget balance (% of GDP)	-6.09060***	-6.21848***	-11.1666***	-5.64099***
First Difference of the Public debt (% of GDP)	-13.8302***	-13.8185***	-16.5893***	-14.8464***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Author's calculation

Similarly, the solvency condition was also met in the group of Latin America, the Caribbean, and North American countries, as the stationarity of the first difference of public debt can be confirmed with both first-generation unit root tests. At a significance level of more than 5%, budget revenues are statistically significantly stationary, which does not apply to budget expenditures, as we cannot reject the unit root at the constant for both the LLC and IPS tests. When considering both constant and trend, at a 5% significance level, we can reject the unit root in budget expenditures using both unit root tests. The primary budget balance is stationary in both first-generation unit root tests, with no significant difference in statistical significance when considering the constant and the constant and trend. Based on the obtained unit root results, we can draw similar conclusions as for the group of European and Asian countries and Oceania. While considering both constant and trend allows us to confirm fiscal sustainability in the group of Latin America, the Caribbean, and North American countries, the presence of a unit root at the constant for the variable of budget expenditures reveals some deviation from the criteria of fiscal sustainability in stationarity tests.

Second-Generation Pesaran's Panel Unit Root Test

Considering cross-dependence is crucial in evaluating groups of countries that are closely interconnected in trade and capital flows and participate in economic integrations (Afonso & Coelho, 2022). These characteristics will be considered in the analyzed country panels, as we will assess fiscal sustainability using Pesaran's second-generation unit root test, which allows for cross-dependence in its assumptions. The results of the first-generation unit root tests confirmed the solvency condition for all groups of countries, as the existence of a unit root could be rejected. When testing the stationarity of the variables of government revenues and expenditures, we could only reject the unit root process in Africa, while in the other three groups of countries, we did not manage to confidently accept the condition of fiscal sustainability or the intertemporal budget constraint. The results of the Pesaran's panel unit root test are presented in Table 4. In the calculations, a lag of one was considered, consistent with the approach used by Afonso & Coelho (2022) in their Pesaran's unit root test calculations. Pesaran's test evaluates the null hypothesis describing the presence of a unit root process in the examined variable.

Table 4
Results of the Pesaran panel unit root test of second generation (CIPS statistic)

	Europe	*Asia and Oceania*	*Africa*	*Latin America, the Caribbean, and North America*
Constant				
Government revenue (% of GDP)	-1.50839	-1.89822	-2.07310*	-2.32487***
Government expenditure (% of GDP)	-1.99239	-1.89657	-2.01572	-2.17183**
Primary budget balance (% of GDP)	-1.99674	-1.97427	-2.73163***	-2.38550***
First Difference of the Public debt (% of GDP)	-3.04459***	-2.82710***	-3.72472***	-2.63125***
Constant and trend				
Government revenue (% of GDP)	-1.82415	-2.14902	-2.98306***	-3.07941***
Government expenditure (% of GDP)	-2.52028	-2.15562	-2.62638*	-2.42289
Primary budget balance (% of GDP)	-2.45800	-2.43191	-3.18237***	-2.58841
First Difference of the Public debt (% of GDP)	-3.48148***	-2.99060***	-4.05814***	-3.13240***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Author's calculation

In the group of European countries, we can again accept the solvency condition, as the first difference of the public debt as a percentage of GDP is stationary both with a constant and with a constant and trend. Unlike the first-generation unit root tests, we cannot reject the null hypothesis of the presence of a unit root process for all three remaining fiscal variables. The non-stationarity of government revenues and expenditures with a constant and with a constant and trend requires further examination of fiscal sustainability of European countries in the studied period using a cointegration test of both fiscal variables.

Similar findings to those for European countries can be concluded for the group of Asia and Oceania countries, which also meet the solvency condition, as the first difference of public debt is stationary with both a constant and a constant and trend. Calculated CIPS statistics compared to the corresponding critical values show that government expenditures, government revenues, and primary budget balance are non-stationary. The hypotheses regarding the presence of a unit root process could not be rejected both with a constant and a constant and trend. The first-generation unit root tests only rejected the unit root for government revenues when considering a constant, thus showing some deviation from Pesaran's second-generation unit root test. A conclusion regarding the fiscal sustainability of the group of Asia and Oceania countries will need to be made after examining the cointegration between government expenditures and revenues, as well as between the primary budget balance and public debt.

In the group of African countries, it was possible to confirm the stationarity of all examined fiscal variables, so we were interested in whether similar results would be obtained when considering cross-dependence in the unit root calculations. The first difference of public debt is statistically significantly stationary at less than 1% risk of rejecting the existence of a unit root process with both a constant and a constant and trend. For government revenues, the null hypothesis of a unit root process can be rejected at a 10% statistical significance level when considering a constant, while this variable is statistically significant at less than 1% with both a constant and trend. Government expenditures in African countries are stationary only at a 10% statistical significance level when considering both a constant and trend, which cannot be claimed when considering only a constant, as the null hypothesis of the presence of a unit root process cannot be rejected. On the other hand, the primary budget balance is stationary both with a constant and with a constant and trend. Pesaran's unit root test provided completely different results in assessing fiscal sustainability compared to first-generation unit root tests. Considering a constant in Pesaran's unit root test,

it can be stated at a 5% significance level that African countries are fiscally unsustainable. However, considering both a constant and trend in the second-generation unit root test, at a 10% risk, we can accept the first-order integration for government expenditures and revenues. These findings will also need to be verified with cointegration tests of fiscal variables.

The group of Latin American, Caribbean, and North American countries has confirmed the stationarity of government revenues, primary budget balance, and the first difference of public debt in the unit root tests, while for government expenditures, the unit root process could not be rejected. Considering both a constant and trend in Pesaran's unit root test, we cannot reject the null hypothesis of a unit root process for government expenditures. However, when considering only a constant, it can be observed that the government expenditure variable is stationary at a 5% statistical significance level. At less than 1% risk of rejecting the null hypothesis, we can reject the unit root process with a constant for government revenues, primary budget balance, and the first difference of public debt. Similarly, this applies to government revenues and the first difference of public debt when considering both a constant and trend, while in this case, the primary budget balance is not stationary. Although the condition of solvency is met, fiscal sustainability will need to be verified with the Pedroni cointegration test. Fiscal sustainability can be examined with a cointegration test since government revenue and expenditure variables are statistically significantly stationary at 5% when considering a constant.

Pedroni Cointegration Test and Dumitrescu and Hurlin Panel Causality Test

In accordance with the procedure for testing fiscal sustainability used by Afonso & Coelho (2022), we employed the Pedroni Cointegration Test to examine the cointegration of the following pairs of fiscal variables: government revenue and government expenditure, primary budget balance and lagged public debt, and public debt and lagged primary budget balance. In the calculations of the Pedroni test, spectral estimation was based on Newey-West bandwidth selection using the Bartlett kernel, while assuming one lag. The Pedroni test assesses the null hypothesis that there is no cointegration among the variables. Additionally, among these pairs, we investigated Granger causality using the Dumitrescu and Hurlin test, with one lag and assuming normal distribution, following the procedure and selection of fiscal variable pairs as conducted by Afonso & Coelho (2022).

Table 5

Pedroni's cointegration test for the panel of European countries

	Relation	*Revenues and expenditures*		*Primary balance and lagged debt*		*Debt and lagged primary balance*	
		No trend	Trend	No trend	Trend	No trend	Trend
Within-dimension	Panel *v*	2.7336***	0.9668	5.4697***	1.2454	-1.9001	-1.5977
	Panel *rho*	-4.4083***	-2.9014***	-5.2502***	-2.5690***	2.0231	2.5752
	Panel PP	-4.7124***	-4.7496***	-5.0737***	-4.6190***	1.2594	1.3138
	Panel ADF	-2.5964***	-2.4213***	-4.4421***	-4.1597***	1.5255	2.1041
Between-dimension	Group *rho*	-1.9961**	0.0852	-3.4038***	-0.6964	3.2782	3.6709
	Group PP	-3.7939***	-2.7154***	-5.3489***	-5.7932***	1.7615	1.5730
	Group ADF	-2.3389***	-1.7747**	-5.6678***	-5.8454***	2.4094	3.8105

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.

Source: Author's calculation

If we proceed from the Pedroni Cointegration Test, we can continue examining the fiscal sustainability of European countries, as both government revenue and government expenditure are integrated of the first order. In Table 5, the results of the Pedroni Cointegration Test for the three pairs of fiscal variables of the group of European countries are presented. Considering the constant term, government revenue and government expenditure are statistically significantly cointegrated at least at the 5% level, allowing us to infer the presence of fiscal sustainability among the group of European countries. Similarly, the primary budget balance and lagged public debt are also cointegrated at the constant term, indicating a long-term stable relationship between

these fiscal variables. However, for public debt and lagged primary budget balance, we cannot confirm cointegration, and it is also not possible to conclude cointegration when considering both constant and trend for the pairs of government revenue and government expenditure and primary budget balance and lagged public debt in the calculation of cointegration test statistics in the Pedroni test.

With the Dumitrescu and Hurlin Granger causality test, we examined the causal relationship between different pairs of fiscal variables. The results of the Dumitrescu and Hurlin causality test for the group of European countries are presented in Table 6. We observe that there is no statistically significant impact of government revenue on government expenditure, as also found by Afonso & Coelho (2022) in the case of European Union countries. The absence of this relationship implies that governments do not adjust government expenditures based on collected government revenues. On the other hand, we can confirm a statistically significant impact of government expenditure on government revenue, indicating that governments of European countries adjust government expenditures based on collected government revenues. Similarly, there is a causal relationship between lagged public debt and primary budget balance, as well as lagged primary budget balance and public debt, although these latter two variables are not cointegrated.

Table 6

Dumitrescu and Hurlin causality test for the panel of European countries

Null Hypothesis:	*W-statistic*	*Z bar-statistic*	*p-value*
Government expenditures does not homogeneously cause government revenues	2.65652	5.13080	0.0000***
Government revenues does not homogeneously cause government expenditures	1.35938	0.86804	0.3854
Lagged debt does not homogeneous cause primary budget balance	2.63264	4.99154	0.0000***
Lagged primary budget does not homogeneous cause debt	2.21041	3.61797	0.0003***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.

Source: Author's calculation

For the group of countries in Asia and Oceania, based on the results of the Pedroni Cointegration Test presented in Table 7, we can confirm the cointegration of lagged primary budget balance and public debt, as well as lagged public debt and primary budget balance, considering the constant term. Government revenue and government expenditure are cointegrated at a 10% level of statistical significance, indicating that we cannot assert strong fiscal sustainability within the group of Asia and Oceania countries. However, when both constant and trend are considered in the cointegration test, due to the panel and group rho statistics, we cannot confirm cointegration between government revenue and government expenditure, primary budget balance and lagged public debt, and public debt and lagged primary budget balance.

Table 7

Pedroni's cointegration test for the panel of Asian and Oceanian countries

	Relation	*Revenues and expenditures*		*Primary balance and lagged debt*		*Debt and lagged primary balance*	
		No trend	Trend	No trend	Trend	No trend	Trend
Within-dimension	Panel *v*	1.4067*	-1.8887	4.4484***	0.4223	1.9976**	-1.9420
	Panel *rho*	-6.3402***	-4.8120***	-6.3416***	-3.6158***	-7.7650***	-6.6870***
	Panel PP	-6.4326***	-7.1902***	-6.3288***	-6.0432***	-7.3727***	-10.458***
	Panel *ADF*	-3.3050***	-3.0541***	-3.2786***	-4.1080***	-4.9865***	-7.5389***
Between-dimension	Group *rho*	-3.1217***	-1.1213	-3.7260***	-1.2645	-4.1364***	-2.6190***
	Group *PP*	-5.3293***	-4.9665***	-5.8870***	-5.7312***	-6.0841***	-7.5438***
	Group *ADF*	-4.0284***	-3.9036***	-4.8495***	-6.0189***	-3.9415***	-4.7847***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.

Source: Author's calculation

The results of the Dumitrescu and Hurlin causality test for fiscal variables of Asian and Oceanian countries are presented in Table 8. At less than a 1% level of statistical significance, we can confirm the causal relationship among all examined links between fiscal variables. This implies bidirectional causality between government revenue and government expenditure, as well as lagged public debt affecting the primary budget balance and lagged primary budget balance affecting public debt. Unlike European countries, in the group of Asia and Oceania countries, the influence of government expenditure on government revenue can be detected.

Table 8

Dumitrescu and Hurlin causality test for the panel of Asian and Oceanian countries

Null Hypothesis:	*W-statistic*	*Z bar-statistic*	*p-value*
Government expenditures does not homogeneously cause government revenues	2.11584	3.71803	0.0002***
Government revenues does not homogeneously cause government expenditures	3.67707	9.40926	0.0000***
Lagged debt does not homogeneous cause primary budget balance	2.37614	4.61114	0.0000***
Lagged primary budget does not homogeneous cause debt	1.84447	2.68889	0.0072***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Authors' calculation

For the group of African countries, using the Pesaran unit root test, we found that government revenue is integrated of order zero at a 10% level of statistical significance, while we failed to reject the null hypothesis of a unit root process for government expenditure. Given these results of the unit root test at a 10% level of significance, further testing of fiscal sustainability is precluded as it cannot be confirmed. The Pedroni Cointegration Test for the group of African countries can only be continued at a lower level of statistical significance and considering only the estimates with constant and trend. From Table 9, displaying the results of the Pedroni Cointegration Test for Africa, we can infer that there is cointegration among all examined pairs of fiscal variables when the constant term is considered. The obtained results of the statistical significance of the cointegration test enable similar conclusions to those of the Asia and Oceania group. Based on these results, fiscal sustainability can be confirmed in the studied group of African countries. However, considering both the constant and trend, cointegration among the examined pairs of fiscal variables cannot be confirmed due to differing results of the test statistics, as all cases of the panel t-statistics are statistically insignificant. These results are not representative when considering a 5% level of statistical significance, as government revenue and government expenditure are not integrated of the same order.

Table 9

Pedroni's cointegration test for the panel of African countries

	Relation	*Revenues and expenditures*		*Primary balance and lagged debt*		*Debt and lagged primary balance*	
		No trend	Trend	No trend	Trend	No trend	Trend
Within-dimension	Panel *v*	10.5484***	4.9245***	4.1592***	-0.3197	5.3668***	0.5598
	Panel *rho*	-17.081***	-14.1906***	-7.1144***	-4.8442***	-13.461***	-11.2900***
	Panel PP	-24.133***	-22.891***	-7.6486***	-8.0184***	-13.867***	-16.098***
	Panel *ADF*	-4.1920***	-2.1541***	-3.8303***	-3.4768***	-4.4789***	-4.9332***
Between-dimension	Group *rho*	-5.0910***	-2.5941***	-4.8307***	-2.8620***	-5.9721***	-4.4017***
	Group *PP*	-7.7680***	-7.3456***	-8.0491***	-8.9015***	-9.3700***	-13.4063***
	Group *ADF*	-3.6312***	-3.7432***	-5.0920***	-6.3710***	-5.0074***	-7.1234***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Authors' calculation

In Table 10, the results of the Dumitrescu and Hurlin causality test for the examined pairs of fiscal variables for the group of African countries are presented. Government expenditure influences government revenue at a 5% level of statistical significance. At less than a 1% level of statistical significance, we can assert that government revenue influences government expenditure and lagged primary budget balance affects public debt. However, it is not possible to confirm the statistically significant influence of lagged public debt on the primary budget balance.

Table 10

Dumitrescu and Hurlin causality test for the panel of African countries

Null Hypothesis:	*W-statistic*	*Z bar-statistic*	*p-value*
Government expenditures does not homogeneously cause government revenues	1.74687	2.21165	0.0270**
Government revenues does not homogeneously cause government expenditures	2.88079	6.06024	0.0000***
Lagged debt does not homogeneous cause primary budget balance	1.26892	0.56870	0.5696
Lagged primary budget does not homogeneous cause debt	2.27819	3.96653	0.0000***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Authors' calculation

In Table 11, the results of the Pedroni Cointegration Test for various pairs of fiscal variables for the group of Latin American, Caribbean, and North American countries are presented. To assess the fiscal sustainability of this group of countries using the Pedroni Cointegration Test, we can focus solely on the results that consider the constant term, as government revenue and government expenditure are integrated of different orders. Government revenue and government expenditure are statistically significantly cointegrated at less than a 1% level, thus confirming the existence of fiscal sustainability in the group of Latin American, Caribbean, and North American countries.

Additionally, according to Table 10, it can be observed that primary budget balance and lagged public debt are cointegrated at a statistically significant level of at least 1%, while public debt and lagged primary budget balance are not cointegrated.

The Dumitrescu and Hurlin causality test, presented in Table 12, for the group of Latin American, Caribbean, and North American countries, confirms bidirectional causality between government expenditure and government revenue at a 1% level of statistical significance. The influence of lagged public debt on the primary budget balance is statistically significant at 5%. At less than a 1% level of statistical significance, lagged primary budget balance affects public debt, although this relationship cannot be meaningfully interpreted due to the absence of cointegration between the variables.

Table 11

Pedroni's cointegration test for the panel of Latin American, Caribbean, and North American countries

	Relation	*Revenues and expenditures*		*Primary Balance and Lagged debt*		*Debt and Lagged Primary balance*	
	Statistics	No trend	Trend	No trend	Trend	No trend	Trend
Within-dimension	Panel *v*	3.5936***	0.9500	4.6691***	1.9395**	0.0048	-2.3152
	Panel *rho*	-5.5552***	-4.7446***	-5.4492***	-4.4167***	-1.0918	2.6602
	Panel PP	-5.5923***	-6.9991***	-5.6296***	-6.9183***	-1.0467	1.6554
	Panel *ADF*	-3.6845***	-3.8260***	-4.4653***	-6.2860***	3.5636	5.0459
Between-dimension	Group *rho*	-2.8065***	-1.2102	-2.9859***	-1.1272	2.9249	2.3692
	Group *PP*	-4.3463***	-4.3599***	-4.7215***	-4.9284***	2.2347	0.5067
	Group *ADF*	-2.2467**	-2.7065***	-4.1719***	-4.7827***	4.6787	3.4666

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Authors' calculation

Table 12
Dumitrescu and Hurlin causality test for the panel of Latin American, Caribbean, and North American countries

Null Hypothesis:	*W-statistic*	*Z bar-statistic*	*p-value*
Government expenditures does not homogeneously cause government revenues	2.23502	3.61863	0.0003***
Government revenues does not homogeneously cause government expenditures	2.41521	4.19070	0.0000***
Lagged debt does not homogeneous cause primary budget balance	1.77436	2.11971	0.0340**
Lagged primary budget does not homogeneous cause debt	4.86224	11.8436	0.0000***

Notes: ***statistically significant at 1% significance level, ** statistically significant at 5% significance level.
Source: Authors' calculation

Conclusions

We examined fiscal sustainability in the groups of European, Asian and Oceanic, African, and Latin American, Caribbean, and North American countries. These four groups of countries represented separate panel data, on which we verified the presence of fiscal sustainability. Fiscal sustainability of the four groups of countries was examined over the period 1995-2021. The panel data consisted of fiscal variables such as government revenue, government expenditure, primary budget balance, and public debt, with all analyzed variables expressed as a percentage of GDP. The methodology for examining fiscal sustainability followed the procedure of Afonso & Rault (2010) and Afonso & Coelho (2022).

We tested the fiscal variables for the presence of a unit root using the Levin, Lin, and Chu test and the Im, Pesaran, and Shin test, both of which confirmed the solvency condition in all four groups of countries. Government expenditure and government revenue showed different orders of integration when considering the constant term in European countries, Asian and Oceanic countries, and the group of Latin American, Caribbean, and North American countries. Considering both the constant and trend in both first-generation unit root tests confirmed the stationarity or the same order of integration of fiscal variables, except for European countries. Given the emphasis on cross-dependencies by many authors, recent research on the fiscal sustainability of countries often employs only second-generation unit root tests. From this group of unit root tests, we used the Pesaran unit root test, which accounts for cross-dependencies, to obtain the basis for further examining fiscal sustainability. The Pesaran unit root test again confirmed the solvency condition, as we were able to reject the unit root process for the first difference of public debt. However, the Pesaran unit root test yielded different results than first-generation unit root tests. Government revenue and government expenditure showed first-order integration when considering the constant term at a 5% level of statistical significance. Considering both the constant and trend in the Pesaran unit root test and a 5% level of statistical significance, the same order of integration was present only in European countries and the group of Asian and Oceanic countries.

Based on the findings presented, we can accept the hypothesis set before the research. Despite confirming the solvency condition and fiscal sustainability for all groups of countries at a 10% level of statistically significant cointegration of government expenditure and government revenue when considering the constant term, the results showed some deviations. These were mainly present when examining other pairs of fiscal variables and when considering both the constant and trend in both cointegration tests and unit root tests. In the review of the empirical literature, we mostly found studies that confirmed fiscal sustainability, albeit in a weak form. While the groups of countries under study were larger than those in previous research, we found alignment with the findings of these studies. For a more detailed examination, it would be reasonable to further divide countries into smaller and economically more homogeneous groups in future research. Moreover, it would be reasonable to incorporate structural break tests, which would provide us with more accurate and robust results regarding assessment of the fiscal sustainability using unit root tests. However, these tests are out of the scope of this study.

Based on the findings presented, we can accept the hypothesis set before the research. Despite confirming the solvency condition and fiscal sustainability for all groups of countries at a 10% level of statistically significant cointegration of government expenditure and government revenue when considering the constant term, the results showed some deviations. These were

mainly present when examining other pairs of fiscal variables and when considering both the constant and trend in both cointegration tests and unit root tests. In the review of empirical literature, we mostly found studies that confirmed fiscal sustainability, albeit in a weak form. While the groups of countries under study were larger than those in previous research, we found alignment with the findings of these studies.

For a more detailed examination, it would be reasonable to further divide countries into smaller and economically more homogeneous groups in future research. Moreover, it would be reasonable to incorporate structural break tests, which would provide us with more accurate and robust results regarding assessment of the fiscal sustainability using unit root tests. However, these tests are out of the scope of this study. Additionally, individual cross-sectional units or countries were not examined, which could have enabled the identification of the characteristics of fiscal sustainability of each country in the corresponding group. Based on the available data, it would also be sensible to form smaller groups of countries with longer time series of fiscal data.

Furthermore, it would be necessary to estimate fiscal reaction functions, which could provide additional information on fiscal sustainability. Assessment of the fiscal sustainability with panel unit root and cointegration tests has a major informational drawback from its methodological approach, as it only provides us the information about the state of fiscal sustainability in the analyzed group of countries. The extension of the analysis with the employment of fiscal reaction functions would provide us with necessary information about determinants of fiscal sustainability that would enable us to develop usable policy implications.

References

Adams, C., Ferrarini, B., & Park, D. (2010). Fiscal Sustainability in Developing Asia. *Asian Development Bank Economics Working Paper Series No. 205*. Manilla: ADB. DOI: http://dx.doi.org/10.2139/ssrn.1640264

Afonso, A. (2005). Fiscal sustainability: The unpleasant European case. *FinanzArchiv/Public Finance Analysis, 61*(1), 19–44. DOI: http://dx.doi.org/10.1628/0015221053722532

Afonso, A., & Coelho, J. C. (2022). Fiscal Sustainability, Fiscal Reactions, Pitfalls and Determinants. *CESifo Wroking Paper No. 9635*. München: CESifo. DOI: http://dx.doi.org/10.2139/ssrn.4063444

Afonso, A., & Jalles, J. T. (2014). A Longer-Run Perspective on Fiscal Sustainability. *Empirica, 41*, 821–847. DOI: http://dx.doi.org/10.1007/s10663-013-9240-0

Afonso, A., & Rault, C. (2010). What Do We Really Know About Fiscal Sustainability in the EU? A Panel Data Diagnostic. *Review of World Economics*, *145*, 731–755. DOI: http://dx.doi.org/10.1007/s10290-009-0034-1

Baharumshah, A. Z., & Lau, E. (2007). Regime Changes and the Sustainability of Fiscal Imbalance in East Asian Countries. *Economic Modelling, 24*(6), 878–894. DOI: http://dx.doi.org/10.1016/j.econmod.2007.03.002

Beqiraj, E., Fedeli, S., & Forte, F. (2018). Public Debt Sustainability: An Empirical Study on OECD Countries. *Journal of Macroeconomics, 58*, 238–248. DOI: http://dx.doi.org/10.1016/j.jmacro.2018.10.002

Bohn, H. (1998). The Behavior of US Public Debt and Deficits. *The Quarterly Journal of Economics, 113*(3), 949–963. Retrieved from: https://msuweb.montclair.edu/~lebelp/BohnPubDebtQJE1998.pdf

Bohn, H. (2005). The Sustainability of Fiscal Policy in the United States. *CESifo Working Paper No. 1446*. München: CESifo. DOI: http://dx.doi.org/10.2139/ssrn.708173

Bohn, H. (2007). Are Stationarity and Cointegration Restrictions Really Necessary for the Intertemporal Budget Constraint? *Journal of Monetary Economics, 54*(7), 1837–1847. DOI: http://dx.doi.org/10.1016/j.jmoneco.2006.12.012

Brady, G. L., & Magazzino, C. (2018). Fiscal Sustainability in the EU. *Atlantic Economic Journal, 46*, 297–311. DOI: http://dx.doi.org/10.1007/s11293-018-9588-4

Brady, G. L., & Magazzino, C. (2019). Government Expenditures and Revenues in Italy in a Long-Run Perspective. *Journal of Quantitative Economics, 17*, 361–375. DOI: http://dx.doi.org/10.1007/s40953-019-00157-z

Campo-Robledo, J., & Melo-Velandia, L. F. (2015). Sustainability of Latin American Fiscal Deficits: A Panel Data Approach. *Empirical Economics, 49*(3), 889–907. DOI: http://dx.doi.org/10.1007/s00181-014-0905-8

Can, C. K. (2023). Estimating Bohn's Fiscal Sustainability Model with Temporal Variation: Evidence from Turkey. *Prague Economic Papers, 32*(1), 61–83 DOI: http://dx.doi.org/10.18267/j.pep.822

Carrion-i-Silvestre, J. L., del Barrio-Castro, T., & Lopez-Bazo, E. (2005). Breaking the Panels: An Application to the GDP per Capita. *The Econometrics Journal, 8*(2), 159–175. Retrieved from: https://www.jstor.org/stable/23113636

Case, K. E., Fair, R. C., & Oster, S. M. (2012). *Principles of Macroeconomics* (10. iss.). Boston: Pearson.

Chen, S. W. (2014). Testing for fiscal sustainability: New evidence from the G-7 and some European countries. *Economic Modelling, 37*, 1–15. DOI: http://dx.doi.org/10.1016/j.econmod.2013.10.024

Cho, D., & Lee, K. W. (2022). Population Aging and Fiscal Sustainability: Nonlinear Evidence from Europe. *Journal of International Money and Finance, 126*, 102665. DOI: http://dx.doi.org/10.1016/j.jimonfin.2022.102665

Croce, E., & Juan-Ramón, H. (2003). Assesing Fiscal Sustainability: A Cross-Country Comparison. *IMF Working Paper No. WP/03/145*. Washington D. C.: IMF. Retrieved from: https://www.imf.org/external/pubs/ft/wp/2003/wp03145.pdf

Döring, T., & Oehmke, R. D. (2019). About the Economic Psychology of Public Debt. *Intereconomics, 54*(5), 297–303. DOI: http://dx.doi.org/10.1007/s10272-019-0842-z

Fall, F., Bloch, D., Fournier, J. M., & Hoeller, P. (2015). Prudent Debt Targets and Fiscal Frameworks. *OECD Economic Policy Paper No. 15*. Pariz: OECD. DOI: http://dx.doi.org/10.2139/ssrn.2649081

Guellec, D., & Wunsch-Vincent, S. (2009). Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth. *OECD Digital Economy Papers No. 159*. Pariz: OECD Publishing. Retrieved from: https://www.oecd-ilibrary.org/science-and-technology/policy-responses-to-the-economic-crisis_222138024482

Hamilton, J. D., & Flavin, M. A. (1986). On the Limitations of Government Borrowing: A Framework for Empirical Testing. *The American Economic Review, 76*(4), 808–819. Retrieved from: https://www.nber.org/system/files/working_papers/w1632/w1632.pdf

IMF. (2023). *Public Finances in Modern History*. Retrieved 1. 8. 2023 from IMF: Retrieved from: https://www.imf.org/external/datamapper/datasets/FPP

Khadan (2019). Fiscal Sustainability in the Caribbean: An Econometric Analysis. *Inter-American Development Bank Working Paper No. IDB-WP-1014*. Washington D. C.: IDB. DOI: http://dx.doi.org/10.5296/rae.v11i2.14697

Krajewski, P., Mackiewicz, M., & Szymańska, A. (2016). Fiscal Sustainability in Central and Eastern European Countries- A Post-Crisis Assessment. *Prague Economic Papers, 25*(2), 175-188. DOI: http://dx.doi.org/10.18267/j.pep.553

Krejdl, A. (2006). Fiscal Sustainability - Definition, Indicators and Assessment of Czech Public Finance Sustainability. *Czech National Bank Working Paper Series 3*. Prague: Czech National Bank. Retrieved from: https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/cnb_wp/cnbwp_2006_03.pdf

Magazzino, C. (2022). Fiscal Sustainability in the GCC Countries. *International Journal of Economic Policy Studies, 16*(2), 389-408. DOI: http://dx.doi.org/10.1007/s42495-022-00082-9

Mauro, P., Romeu, R., Binder, A., & Zaman, A. (2015). A Modern History of Fiscal Prudence and Profligacy. *Journal of Monetary Economics, 76*, 55-70. DOI: http://dx.doi.org/10.1016/j.jmoneco.2015.07.003

Nzimande, N., & Ngalawa, H. (2019). Fiscal Policy Sustainability in SADC Countries. *African Finance Journal, 21*(1), 86-97. Retrieved from: https://journals.co.za/doi/abs/10.10520/EJC-16fb275d5b

OECD (2009). *Government at a Glance 2009*. Paris: OECD. DOI: http://dx.doi.org/10.1787/9789264075061-en

OECD (2013). *Government at a Glance 2013*. Paris: OECD. DOI: http://dx.doi.org/10.1787/gov_glance-2013-en

Rajakaruna, I., & Suardi, S. (2022). Fiscal Sustainability, Fiscal Debt and Economic Growth in the South Asian Region. The Journal of Developing Areas, 56(1), 249-265. DOI: http://dx.doi.org/10.1353/jda.2022.0001

Sandica, A. M. (2013). Fiscal Sustainability: A Panel Cointegration for CEE Countries. *International Journal of Academic Research in Economics and Management Sciences, 2*(5), 121. DOI: http://dx.doi.org/10.6007/IJAREMS/v2-i5/348

Schick, A. (2005). Sustainable Budget Policy: Concepts and Approaches. *OECD Journal on Budgeting, 5*(1), 107-126. DOI: http://dx.doi.org/10.1787/budget-v5-art5-en

Shastri, S., Giri, A. K., & Mohapatra, G. (2018). Fiscal Sustainability in Major South Asian Economies: Evidences from Panel Data Analysis. *Journal of Economic Cooperation & Development, 39*(2), 69-93. Retrieved from: https://jecd.sesric.org/pdf.php?file=ART16121402-2.pdf

Trehan, B., & Walsh, C. E. (1991). Testing Intertemporal Budget Constraints: Theory and Applications to US Federal Budget and Current Account Deficits. *Journal of Money, Credit and Banking, 23*(2), 206-223. Retrieved from: https://people.ucsc.edu/~walshc/MyPapers/TrehanWalsh_JMCB1991.pdf

Westerlund, J. (2006). Testing for Panel Cointegration with Multiple Structural Breaks. *Oxford Bulletin of Economics and Statistics, 68*(1), 101-132. DOI: http://dx.doi.org/10.1111/j.1468-0084.2006.00154.x

Westerlund, J., & Prohl, S. (2010). Panel Cointegration Tests of the Sustainability Hypothesis in Rich OECD Countries. *Applied Economics, 42*(11), 1355-1364. DOI: http://dx.doi.org/10.1080/00036840701721323

Appendix 1. List of countries covered in the study

Europe	*Asia and Oceania*	*Africa*	*Latin America, the Caribbean, and North America*
Austria	Australia	Algeria	Antigua and Barbuda
Belgium	Azerbaijan	Benin	Argentina
Bulgaria	Bahrain	Burkina Faso	Aruba
Croatia	Bangladesh	Burundi	Grenada
Cyprus	Bhutan	Cape Verde	Bahamas
Czechia	Cambodia	Central African Republic	Barbados
Denmark	China	Chad	Bolivia
Estonia	Fiji	Comoros	Chile
Finland	Georgia	Congo	Dominica
France	India	Djibouti	Dominican Republic
Germany	Indonesia	Equatorial Guinea	Nicaragua
Greece	Israel	Eswatini	Ecuador
Hungary	Japan	Ethiopia	Costa Rica
Iceland	Jordan	Gabon	Honduras
Ireland	Kiribati	Ghana	Guatemala
Italy	Kuwait	Guinea	Jamaica
Luxembourg	Kyrgyzstan	Guinea-Bissau	Colombia
Moldova	Malaysia	Kenya	Mexico
Netherlands	Maldives	Lesotho	Panama
Norway	Marshall Islands	Madagascar	Paraguay
Poland	Micronesia	Morocco	Peru
Portugal	Mongolia	Namibia	El Salvador
Romania	New Zealand	Niger	Suriname
Slovakia	Oman	Nigeria	Saint Lucia
Slovenia	Pakistan	Rwanda	Saint Kitts and Nevis
Spain	Papua New Guinea	Senegal	Saint Vincent and the Grenadines
Sweden	Philippines	Seychelles	Trinidad and Tobago
Switzerland	Qatar	South Africa	Venezuela
Ukraine	Saudi Arabia	Sudan	
United Kingdom	Solomon Islands	Tanzania	
	South Korea	Togo	
	Sri Lanka	Tunisia	
	Thailand		
	Turkey		
	United Arab Emirates		
	Vanuatu		
	Yemen		

Ocenjevanje fiskalne vzdržnosti s panelnimi testi enotskega korena, kointegracije in Grangerjeve vzročnosti: ugotovitve za širše skupine držav

Izvleček

Vprašanje fiskalne vzdržnosti držav je postala ena izmed osrednjih tem ekonomske politike, zlasti v času naraščajočega javnega dolga. Eden od načinov ocenjevanja fiskalne vzdržnosti je preverjanje skladnosti z medčasovno proračunsko omejitvijo, kar vključuje preverjanje stacionarnosti javnofinančnih prihodkov in izdatkov, primarnega proračunskega salda in prve diference javnega dolga. Del tega pristopa je tudi testiranje kointegracije in vzročnosti med različnimi pari spremenljivk. V okviru tega pristopa se članek osredotoča na prvo in drugo generacijo panelnih testov enotskega korena, kointegracijo in Grangerjev test vzročnosti. Ta članek se osredotoča na ocenjevanje fiskalne vzdržnosti štirih panelov držav, razdeljenih po celinah: Evropa, Azija in Oceanija, Afrika ter Latinska Amerika, Karibi in Severna Amerika. Ugotovljeno je bilo, da je fiskalna vzdržnost prisotna v vseh obravnavanih širših skupinah držav, vendar v šibki obliki. Fiskalna vzdržnost je bila potrjena, ko je bila v izračunih upoštevana konstanta, medtem ko so bila med skupinami držav opažena odstopanja, če sta bila upoštevana tako konstanta kot trend. Študija služi kot izhodišče za obsežnejšo analizo fiskalne vzdržnosti. Za natančnejše ugotovitve bi bilo treba države razvrstiti v manjše in ekonomsko bolj homogene skupine ter jih analizirati tudi z uporabo drugih metod fiskalne vzdržnosti.

Ključne besede: testi kointegracije, fiskalna vzdržnost, Grangerjev test vzročnost, medčasovna proračunska omejitev, testi enotskega korena.

Artificial Intelligence in Employee Learning Process: Insights from Generation Z

Branka Zolak Poljašević[a], Simona Šarotar Žižek[b], Ana Marija Gričnik[*b]
[a] *University of Banja Luka, Faculty of Economics, Bosnia and Herzegovina*
[b] *University of Maribor, Faculty of Economics and Business, Slovenia*
branka.zolak-poljasevic@ef.unibl.org, simona.sarotar-zizek@um.si, ana.gricnik@student.um.si

ARTICLE INFO

Original Scientific Article

Article history:
Received July 2024
Revised September 2024
Accepted September 2024

JEL Classification
M14, M15, M53

Keywords:
Learning process
Artificial intelligence
Employees
Generation Z
Sociodemographic characteristic

UDK: 004.8:658.3
DOI: 10.2478/ngoe-2024-0014

Cite this article as: Zolak Poljašević, B., Šarotar Žižek, S. & Gričnik, A. M. (2024). Artificial Intelligence in Employee Learning Process: Insights from Generation Z. *Naše gospodarstvo/Our Economy, 70*(3), *21-36*. DOI: 10.2478/ngoe-2024-0014

Abstract

Artificial intelligence, as a field of computer science focused on developing technologies that simulate intelligent behaviours and human cognitive functions, undoubtedly has huge potential to transform all business activities, including the process of employee learning. However, different generations have varying attitudes toward the rapid advancement of technology and the increasing possibilities offered by artificial intelligence. The general purpose of this research is to gain insights into the attitudes of Generation Z regarding the use of AI in the context of the employee learning process. Empirical research was conducted on a sample of 264 respondents from Slovenia and Bosnia and Herzegovina. In addition to descriptive statistics, Cronbach's alpha, Shapiro-Wilk, and Mann-Whitney tests were used to test hypotheses. Generally, the research findings indicate that the upcoming generation of the workforce considers artificial intelligence a significant factor in improving the employee learning process. The study contributes to human resource management literature because it brings new insights into Generation Z attitudes, whose participation in the active workforce will significantly increase in the coming years.

Introduction

Employee learning has become a key human resource management strategy in contemporary business environments. Employee learning is a multidimensional concept, a general term used for all organizational activities aimed at developing employees' knowledge and skills. It is not just the result of individual efforts of employees but also a collective process in which the organization plays a significant role in creating an environment that encourages knowledge sharing, innovation, and continuous improvement of training and development programs.

The importance of continuous employee learning can be explained in various ways. In this paper, it is examined in the context of technological changes and the evolution of the workforce. Information technologies (IT) are rapidly evolving and transforming all aspects of

[*] *Corresponding author*

business, including employee learning. The connection between technological development and employee learning can be characterized as a two-way relationship. On the one hand, the development of technology affects the obsolescence of employees' knowledge and skills, making continuous learning a necessity. Continuous training and the general encouragement of a learning culture become the only way to ensure organizational flexibility and success. On the other hand, technological development affects the way how organizations conduct training and development programs. Modern technologies affect the manner in which employees gain new knowledge and skills, enabling innovative and more efficient learning methods. In general, technological tools enhance interactivity in the learning process and make the learning process more dynamic and personalized.

One of the most significant advances in this area is offered by the implementation of technologies from the domain of artificial intelligence (AI). For example, adaptive learning systems use AI to dynamically tailor content based on the individual progress of each employee (Capuano & Caballé, 2020). Additionally, data analytics powered by AI enables the analysis of large datasets to identify patterns and predict future training needs (Kataria, 2023). Also, via augmented reality (AR) or virtual reality (VR), artificial intelligence allows employees to learn in realistic but safe environments, trying different scenarios, operating devices, and developing practical skills without risk (Holuša et al., 2023). Overall, AI enhances training programs' efficiency, personalization, and adaptability (Guan, 2021; Maity, 2019).

Although the use of AI-enabled systems offers many benefits for the field of employee learning, it also raises several challenges. For instance, there are concerns about the possibility of misinformation and biased content, which echoes the existing literature on the ethical challenges posed by AI (Gillissen et al., 2022; Jha et al., 2022). Moreover, the limited emotional intelligence and empathy of technology, or lack thereof, and the over-reliance on statistics leads to resistance from staff (Chan & Lee, 2023). It is important to note that modern technologies are not a substitute for human instructors and educators, but rather a mere support, which is important to consider when implementing them (Chan & Tsi, 2023).

Different generations have varying attitudes toward the rapid advancement of technology and the increasing capabilities offered by artificial intelligence. Generations can be defined as groups of individuals born within the same period, experiencing similar socio-cultural circumstances and challenges. These shared experiences result in common values, beliefs, expectations, and behaviours among individuals from the same generation (Taş et al., 2017; Lyons et al., 2012).

In the context of discussing different generational attitudes towards modern technologies, it can generally be said that older generations may often exhibit resistance due to fear of the unknown, lack of technical skills, or simply a preference for methods they have used for years to acquire new knowledge and skills (Shakina et al., 2021). On the other hand, younger workforce populations naturally embrace digital innovations and adapt more quickly to new technological environments (Greener, 2019). Generation Z, which is the focus of this research, is not yet fully integrated into the labour market but is anticipated to be the next significant cohort in the workforce.

While a lot of research explores how AI is transforming various human resource management functions, there is still a limited understanding of specific generational preferences for AI-powered training methods and how each generation responds to them. This gap in knowledge underscores the need for more research in this area. The focus on Generation Z and their key sociodemographic characteristics, such as gender, area of education, and work experience, additionally highlights their attitudes and potential concerns towards AI. This contributes to the expansion of the literature on the role of AI in the future of employee training and development. The aim of the conducted empirical research is to provide insights into the attitudes of the upcoming workforce generation towards contemporary training models, regardless of their sociodemographic characteristics.

The data used in the analysis were collected in a study conducted in two countries, Slovenia and Bosnia and Herzegovina. We applied appropriate statistical methods to test the defined hypotheses on a sample of 264 respondents. Cronbach's alpha, Shapiro-Wilk test, Mann-Whitney test and descriptive statistical methods were applied. Research of this kind can help identify and understand the specific impacts of sociodemographic characteristics on respondents' attitudes toward future employment and technology acceptance.

The structure of this paper follows the IMRAD format. After the introduction, the first section provides a theoretical overview of the research, focusing on

elaborating on employee learning, the opportunities provided by artificial intelligence, and generational differences in the application of modern technologies. The second part describes in detail the research methodology, the research instrument, the sample, and the methods used to test the hypotheses. This is followed by the presentation of research results, discussion and conclusions.

Theoretical Background

Employee learning is a broad term encompassing all organizational activities aimed at enhancing and developing employees' knowledge and skills, and it is considered one of the most important areas of human resource development (HRD) and also human resource management (HRM). It should be emphasized that learning involves not only the cognitive process of assimilating information in symbolic form but also includes an affective and behavioural process (Gruber et al., 2020). In organizations, the process of employee learning or education occurs for various purposes. Depending on the purpose of learning, we distinguish two fundamental components of this process: employee training and career development (Zolak Poljašević, 2021). Through training programs, employees are prepared for their current job roles or other related tasks. Additionally, training helps employees to expand their knowledge and adapt to potential job changes (Chaudhuri & Mehra, 2020; Poongavanam, 2017). In contrast to training, development focuses on future job requirements or career advancement. Development involves enhancing employees' knowledge to perform more complex tasks in the future and to align with future organizational needs.

The importance of continuous employee learning is best illustrated through the dynamic changes in the business environment (Sivakami et al., 2023; Singh & Malhotra, 2020). In today's business environment, organizations face constant and rapid changes that require adaptability and ongoing acquisition of new knowledge and skills. This is certainly influenced by technological progress that causes rapid obsolescence of existing knowledge (Kling, 1996). This issue becomes more complex when we connect the extremely fast development of technology with the fact that educational systems in many countries are too rigid and often fail to adapt to rapid changes in the labour market (Ilić & Zolak Poljašević, 2013).

This creates a gap between the knowledge acquired in schools and universities and the actual needs of employers, thereby transferring the responsibility for training and developing new employees to employers (Ilić & Zolak Poljašević, 2013). Organizations that invest in employee training and development programs not only enhance the competence and flexibility of their workforce but also motivate employees, increase job satisfaction, and foster loyalty to the company (Riyanto et al., 2023; Talwar & Thakur, 2016). Considering all the above, it can be concluded that employee learning is necessary, as knowledge has become the most critical factor distinguishing successful from unsuccessful organizations.

As already mentioned in the elaboration of the importance of employee learning, information technologies are developing rapidly and affect all business activities and processes. The connection between technological development and employee training and development is particularly interesting, especially when discussing technologies that can be brought into the field of artificial intelligence (AI).

AI is a field of computer science focused on developing technologies that simulate intelligent behaviours and human cognitive functions, including human cognitive functions such as problem-solving, language understanding, reasoning, pattern recognition, and many other abilities possessed by humans (Budhwar et al., 2022; Das et al., 2015). Historically, AI has evolved through diverse subfields like robotics, computer vision, speech processing, natural language processing, neural networks, evolutionary computing, expert systems, and machine learning. Today, the term ‘artificial intelligence system’ encompasses all these domains, reflecting how modern technology integrates them into a cohesive framework (Ćormarković et al., 2022). AI has enormous potential to transform the way work processes are designed and executed. By integrating AI-based systems into business organizations, significant impacts can be expected across various dimensions, including job characteristics, employer-employee relationships, human-technology interactions, customer experience, and competitive advantage in a dynamic market environment (Connely et al., 2021; Malik et al., 2022). Kaplan and Haenlein (2019) propose a tripartite classification of AI systems: analytical, human-inspired, and humanized artificial systems.

When it comes to employee learning, AI can reshape this field in various ways. Firstly, AI supports the personalization of the learning process. By analyzing each individual's learning data, systems can customize content and training methods to meet each employee’s

specific needs and preferences (Jian, 2023). For instance, machine learning algorithms can monitor employees' progress, identify their strengths and weaknesses, and suggest customized courses or materials that will be most beneficial to them (De Mauro et al., 2022; Jordan & Mitchell, 2015). Personalization enables more efficient learning by focusing on individual needs. Moreover, AI can improve the learning experience through tools such as virtual assistants and chatbots. Such tools can offer immediate support to employees by simulating human interactions (Adiguzel et al., 2023), addressing various questions, and minimizing the necessity for constant instructor presence (Dimitriadis, 2020). With the help of big data and analytical tools, AI enables advanced analytics and evaluation of employee learning processes. The identification of patterns in employee learning enables resource optimization and customization of training approaches. Additionally, administrative aspects of training, such as attendance tracking, performance evaluation, and certification, can be automated. Automating these administrative tasks allows managers to focus on creating higher-quality training content.

Certainly, the most interesting aspect of AI is its capability to introduce innovations into training processes. Among other things, this includes employee learning through simulations and augmented reality (AR) or virtual reality (VR). These technologies allow employees to learn in realistic but safe environments, where they can try different scenarios, operate devices and develop practical skills without risk (Holuša et al., 2023). Such methods not only improve practical skills but also increase the engagement of employees during the learning process (Papanastasiou et al., 2018; Allcoat & Mühlenen, 2018), because they are designed with a clear learning goal, but at the same time, they are enjoyable for participants. In this manner, employees' readiness to learn and practice increases, as does their active participation and knowledge transfer.

Generative AI technologies, particularly large-scale language models such as ChatGPT, have the potential to influence employees' training and coaching through new and innovative approaches and methods (Hu, 2023). To create human-like text based on the input data, new technologies use deep learning techniques and advanced natural language processing. Since the latter allows them to be context-aware, these technologies are ideal for the development of AI-powered virtual mentors that can provide employees with the necessary information, personalized guidance, and feedback on a variety of topics (Alam, 2022; Celik et al., 2022; Goodfellow et al., 2020; Terzopoulos & Satratzemi, 2019). Furthermore, this can support employees' learning, enhance their level of understanding, help eliminate confusion, and enable them to access it anywhere and at any time. Generative AI-powered systems can also be integrated into various communication platforms to promote interdisciplinary collaboration, knowledge sharing, and group problem-solving (McLaren et al., 2010). This represents a significant innovation in the field of employee training and development and can contribute to the development of a more dynamic and inclusive learning community (Chan & Lee, 2023).

All these possibilities indicate that AI can significantly improve the employee learning processes, making them more efficient, adaptable, and interactive. Regardless of the aforementioned, it should be emphasized that not all generations in the workforce are equally receptive to the use of AI in work processes, including employee learning. Older generations, who are used to traditional learning methods, may show resistance to new technologies. This resistance is often due to fear of the unknown, lack of technical skills (Shakina et al., 2021), or simply a preference for methods they have used for years in acquiring new knowledge and skills. On the other hand, younger generations, who have grown up with digital technologies, are already familiar with many tools and platforms, making them more adaptable to new learning systems (Greener, 2019). Members of the younger workforce are commonly referred to as Generation Z. Although they are not yet fully integrated into the active workforce population, they have attracted considerable attention from researchers, who largely believe their integration into the workforce will pose a significant challenge for employers. This is due to significant differences in behaviour and approach to work that they demonstrate. It may be stated that Generation Z brings 'unique characteristics to the workplace' (Pichler et al., 2021). Generation Z is the first generation that grew up with digital technologies and a globally connected world, which significantly shaped their habits, values, expectations, and also their educational experiences (Hernández-de-Menéndez et al., 2020). They are used to instant access to information, and they can adopt new technologies and digital tools quickly. They are used to multitasking (Chillakuri & Mahanandia, 2018) since they can simultaneously use the phone, laptop, and tablet for different activities. These skills enable them to manage time and tasks efficiently.

Due to their lifelong exposure to technology, several academics believe Generation Z possesses a distinctive learning style (Hernández-de-Menéndez et al., 2020). Regarding the format of the content they consume, members of Generation Z prefer video and image content (Szymkowiak et al., 2021) over textual information. They also prefer visual communication on various platforms and use their 'tech language' to think and communicate (Ajman, 2020). However, due to the large amount of information they are exposed to, Generation Z often has a short attention span. They prefer concise, direct information and content that quickly captures their attention (Moreno et al., 2023). Members of Generation Z are open to new ideas and can swiftly apply any useful innovation to their daily lives. These innovations include mobile communication, social media, wearable technology, and AI. Therefore, Generation Z individuals are also called digital natives (Kayıkç & Bozkurt, 2018).

Some research indicates that the majority of Generation Z believes that the development of AI has and will continue to positively influence society (Dióssy, 2021). Generally, they are optimistic about future changes that AI may bring (Jyothychandra & Sulaimann, 2022). It is certain that the digital literacy of Generation Z members, along with their pragmatic approach, will bring innovations and changes in many fields. At the same time, it can be said with great certainty that even among Generation Z members, there may be a need for additional education and training to use most of the advantages that AI provides in the HRD segment. Considering the existing knowledge about Generation Z and the fact that a large part of this population still lacks significant work experience, the research conducted for this paper assumed that a certain number of respondents are not familiar with the possibilities of applying AI in the employee learning process. This was taken into account during the development of the scale to assess the significance of various aspects of AI in employee learning. The attitudes of Generation Z towards the use of AI in employee training and development were examined through the prism of several sociodemographic characteristics of the respondents.

The first sociodemographic characteristic examined in this research was the gender of the respondents. Social norms and educational systems can shape the interest of different genders in technology and artificial intelligence (Gant & Gill, 2018; Craiut & Iancu, 2022). Traditionally, men have been encouraged to pursue careers in science, technology, engineering, and mathematics (STEM), while women have been underrepresented in these fields (Stewart-Williams & Halsey, 2020). These trends are slowly changing, and an increasing number of women are becoming interested in technology and AI. However, patterns of technology use can vary by gender. If we consider the assertion that "men prefer working with things while women prefer working with people" (Su et al., 2009) in the context of technology use, it could be said that men often show more interest in the technical aspects of devices and tools and in playing video games, while women may be more focused on communication apps and social networks (Kimbrough et al., 2013). Also, women may be more sceptical about the use of AI and more concerned about ethics, privacy, and its impact on jobs (Fietta et al., 2022). These differences are not strictly defined and can overlap with many other factors, such as socioeconomic status, education, cultural context, and individual preferences (Ameen et al., 2023). So, there is limited evidence that gender alone directly and significantly affects Generation Z's attitudes and interest in technology and AI (Halpern & Lamay, 2000). Based on these considerations, the following hypotheses have been formulated:

H1.1 Members of Generation Z consider AI as a significant tool for the employee learning process, regardless of their gender.
H1.2 Members of Generation Z have positive attitudes regarding the use of AI in the employee learning process, regardless of their gender.

Students in fields like computer science or engineering naturally lean towards AI education due to their interest in the subject and its relevance to their future career opportunities. Regarding the study field, there is some evidence that students studying in different fields have more positive perceptions of AI and its applications (Gherheș & Obrad, 2018; Chan & Hu, 2023). This is explained by the fact that students in technical faculties more frequently interact with AI technologies during their education, contributing to their greater confidence and positive attitude towards these technologies both academically and professionally (Chan & Hu, 2023). However, overall, students from other fields show a less pronounced but still positive attitude toward AI (Gherheș & Obrad, 2018). Additionally, some studies show no significant differences in attitudes towards AI between different study fields, indicating the need to teach about AI in all disciplines, not just computer science (Latto et al., 2020). Considering these conclusions, we defined hypotheses that indicate a positive attitude of all respondents towards the use of AI in the context of their future employment and the employee learning process. The hypotheses are as follows:

H2.1 Members of Generation Z consider AI as a significant tool for the employee learning process, regardless of their study field.
H2.2 Members of Generation Z have positive attitudes regarding the use of AI in the employee learning process, regardless of their study field.

The next factor we used to examine differences in respondents' attitudes is their work experience. Respondents lacking work experience often have an abstract, theoretical understanding of AI applications in business processes, while its practical use may be unclear to them. On the other hand, respondents with work experience are more exposed to technological tools, which can shape their positive or negative attitudes toward the use of AI in employee learning. Although some research indicates that students with more work experience tend to be open and positive towards the application of AI in learning and work processes because they have seen firsthand the benefits that AI can bring (Chou, 2022), it is reasonable to assume that influence of work experience may vary depending on other individual factors such as technical literacy, personal affinity towards technology, socioeconomic status, and so on. Certainly, it also depends on the type of work experience gained during the study period. Students with work experience in jobs and roles that involve advanced technologies may have greater confidence in AI tools and their benefits for employee learning. In contrast, students who gained experience in more traditional work environments may be more sceptical or less enthusiastic about new technologies. Taking into account the varying perspectives on this issue and the fact that students traditionally perform simpler contract-based jobs for a limited time and do not have access to all training and development programs designed for permanent employees, the following hypotheses have been defined:

H3.1 Members of Generation Z consider AI as a significant tool for the employee learning process, regardless of their work experience.
H3.2 Members of Generation Z have positive attitudes regarding the use of AI in the employee learning process, regardless of their work experience.

Finally, the country of origin can influence respondents' attitudes toward the use of AI in employee learning. This is influenced by factors such as cultural norms and values, educational systems, level of economic development, media and public opinion, as well as access to modern technologies. Although Slovenia and Bosnia and Herzegovina share a common socialist heritage as part of the former Yugoslavia, there are several factors suggesting that students from these countries may have different attitudes toward using AI in employee learning. For example, Slovenia is a member of the European Union and has a more stable political and social system compared to Bosnia and Herzegovina. Slovenia also has greater access to international funds, investments, and technological innovations. Additionally, the higher economic stability and more developed technological infrastructure in Slovenia may contribute to greater openness among respondents towards the importance and application of artificial intelligence. Therefore, the following hypotheses have been defined:

H4.1 Members of Generation Z consider AI as a significant tool for the employee learning process, depending on their origin country.
H4.2 Members of Generation Z have positive attitudes regarding the use of AI in the employee learning process, depending on their origin country.

The defined hypotheses were tested using the appropriate statistical analysis, which is presented in the methodology segment.

Methodology and Sample

The primary objective of this research is to delve into Generation Z's attitudes towards the use of AI in the context of the employee learning process. In this study, two constructs were investigated. The first refers to the significance of different possibilities of applying AI in the employee learning process, while the second concerns the general attitudes of respondents towards the use of AI in these processes. For each researched construct it was developed an appropriate scale.

In developing the first scale, it was assumed that a certain number of respondents were not familiar with the possibilities of applying AI in the process of training and development of employees, and the collected data confirmed this. Specifically, only 41.08% of respondents stated that they are familiar with the possibilities of applying AI in the employee learning process. Therefore, a set of nine statements was created to describe various ways AI can improve training and development activities. For instance, "AI tools can recommend customized learning paths, including workshops, courses, and development opportunities, based on performance metrics and identified employee skill gaps". All statements within this scale are positive, highlighting the beneficial aspects of applying artificial intelligence

in employee training and development programs. The statements were formed based on theoretical knowledge about various applications of artificial intelligence in employee learning processes, taking into account their interdependence and creating a cohesive scale. Using a five-point scale, ranging from "not important at all" to "extremely important", the respondents expressed their attitudes regarding the significance of each of the nine formulated statements. The reliability of this scale was assessed using Cronbach's alpha coefficient, which is 0.902. This coefficient value indicates high internal consistency of the scale, reflecting a high level of stability and reliability in measurement.

The second scale used in the research aimed to assess respondents' overall attitudes regarding the application of AI in employee training and development. In this scale, we included seven positive statements (e.g., "AI improves employee experience during the learning and development process") and three negative statements (e.g., "AI dehumanizes the learning and development process"). Respondents expressed their attitudes using a five-point scale, ranging from "strongly disagree" to "strongly agree". To prevent biased responses, the order of questions was randomized. Due to the opposite direction of scoring for positive and negative statements, they were aligned to contribute correctly to the overall scale score. For this purpose, the negative statements were recoded. After recoding, all statements (both positive and negative) were aligned so that higher ratings consistently indicated higher values of the same construct measure.

Although recoding can align statements in terms of scoring direction, it cannot eliminate differences in how respondents react to positive and negative statements. As a result, the inclusion of both positive and negative statements within this scale led to a lower Cronbach's alpha coefficient value of 0.598. This coefficient value indicates the low internal consistency of the scale. Such impact on the Cronbach's alpha coefficient value is often due to respondents interpreting positive and negative statements differently, leading to more significant response variability. Negative statements may require additional thought and reverse interpretation by respondents, which can increase cognitive load and lead to inconsistent responses. This especially happens when positive and negative statements are not evenly represented, as is the case with this scale. After excluding the negative statements from the analysis, Cronbach's alpha coefficient obtained a value of 0.766, which is considered an acceptable level of internal consistency for the scale.

Data were collected using an online questionnaire. In addition to the described scales for expressing respondents' attitudes towards the application and significance of AI in the context of employee training and development, other questions in the questionnaire were closed-ended and focused on identifying respondents' sociodemographic characteristics and general understanding of artificial intelligence. Data collection was carried out in January 2024. A total of 264 respondents from Slovenia and Bosnia and Herzegovina participated in the research. These participants are students, i.e., young individuals who belong to Generation Z by their age. While some respondents have work experience, it is anticipated that this group will fully integrate into the labour market within a few years.

Table 1

The structure of the sample according to sociodemographic characteristics

Sample Characteristic	*Frequency*	*Percent*
Gender		
Mail	68	30.68%
Female	170	71.43%
Study Field		
Social Science	211	79.92%
Technical and Natural Science	54	20.45%
Employment Status		
Employed	98	37.12%
Unemployed	166	62.88%
Country		
Slovenia	129	48.86%
Bosnia and Herzegovina	135	51.14%

Source: Authors

Table 1 shows that respondents from Bosnia and Herzegovina (51.14%) and Slovenia (48.86%) are almost equally represented in the sample. In terms of sociodemographic structure, there is a notably higher proportion of women in the sample, constituting more than two-thirds or 71.43% of the respondents. Furthermore, respondents studying social sciences (79.92%) are significantly more represented in the sample compared to those studying technical and natural sciences (20.45%). Regarding employment status, students with permanent, temporary, or occasional employment accounted for 37.12% of the sample.

Initially, the intention was to use the t-test for hypothesis testing, as it is a commonly used statistical method to determine the presence of statistically significant differences between two independent groups. However, an important precondition for applying this test is the

normal distribution of data. The data distribution was assessed using the Shapiro-Wilk test, assuming that the data in the sample were normally distributed. The results of testing both scales are identical. All items in the scales have a p-value less than the defined level of significance (p=0.00; p<0.05), indicating that the data are not normally distributed. Therefore, instead of the t-test, the non-parametric Mann-Whitney test was used in further analysis. The data were processed using the statistical software SPSS.

Results

Research results indicate that respondents have a moderate understanding of AI. The level of understanding was estimated using a five-point scale, with an average value of 3.09 (the midpoint value is 2.5).

Table 2

Significance of AI for improvement of employee learning - descriptive statistic

	N	Min.	Max.	Mean	Std. Deviation
AI_ Possibil_Using_in_ learning _1	264	1	5	3.83	0.872
AI_ Possibil_Using_in_ learning _2	264	1	5	4.05	0.858
AI_ Possibil_Using_in_ learning _3	264	1	5	4.14	0.931
AI_ Possibil_Using_in_ learning _4	264	1	5	4.16	0.875
AI_ Possibil_Using_in_ learning _5	264	1	5	3.74	0.992
AI_ Possibil_Using_in_ learning _6	264	1	5	3.76	0.924
AI_ Possibil_Using_in_ learning _7	263	1	5	3.88	0.933
AI_ Possibil_Using_in_ learning _8	264	1	5	3.95	0.888
AI_ Possibil_Using_in_ learning _9	264	1	5	3.91	0.945
Valid N (listwise)	263				

Source: Authors

This result is not surprising because only 47.35% of the respondents have had the opportunity to learn about AI through formal and informal learning practices. Despite the mentioned results, Generation Z shows great interest in AI, which is confirmed by the fact that 82.58% of respondents stated that they search for information and learn about AI on their initiative. Additionally, 88.26% of respondents believe that every student, regardless of their field of study, should learn about AI.

As explained in the methodology section, respondents' attitudes toward the application of AI in employee learning processes were examined using two five-point scales. The first scale includes nine items related to potential applications of AI in employee training and development programs. Table 2 displays the average-rated level of perceived significance for each of the nine items.

It can be observed that, on average, respondents consider all nine items to be significant, as the mean values for each item are above the neutral midpoint. The standard deviation for all items indicates a moderate variation in respondents' answers.

Table 3

General attitudes regarding the use of AI in employee learning - descriptive statistic

	N	Min.	Max.	Mean	Std. Deviation
AI_in_learnin g_General_At titudes_1	264	1	5	3.80	0.894
AI_in_learnin g_General_At titudes_2	264	1	5	3.75	0.897
AI_in_learnin g_General_At titudes_3	264	1	5	3.70	0.909
AI_in_learnin g_General_At titudes_4	264	1	5	3.87	0.980
AI_in_learnin g_General_At titudes_5	264	1	5	3.54	0.938
AI_in_learnin g_General_At titudes_6	264	1	5	3.74	1.073
AI_in_learnin g_General_At titudes_7	264	1	5	2.67	1.334
Valid N (listwise)	264				

Source: Authors

On average, respondents' level of agreement with the statements is higher than the neutral mean. However, there is a significantly lower level of agreement (2.67)

with statement seven, which refers to the possibility of AI completely replacing humans (trainers, instructors, mentors) in the employee learning and development process. The standard deviation value for this item (1.334) indicates a higher degree of variation in respondents' answers.

In the next step of the analysis, the defined hypotheses were tested using the Mann-Whitney test, and the results are presented in the following tables.

Table 4

Significance of AI for improvement of employee learning - differences by gender

Ranks					*Test Statistics[a]*	*AIPU_Average*
	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	7353.000
AIPU_	0	81	131.78	10674.00	Wilcoxon W	10674.000
Average	1	183	132.82	24306.00	Z	-0.102
	Total	264			Asymp. Sig. (2-tailed)	0.918

a. Grouping Variable: Gender

Source: Authors

Regarding the first construct (the significance of various applications of AI in employee learning processes), the results of the Mann-Whitney U test (p=0.918; p>0.05; Z=-0.102) show that there is no statistically significant difference in attitudes between men and women in the analyzed sample, thus confirming hypothesis H1.1.

Table 5

General attitudes regarding the use of AI in employee learning - differences by gender

Ranks					*Test Statistics[a]*	*AIPU_Average*
	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	6724.000
AIGA_	0	81	140.99	11420.00	Wilcoxon W	23560.000
Average	1	183	128.74	23560.00	Z	-1.206
	Total	264			Asymp. Sig. (2-tailed)	0.228

a. Grouping Variable: Gender

Source: Authors

In the case of the second construct (general attitudes towards the use of artificial intelligence in employee learning processes), the p-value exceeds the defined level of significance. The test results (p=0.228; p>0.05; Z=-1.206) indicate that the difference in attitudes between the observed groups is not large enough to be considered statistically significant, thus confirming hypothesis H1.2.

Table 6

Significance of AI for improvement of employee learning - differences by study field

Ranks					*Test Statistics[a]*	*AIPU_Average*
	St_field	N	Mean Rank	Sum of Ranks	Mann-Whitney U	4978.500
AIPU_	0	211	135.41	28570.50	Wilcoxon W	6409.500
Average	1	53	120.93	6409.50	Z	-1.236
	Total	264			Asymp. Sig. (2-tailed)	0.216

a. Grouping Variable: Study_field

Source: Authors

Regarding the second socio-demographic characteristics of respondents (study field) and first construct (the significance of various applications of AI in employee learning processes), the test results presented in Table 6 (p=0.216; p>0.05; Z=-1.236) show that there is no statistically significant difference in attitudes between respondents studying social sciences compared to those studying natural and technical sciences. These results confirm hypothesis H2.1.

Table 7
General attitudes regarding the use of AI in employee learning - differences by study field

Ranks					*Test Statistics[a]*	*AIPU_Average*
	St_field	N	Mean Rank	Sum of Ranks	Mann-Whitney U	5328.000
AIGA_	0	211	131.25	27694.00	Wilcoxon W	27694.000
Average	1	53	137.47	7286.00	Z	-0.532
	Total	264			Asymp. Sig. (2-tailed)	0.595

a. Grouping Variable: Study_field
Source: Authors

The results shown in Table 7 (p=0.595; p>0.05; Z=-0.532) lead to the same conclusion regarding the second construct (general attitudes towards the use of artificial intelligence in employee learning processes). As there is no statistically significant difference in attitudes between respondents studying social sciences compared to those studying natural and technical sciences, hypothesis H2.2 is also confirmed.

Table 8
Significance of AI for improvement of employee learning - differences by employment status

Ranks					*Test Statistics[a]*	*AIPU_Average*
	Em_stat	N	Mean Rank	Sum of Ranks	Mann-Whitney U	7346.000
AIPU_	0	166	137.25	22783.00	Wilcoxon W	12197.000
Average	1	98	124.46	12197.00	Z	-1.317
	Total	264			Asymp. Sig. (2-tailed)	0.188

a. Grouping Variable: Employment_status
Source: Authors

The third socio-demographic characteristic analyzed in this study relates to respondents' work experience. Depending on whether they have work experience or not, respondents are divided into two groups (respondents with and without permanent, temporary, or occasional employment). Regarding the first construct (the significance of various applications of AI in employee learning processes), the results of the Mann-Whitney U test (p=0.188; p>0.05; Z=-1.317) show that there is no statistically significant difference in attitudes between the observed groups of respondents in the analyzed sample, confirming hypothesis H3.1.

Table 9
General attitudes regarding the use of AI in employee learning - differences by employment status

Ranks					*Test Statistics[a]*	*AIPU_Average*
	Em_stat	N	Mean Rank	Sum of Ranks	Mann-Whitney U	8113.500
AIGA_	0	166	132.38	21974.50	Wilcoxon W	21974.500
Average	1	98	132.71	13005.50	Z	-0.034
	Total	264			Asymp. Sig. (2-tailed)	0.973

a. Grouping Variable: Employment_status
Source: Authors

The results shown in Table 9 (p=0.973; p>0.05; Z=-0.034) lead to the same conclusion regarding the second construct (general attitudes towards the use of artificial intelligence in employee learning processes). As there is no statistically significant difference in attitudes between the defined groups of respondents, hypothesis H3.2 is also accepted.

Table 10
Significance of AI for improvement of employee learning - differences by country

Ranks					*Test Statistics[a]*	*AIPU_Average*
AIPU_ Average	Country	N	Mean Rank	Sum of Ranks	Mann-Whitney U	7155.000
	0	135	144.00	19440.00	Wilcoxon W	15540.000
	1	129	120.47	15540.00	Z	-2.508
	Total	264			Asymp. Sig. (2-tailed)	0.012

a. Grouping Variable: Country
Source: Authors

In the final segment of the analysis, we examined whether there are differences in attitudes between respondents from Slovenia and Bosnia and Herzegovina. Regarding the first construct (the significance of various applications of AI in employee learning processes), the research results presented in Table 10 ($p=0.012$; $p<0.05$; $Z=-2.508$) show that there are statistically significant differences in attitudes between the observed groups of respondents in the analyzed sample, confirming hypothesis H4.1.

Table 11
General attitudes regarding the use of AI in employee learning - differences by country

Ranks					*Test Statistics[a]*	*AIPU_Average*
AIGA_ Average	Country	N	Mean Rank	Sum of Ranks	Mann-Whitney U	8645.000
	0	135	132.96	17950.00	Wilcoxon W	17030.000
	1	129	132.02	17030.00	Z	-0.101
	Total	264			Asymp. Sig. (2-tailed)	0.919

a. Grouping Variable: Country
Source: Authors

In the case of the second construct (general attitudes towards the use of artificial intelligence in employee learning processes), the results of the Mann-Whitney U test differ ($p=0.919$; $p>0.05$; $Z=-0.101$), indicating that there is no statistically significant difference in attitudes between respondents from Slovenia and Bosnia and Herzegovina in the analyzed sample. Based on these test results, hypothesis H4.2 is rejected.

Discussion and Conclusions

The rapid development of modern technology, especially in AI, is revolutionizing our world. Generation Z, commonly known as digital natives, was born and raised in an era of widespread access to the internet and other technologies. Consequently, Generation Z individuals are defined by their strong dependence on and use of technology in every aspect of their daily lives. Also, the upcoming generation of the workforce that was born, educated and formed in the era of digital technologies has specific expectations from employers regarding the application of modern technologies in the workplace (Gričnik et al., 2024). Generation Z's use of technology in education can foster or develop additional skills and competencies (Hernández-de-Menéndez et al., 2020) Additionally, findings suggest that while the majority of Generation Z members see great potential in AI and believe it will positively influence society, there are also some concerns, mainly regarding its potential to eliminate some jobs and reduce opportunities for interpersonal interactions (Schroth, 2019). Also, ethical considerations of AI are raised (Jyothychandra & Sulaimann, 2022).

Understanding the perspectives of the next generation of employees regarding the use of AI in training and development is essential for the effective adoption of modern technologies as well as meeting the needs of younger generations (Chan & Lee, 2023). Organisations need to understand the specific characteristics of generation Z to provide them with effective support, guidance and satisfaction (Linnes and Metcalf, 2017). By understanding and adapting to the preferences of each generation, organizations can integrate modern technologies into their training and development programs, thus improving their quality as well as meeting the needs of their employees (Chan & Lee, 2023).

The rapidly evolving technology that has surrounded them since birth has had a significant impact on both the learning characteristics and preferences of Generation Z. The latter is closely connected to their need for

immediate feedback. Employers need to adapt AI-related training and development programs in their organizations and introduce new approaches to increase the level of engagement and satisfaction of the next generation of the workforce. Training and development programs must focus on the visual and interactive aspects. For this purpose, employers should combine creative lectures with digital simulations and case studies, which can be supported by videos, visual graphics, or virtual reality. It is also recommended for employers to make the most of the opportunities offered by the digital learning and learning environment. It is also advisable to give Generation Z instant employees access to materials and to include the use of social media in the teaching and learning programs on a regular basis (Cilliers, 2017; Vizcaya-Moreno & Pérez-Cañaveras, 2020).

Regarding the application of AI in learning processes, the majority of research focuses on the formal learning processes of young individuals, such as those in higher education. Such research indicates that members of Generation Z are "generally optimistic about the potential benefits of AI, including enhanced productivity, efficiency, and personalized learning, and expressed intentions to use AI for various educational purposes" (Chan & Lee, 2023). However, there is not much research that considers members of Generation Z as the upcoming workforce and thus examines their attitudes through the prism of future employment. In terms of employee learning programs, it is quite certain that there will be integration between traditional learning approaches and new approaches based on AI in the future, which may not be equally acceptable for all generations of employees (Zolak Poljašević et al., 2024). The research results presented in this paper provide additional insights into Generation Z regarding their attitudes toward the significance of various applications of AI in employee training processes and the general views of this specific group of respondents on the use of artificial intelligence in employee learning processes. Overall, the results of this research showed that the upcoming generation of the workforce considers AI a significant factor in improving employees' learning process. Generally, they have positive attitudes regarding the use of AI in the employee learning process. Interestingly, all respondents have positive attitudes towards AI, although some were not familiar with the possibility of applying AI in the process of training and development of employees. As expected, such results are aligned with the results of similar research (Andrschchuk et al., 2022; Hernández-de-Menéndez et al., 2020; Persada et al., 2019) and previous knowledge about Generation Z.

A deeper analysis of the collected data provides answers to the research questions in the context of four sociodemographic characteristics of the respondents: gender, field of education, work experience, and country of origin. The statistical test applied in this research showed a difference in respondents' attitudes towards the significance of various applications of AI in employee training processes, depending on whether the respondents come from Slovenia or Bosnia and Herzegovina. In all other tested relationships, no statistically significant difference was found among the defined sociodemographic differences of the respondents, confirming all defined hypotheses except hypothesis H 4.2. Therefore, the research results align with existing knowledge regarding the impact of gender (Ameen et al., 2023; Halpern & Lamay, 2000) and field of study (Latto et al., 2020; Gherheș & Obrad, 2018), as well as the initial assumptions regarding the impact of work experience on respondents' attitudes towards the application of AI in employee training processes.

One of the primary limitations of the presented research is the small sample size, in which respondents are unevenly distributed across the three observed sociodemographic characteristics. There is a significantly higher proportion of women compared to men, respondents studying in the field of social sciences compared to those in natural and technical sciences, and significantly higher participation of students with work experience compared to those without work experience, which constitutes a limitation of the observed sample. Additionally, testing the internal consistency of the applied scales revealed a low level of reliability for the scale assessing the general attitudes of respondents towards the use of AI in employee training processes. This limitation arose due to the uneven distribution of positive and negative statements that make up the content of this scale. This limitation was addressed by removing three statements from the data analysis process that were affecting the reliability of the measurement scale.

Despite the small research sample and the disproportionate structure of the sample based on sociodemographic characteristics, which are major limitations of this study, research that considers Generation Z as the upcoming workforce can have multiple benefits. Firstly, it contributes to the expansion of the literature on the role of AI in the employee learning process. Additionally, it provides a better understanding of the young generation's perspective towards AI and helps organizations design training and development programs that align with Generation Z's needs.

Additionally, organizations could use this knowledge to attract and retain young professionals, which is currently one of the major challenges in human resources management. For future research, it would be useful to explore how attitudes toward AI differ across generations. It would be interesting to see how AI is received by younger generations who were born and raised with ICT compared to older generations who have had to learn how to use it. Such a direction for further research is significant because successful implementation of AI in learning processes relies on analyzing different generational perspectives and choosing the right approach, which may involve a combination of traditional and modern learning methods, gradual adoption of new technologies, providing continuous support for all employees, and creating an inclusive environment that fosters acceptance of new technologies and enables all employees, regardless of generational differences, to leverage the benefits that AI brings. Only a holistic approach can help organizations realize significant benefits from AI while enabling all employees to develop and advance.

References

Adiguzel, T., Kaya, M., & Cansu, F. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology*, *15*(3), ep429. DOI: https://doi.org/10.30935/cedtech/13152

Ajmain, T. (2020). Impacts and Effective Communication on Generation Z in Industrial Revolution 4.0 Era. *Journal of English Teaching & Applied Linguistics*, 2, 37–42. DOI: https://doi.org/ 10.36655/jetal.v2i1.204

Alam, A. (2022). Employing adaptive learning and intelligent tutoring robots for virtual classrooms and smart campuses: reforming education in the age of artificial intelligence. In *Advanced computing and intelligent technologies: Proceedings of ICACIT 2022* (pp. 395–406). Singapore: Springer Nature Singapore. DOI: https://doi.org/10.1007/978-981-19-2980-9_32

Allcoat, D., & Mühlenen, A. (2018). Learning in virtual reality: Effects on performance, emotion and engagement. *Research in Learning Technology*, *26*, 2140. DOI: https://doi.org/10.25304/ RLT.V26.2140

Ameen, N., Hosany, S., & Taheri, B. (2023). Generation Z's psychology and new-age technologies: Implications for future research. *Psychology & Marketing*, *40*(10), 2029–2040. DOI: https://doi.org /10.1002/mar.21868

Androshchuk, I., Banit, O., Shtepura, A., Rostoka, M., & Cherevychnyi, G. (2022). Modern Information and Educational Environment in the Context of the Theory of Generations. *International Journal of Pedagogy, Innovation and New Technologies*, *9*(1), 54–62, DOI: https://doi.org/10. 5604/01.3001.0016.2095

Budhwar, P. Malik, A., De Silva, T. T. & Thevisuthan, P. (2022) Artificial intelligence - Challenges and opportunities for international HRM: a review and research agenda. *The International Journal of Human Resource Management*, *33*(6), 1065–1097. DOI: https://doi.org/10.1080/09585192. 2022.2035161

Capuano, N., & Caballé, S. (2020). Adaptive Learning Technologies. *AI Magazine*, *41*(2), 96–98. DOI: https://doi.org/10.1609/aimag.v41i2.5317

Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends*, *66*(4), 616–630. DOI: https://doi.org/10.1007/s11528-022-00715-y

Chan, C. K. Y., & Lee, K. K. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers?. *Smart learning environments*, *10*(1), 60. DOI: https://doi.org/10.1186/s40561-023-00269-3

Chan, C.K.Y., & Hu, W. (2023). Students' voices on generative AI: perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education*, *20*(43). DOI: https://doi.org/10.1186/s41239-023-00411-8

Chan, C.K.Y., & Lee, K.K.W. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? *Smart Learning Environments*, *10*(60), 1–23. DOI: https://doi.org/10.1186/s40561-023-00269-3

Chaudhuri, M., & Mehra, P. (2020). Bearing of Training on Employee Performance: Evidence from the Banking Sector in India. *American Research Journal of Business and Management*, *6*, 1–10. DOI: https://doi.org/10.21694/2379-1047.20014

Chillakuri, B., & Mahanandia, R. (2018). Generation Z entering the workforce: the need for sustainable strategies in maximizing their talent. *Human Resource Management International Digest*, *26*, 34-38. DOI: https://doi.org/10.1108/HRMID-01-2018-0006

Chou, C.M., Shen, T.C., Shen, T.C., & Shen, C.H. (2022). Influencing factors on students' learning effectiveness of AI-based technology application: Mediation variable of the human-computer interaction experience. *Education and Information Technologies*, *27*, 8723–8750. DOI: https://doi.org/10.1007/s10639-021-10866-9

Cilliers, E. J. (2017). The challenge of teaching generation Z. *PEOPLE International Journal of Social Sciences*. DOI: http://hdl.handle.net/10453/158991

Connelly, C.E., Fieseler, C., Černe, M., & Giessner, S.R. (2021). Working in the digitized economy: HRM theory & practice. *Human Resource Management Review*, *31*(1). DOI: https://doi.org/10.1016/j.hrmr.2020.100762

Ćormarković, T., Dražeta, L., & Njeguš, A. (2022). The levels of artificial intelligence application in human resource systems. *The European Journal of Applied Economics*, *19*(2), 28–42. DOI: https://doi.org/10.5937/EJAE19-39535

Craiut, M., & Iancu, I. (2022). Is technology gender neutral? A systematic literature review on gender stereotypes attached to artificial intelligence. *Human Technology*, *18*(3), 297–315. DOI: https://doi.org/10.14254/1795-6889.2022.18-3.6

Das, S., Dey, A., & Roy, N. (2015). Applications of Artificial Intelligence in Machine Learning: Review and Prospect. *International Journal of Computer Applications*, *115*(9), 975–987. DOI: https://doi.org/ 10.5120/20182-2402

De Mauro, A., Sestino, A., & Bacconi, A. (2022). Machine learning and artificial intelligence use in marketing: a general taxonomy. *Italian Journal of Marketing*, *2022*(4), 439–457. DOI: https://doi.org/10.1007/s43039-022-00057-w

Dimitriadis, G. (2020). Evolution in Education: Chatbots. *Homo Virtualis*, *3*(1), 47–54. DOI: https://doi .org/10.12681/homvir.23456

Dióssy, K. (2021) Are the Robots Going to Take Our Jobs? This Is How American and Hungarian Economists of Generations Y and Z Conceive the Impact of Artificial Intelligence. In: *New Horizons in Business and Management Studies* (pp. 14–24). Conference Proceedings: Corvinus University of Budapest, Budapest. DOI: https://doi.org/10.14267/978-963-503-867-1_02

Fietta, V., Zecchinato, F., Stasi, B., Polato, M., & Monaro, M. (2022). Dissociation between Users' Explicit and Implicit Attitudes Toward Artificial Intelligence: An Experimental Study. *IEEE Transactions on Human-Machine Systems*, *52*, 481–489. DOI: https://doi.org/10.1109/thms. 2021.3125280

Gherheş, V., & Obrad, C. (2018). Technical and Humanities Students' Perspectives on the Development and Sustainability of Artificial Intelligence (AI). *Sustainability*, *10*(9), 3066. DOI: https://doi.org/10.3390/SU10093066

Gillissen, A., Kochanek, T., Zupanic, M., & Ehlers, J. (2022). Medical students' perceptions towards digitalization and artificial intelligence: A mixed-methods study. *Healthcare, 10*(4), 723. DOI: https://doi.org/10.3390/healthcare10040723

Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A. & Bengio, Y. (2020). Generative adversarial networks. *Communications of the ACM*, *63*(11), 139–144. DOI: https://doi.org/10.1145/3422622

Greener, S. (2019). Digital familiarity: a vital part of education. *Interactive Learning Environments*, *27*, 287–287. DOI: https://doi.org/10.1080/10494820.2019.1588506

Gričnik, A. M., Šarotar Žižek, S., Zolak Poljašević, B. & Črnjar, K. (2024). Talent management in the age of digital transformation and changes in the workforce characteristics. *Tourism and Hospitality Industry 2024*, Congress Proceedings, *27*, 159–165. https://doi.org/10.20867/thi.27.25

Grint, K., & Gill, R. (2018). The Gender-Technology Relation. *Technology and Culture*, 38, 232. DOI: https://doi.org/10.4324/9781315041032

Gruber, T., Bazhydai, M., Sievers, C., Clément, F., & Dukes, D. (2020). The ABC of social learning: Affect, behavior, and cognition. *Psychological Review*. *129*(6), 1296–1318. DOI: https://doi.org/10.1037/rev0000311

Guan, Y. (2021). Application of Artificial Intelligence Technology in Social Training. 2021 3rd International Conference on Artificial Intelligence and Advanced Manufacture (pp. 1857–1860). DOI: https://doi.org/10.1145/3495018.3495501

Halpern, D., & lamay, M. (2000). The Smarter Sex: A Critical Review of Sex Differences in Intelligence. *Educational Psychology Review*, *12*, 229–246. DOI: https://doi.org/10.1023/A:1009027516424

Hernández-de-Menéndez, M., Diaz, C., & Morales-Menéndez, R. (2020). Educational experiences with Generation Z. *International Journal on Interactive Design and Manufacturing*, *14*, 847–859. DOI: https://doi.org/10.1007/s12008-020-00674-9

Holuša, V., Vaněk, M., Beneš, F., Švub, J., & Staša, P. (2023). Virtual Reality as a Tool for Sustainable Training and Education of Employees in Industrial Enterprises. *Sustainability*, *15*(17), 12886. DOI: DOI: https://doi.org/10.3390/su151712886

Hu, K. (2. 2. 2023). ChatGPT sets record for fastest-growing user base - analyst note. *Reuters*. Retrieved from: https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/

Ilić, G. & Zolak Poljašević, B. (2013). Unapređenje kvaliteta radne snage u funkciji smanjenja strukturne nezaposlenosti u Republici Srpskoj. *Acta Economica*, *11*(19), 43–65. DOI: https://doi.org/ 10.7251/ACE1319043I

Jha, N., Shankar, P. R., Al-Betar, M. A., Mukhia, R., Hada, K., & Palaian, S. (2022). Undergraduate medical students' and interns' knowledge and perception of artificial intelligence in medicine. *Advances in Medical Education and Practice, 13*, 927–937. DOI: https://doi.org/10.2147/AMEP.S368519

Jian, M. (2023). Personalized learning through AI. *Advances in Engineering Innovation*, *5*, 16–19. DOI: https://doi.org/10.54254/2977-3903/5/2023039

Jordan, M., & Mitchell, T. (2015). Machine learning: Trends, perspectives, and prospects. *Science*, *349*, 255–260. DOI: https://doi.org/10.1126/science.aaa8415

Jyothychandra, R., & Sulaimann, E. (2022). Effect of Consumer Prior Knowledge on Attitude, Behavioural Intention and Adoption of Artificial Intelligence Enabled Products: A Study among Generation Y and Z. *International Journal of Health Sciences*, *6*, 2109–2128. DOI: https://doi.org/ 10.53730/ijhs.v6nS2.5254

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, *62*(1), 15–25. DOI: https://doi.org/10.1016/j.bushor.2018.08.004

Kataria, K. (2023). AI-Powered Learning: The Future of Education. *International Journal of Advanced Research*, *11*, 199–203. DOI: https://doi.org/10.21474/ijar01/17520

Kayıkç, M.Y., & Bozkurt, A.K. (2018). Dijital çağda z ve alpha kuşağı, yapay zeka uygulamaları ve turizme yansımaları. *Sosyal Bilimler Metinleri*, *1*, 54–64.

Kimbrough, A., Guadagno, R., Muscanell, N., & Dill, J. (2013). Gender differences in mediated communication: Women connect more than do men. *Computers in Human Behavior*, *29*(3), 896–900. DOI: https://doi.org/10.1016/j.chb.2012.12.005

Kling, R. (1996). Does technology drive history? The dilemma of technological determinism. *Information Processing and Management*, 32, 392-393. DOI: https://doi.org/10.1016/S0306-4573(96)90107-7

Laato, S., Vilppu, H., Heimonen, J., Hakkala, A., Bjorne, J., Farooq, A., Salakoski, T., & Airola, A. (2020). Propagating AI Knowledge Across University Disciplines - The Design of A Multidisciplinary AI Study Module. *IEEE Frontiers in Education Conference* (pp. 1–9). Uppsala, Sweden. DOI: https://doi.org/ 10.1109/FIE44824.2020.9273940

Linnes, C., & Metcalf, B. (2017). iGeneration and their acceptance of technology. *International Journal of Management & Information Systems (Online)*, *21*(2), *11*. DOI: https://doi.org/10.19030/ijmis.v21i2.10073

Lyons, S., Ng, E., & Schweitzer, L. (2012). Generational career shift: millennials and the changing nature of careers in Canada. In Ng,, E., Lyons, S., & Schweitzer, L. (eds). *Managing the New Workforce* (pp. 64-85). UK, USA: Edward Elgar Publishing. DOI: https://doi.org/10.4337/9780857933010.00009

Maity, S. (2019). Identifying opportunities for artificial intelligence in the evolution of training and development practices. *Journal of Management Development*, *38*(8), 651–663. DOI: DOI: https://doi.org/10.1108/JMD-03-2019-0069

Malik, N., Tripathi, S.N., Kar, A.K., & Gupta, S. (2022). Impact of artificial intelligence on employees working in industry 4.0 led organizations. *International Journal of Manpower*, *43*(2), 334–354. DOI: https://doi.org/10.1108/IJM-03-2021-0173

McLaren, B. M., Scheuer, O., & Mikšátko, J. (2010). Supporting collaborative learning and e-discussions using artificial intelligence techniques. *International Journal of Artificial Intelligence in Education*, *20*(1), 1–46. DOI: https://doi.org/10.3233/JAI-2010-0001

Moreno, D., Gabatin, R., Agleron, M., Gavasan, C., Santos, E., & Tiongson, S. (2023). Penetrating through Distractions: Analyzing the Function of Storytelling Advertisements in Attracting the Focus of Gen Z Customers. *Journal of Business and Management Studies*, *5*(3), 8–24. DOI: https://doi.org/10.32996/jbms.2023.5.3.2

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2018). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual Reality*, *23*, 425–436. DOI: https://doi.org/10.1007/s10055-018-0363-2

Persada, S., Miraja, B., & Nadlifatin, R. (2019). Understanding the Generation Z Behavior on D-Learning: A Unified Theory of Acceptance and Use of Technology (UTAUT) Approach. *International Journal of Emerging Technologies in Learning*, *14*(05), 20–33. DOI: https://doi.org/10.3991/IJET.V14I05.9993

Pichler, S., Kohli, C., & Granitz, N. (2021). DITTO for Gen Z: A framework for leveraging the uniqueness of the new generation. *Business Horizons*, *64*(5), 599–610. DOI: https://doi.org/10 .1016/J.BUSHOR.2021.02.021

Poongavanam, S. (2017). Training an Effective Way of Organization Growth and Employee Development. International Journal of Research, *4*, 265–282.

Riyanto, S., Handiman, U., Gultom, M., Gunawan, A., Putra, J., & Budiyanto, H. (2023). Increasing Job Satisfaction, Organizational Commitment and the Requirement for Competence and Training. *Emerging Science Journal*, *7*(2), 520–537. DOI: https://doi.org/10.28991/esj-2023-07-02-016

Schroth, H. (2019). Are You Ready for Gen Z in the Workplace? *California Management Review*, *61*, 18–5. DOI: https://doi.org/10.1177/0008125619841006

Shakina, E., Parshakov, P., & Alsufiev, A. (2021). Rethinking the cor-porate digital divide: The complementarity of technologies and the demand for digital skills. *Technological Forecasting and Social Change*, *162*, 120405. DOI: https://doi.org/10.1016/j.techfore.2020.120405

Singh, T., & Malhotra, S. (2020). Study of training & development impact on employees in it sector. *Journal of Management Research and Analysis*, *5*(2), 217–222. DOI: https://doi.org/10.18231/2394-2770.2018.0034

Sivakami, R., Tanuja Bai, S., & Janani, A., (2023). Employee Experience: A Metric for Future Workforce Agility. *International Journal for Multidisciplinary Research*, *5*(5). DOI: https://doi.org/10. 36948/ijfmr.2023.v05i05.7351

Stewart-Williams, S., & Halsey, L. (2020). Men, women and STEM: Why the differences and what should be done? *European Journal of Personality*, *35*, 3–39. DOI: https://doi.org/ 10.1177/0890207020962326

Su, R., Rounds, J., & Armstrong, P. (2009). Men and things, women and people: a meta-analysis of sex differences in interests. *Psychological Bulletin*, 135(6), 859–884. DOI: https://doi.org/10.1037/ a0017364

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., & Kundi, G. (2021). Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people. *Technology in Society*, 65, 101565. DOI: https://doi.org/10.1016/J.TECHSOC.2021.101565

Talwar, E., & Thakur, M. (2016). Training and Development and its Impact on Employee Performance. *International Journal of Basic and Applied Sciences*, 1, 18–27. DOI: https://doi.org/10.21904 /WEKEN/2016/V1/I1/93615

Taş, H.Y., Demirdöğmez, M., & Küçükoğlu, M. (2017). Geleceğimiz olan Z kuşağının çalışma hayatına muhtemel etkileri. *Uluslararası Toplum Araştırmaları Dergisi*, 13(7), 1031–1048. DOI: https://doi.org/10.26466/opus.370345

Terzopoulos, G., & Satratzemi, M. (2019). Voice Assistants and Artificial Intelligence in Education. *Proceedings of the 9th Balkan Conference on Informatics*, 1–6. DOI: https://doi.org/10.1145/3351556.3351588

Vizcaya-Moreno, M. F., & Pérez-Cañaveras, R. M. (2020). Social media used and teaching methods preferred by generation z students in the nursing clinical learning environment: A cross-sectional research study. *International journal of environmental research and public health*, 17(21), 8267. DOI: https://doi.org/10.3390/ijerph17218267

Yuk Chan, C. K., & Tsi, L. H. (2023). The AI Revolution in Education: Will AI Replace or Assist Teachers in Higher Education? *arXiv e-prints*, arXiv-2305.

Zolak Poljašević, B., Šarotar Žižek, S., & Gričnik, A. M. (2024). The Future of Employees' Learning: Understanding Generation Z Attiitudes Towards Artificial Intelligence. *8th FEB International Scientific Conference: Challenges in the Turbulent Economic Environment and Organizations' Sustainable Development* (Vols. 8). Univerzitetna založba Univerze v Mariboru. DOI: https://doi.org/10.18690/um.epf.5.2024

Zolak Poljašević, B. (2021). *Menadžment ljudskih resursa: Tradicionalni u susret savremenom pristupu.* Banja Luka: Ekonomski fakultet Univerziteta u Banjoj Luci.

Umetna inteligenca v procesu učenja zaposlenih: pogled generacije Z

Izvleček

Umetna inteligenca kot področje računalništva, ki se osredotoča na razvoj tehnologij, ki simulirajo inteligentno vedenje in človeške kognitivne funkcije, ima nedvomno velik potencial za preoblikovanje vseh poslovnih dejavnosti, vključno s procesom učenja zaposlenih. Kljub temu imajo različne generacije različen odnos do hitrega napredka tehnologije in vse večjih možnosti, ki jih ponuja umetna inteligenca. Glavni namen raziskave je pridobiti vpogled v odnos generacije Z do uporabe umetne inteligence v okviru procesa učenja zaposlenih. Empirična raziskava je bila izvedena na vzorcu 264 anketirancev iz Slovenije ter Bosne in Hercegovine. Poleg opisne statistike so bili za preverjanje hipotez uporabljeni tudi Cronbachov alfa, Shapiro-Wilkov in Mann-Whitneyjev test. Na splošno ugotovitve raziskave kažejo, da prihajajoča generacija zaposlenih meni, da je umetna inteligenca pomemben dejavnik za izboljšanje procesa učenja zaposlenih. Raziskava prispeva k literaturi s področja managementa človeških virov, saj prinaša nova spoznanja o stališčih generacije Z, katere udeležba v aktivni delovni sili se bo v prihodnjih letih bistveno povečala.

Ključne besede: učni proces, umetna inteligenca, zaposleni, generacija Z, sociodemografske značilnosti

Transformative Dynamics of the Economy of Kosovo: A Perspective on History and Development of Foreign Direct Investment

Jeton Zogjani[*] [a, b], Fife Kovaci-Uruci[a, c], Agon Zogjani[d]
[a] *MSc Economics, Faculty of Economics, University of Prishtina, Prishtina, Kosovo*
[b] *MBA, Faculty of Business, Education and Law, Staffordshire University, Stoke on Trent, UK*
[c] *MSc Public Administration and Diplomacy, Faculty of Public Administration, AAB, Prishtina, Kosovo*
[d] *BA Management and Informatics, Faculty of Economics, University of Prishtina, Prishtina, Kosovo*
zogjanijeton@gmail.com, fife.kovaci@gmail.com, agonzogjani@gmail.com

ARTICLE INFO

Review Article

Article history:
Received April 2024
Revised August 2024
Accepted September 2024

JEL Classification
F21, F23, O16

Keywords:
Business climate
FDI inflow
Foreign investors
Growth
Kosovo

UDK: 339.727.22(497.115)
DOI: 10.2478/ngoe-2024-0015

Cite this article as: Zogjani, J., Kovaci-Uruci, F., & Zogjani, A. (2024). Transformative Dynamics of the Economy of Kosovo: A Perspective on History and Development of Foreign Direct Investment. *Naše gospodarstvo/Our Economy, 70*(3),*37-47*. DOI: 10.2478/ngoe-2024-0015.

Abstract

This paper presents an in-depth overview of foreign direct investments (FDI) in Kosovo's economy over more than twenty years. FDI has played a central role, proving indispensable to the development of Kosovo's economy. Thus, FDI is primarily directed towards economic activities like real estate, finance, manufacturing, construction, etc. In terms of the legal framework, Kosovo has approved a range of regulations and laws with the primary goal of protecting, attracting and encouraging foreign investors to invest. However, obstacles such as political instability, energy insecurity, delayed EU integration, and regional political tensions are recognized as the main barriers affecting FDI in Kosovo. Finally, Kosovo should develop suitable policies to boost its investment competitiveness, attract multinational enterprises for investment opportunities, and prioritize less attractive economic sectors for investment of FDI.

Introduction

Over the past few decades, numerous studies have highlighted the key challenges and opportunities that different countries face in attracting Foreign Direct Investment (FDI). In this context, Kosovo has faced a challenging transition and a serious effort to develop and restore its investment environment, largely as a result of the recent war. Thus, this paper provides an overview of FDI in Kosovo's economy over the past few decades. Several key topics related to FDI in Kosovo are explored, with in-depth discussions and comparisons from various perspectives on FDI in Kosovo. The paper is organized as follows: the first section presents the evolution of FDI from the era of the former Yugoslav Federation to the market liberalization in Kosovo and beyond. The second section provides an overview of FDI development in Kosovo, including the investment trends in Kosovo's economy, the role of FDI in key economic sectors, FDI inflows from foreign investors, the impact and benefits of FDI, and the efforts of Kosovo's institutions to enhance

[*] *Corresponding author*

the business climate and investment environment. The next section highlights the efforts of international and Kosovo institutions to establish and strengthen the legal framework for foreign investments over the past two decades. The final section addresses the main obstacles, barriers, investment risks, and overall business climate affecting FDI in Kosovo.

In terms of methodological approach, a wide range of research papers, documents, and official reports from local and international institutions are used to analyse and evaluate the multidimensional aspects of FDI in Kosovo, including the historical aspects, key challenges of FDI in Kosovo since 1999, major barriers and obstacles, improvements in legal infrastructure and investment environment, dynamics of FDI flows and many other important aspects. Then, the primary research questions to be addressed are as follows: Which are the key sectors that have developed as a result of these investments? How much does the FDI impact well-being, education, the labour force, economic development and growth? What are the main barriers and obstacles to the investment environment in Kosovo? How competitive is Kosovo in attracting FDI compared to other regional countries? Also, the key hypotheses of this paper are as follows: a) Increased FDI in Kosovo leads to economic growth; b) FDI inflows into Kosovo's economy are positively associated with the development of entrepreneurship, business climate and market competition, GDP per capita, etc. Despite various circumstances, difficulties, and challenges, FDI in Kosovo has demonstrated dynamic and relatively consistent growth, with the investment environment evolving from scratch to over 840 million euros in 2023. Also, these investments have facilitated the advancement, modernization, and development of various sectors, including technology, innovation, entrepreneurship, human capital, business climate, market competitiveness, and many others.

The Period From the Former Yugoslav State to the Liberalization of Markets

At the end of the 1960s, the Yugoslav state (including Kosovo) had established key conditions for foreign investors by offering joint venture programs for investments. For many years, it was the only socialist state to permit foreign investments in its economy (Radenkovic-Jocic, 2004). A study by Deichmann *et al*. (2022) argued that the former Yugoslavia's economy was more open to global markets than other countries in the former Soviet bloc. Even though FDI was under strict control by the Yugoslav state, these investments began to rise gradually, contributing to an average annual GDP growth rate of 6.2% from 1948 to 1979 (Radenković, 2016). During the 1980s, the political situation in Yugoslavia began to deteriorate, and FDI inflows remained low but stable in terms of annual rates (Perez, 2003). However, the Yugoslav state implemented significant changes and economic reforms that increased the role of private property and encouraged FDI inflows, but the breakup of Yugoslavia (1990) led to a significant decline in foreign investments, particularly affecting the service sector (Uvalic & Cvijanović, 2018). Despite progress in economic reforms and efforts to attract foreign investments, FDI was largely neglected in the former Yugoslavia and other post-communist countries until market liberalization in the early 1990s (Deichmann, 2021).

Since the 1990s, FDI has been crucial for the countries that emerged from the breakup of the Yugoslav Federation, which has continuously sought to attract and support these investments, but the potential for FDI varies among these countries due to political tensions, the slow EU membership process, different geopolitical and economic goals, ethnic, cultural and economic circumstances between these countries, etc. (Deichmann *et al*., 2022; Topalli *et al*., 2021). In the second half of the 1990s, FDI inflows as a percentage of GDP were relatively low in these countries, although foreign investments exhibited stable average growth between 2001 and 2008 (Kovachev *et al*., 2020). Consequently, these countries enhanced their macroeconomic performance by attracting significant FDI inflows and implementing new economic reforms between 2001 and 2008 (Uvalic & Cvijanović, 2018). During this period, FDI primarily targeted the privatization of socially-owned enterprises and banks, which have provided the economic perspective of these countries (Estrin & Uvalic, 2016). The process of market liberalization has greatly advanced economic reforms and improved the business environment, leading to a consistent increase in foreign investment, but the global financial crisis (2008) reduced FDI inflows into these countries (Topalli *et al*., 2021; UNCTAD Report, 2013).

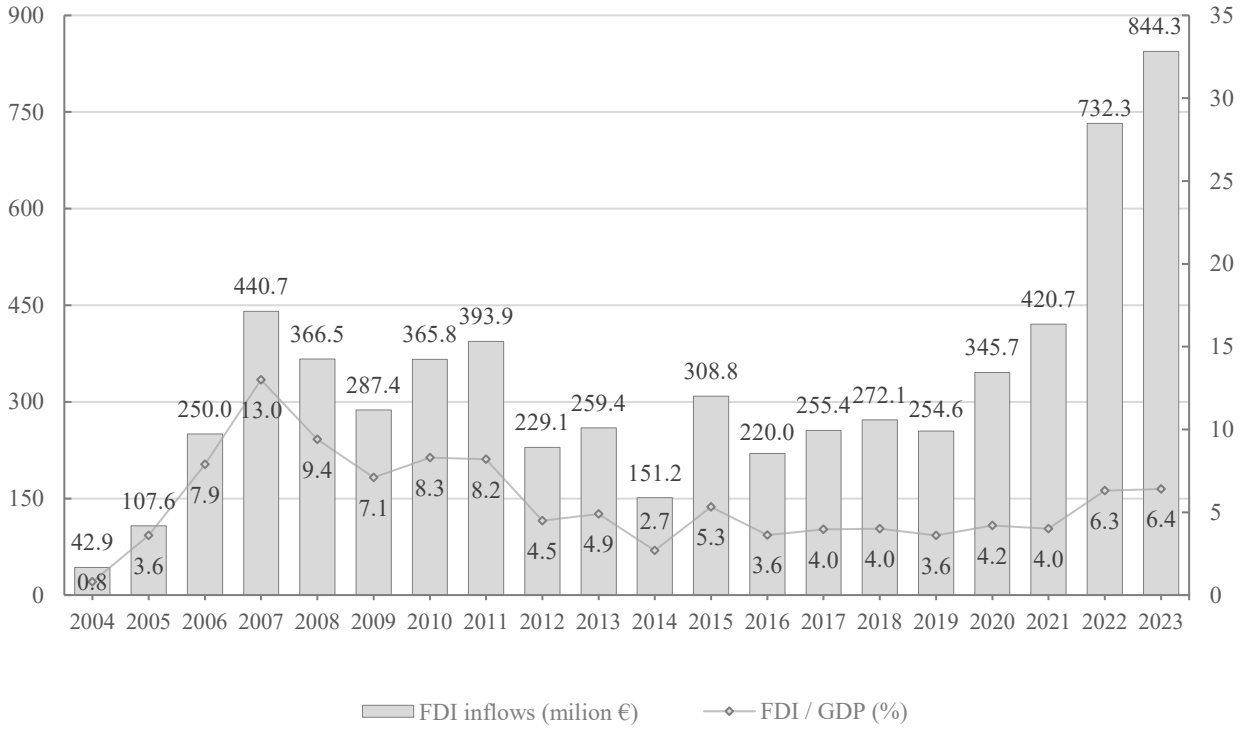
Development of Fdi in Kosovo in the Post-war Period

After the end of the war (1999), foreign investors showed significant interest in Kosovo, but the aftermath of the war created numerous challenges (such as inadequate governmental and local institutions, poor public services, a lack of legal and financial infrastructure, etc.) that made it impossible to establish a stable investment

environment and attract foreign investments (Riinvest, 2002). According to IMF Report (2001) the uncertainty surrounding Kosovo's final status has deterred foreign investors from committing to investments in the post-war period. Also, the business environment in Kosovo was not conducive to entrepreneurial growth, resulting in minimal foreign direct investment inflows into the economy between 2000 and 2002 (EU Report, 2004). In 2003, the Ministry of Trade and Industry (MTI) prioritized boosting both foreign and domestic investments in Kosovo, leading to the establishment of the Investment Promotion Agency and the Export and Domestic Production Promotion Agency (ESI Report, 2003). Then, FDI inflows into Kosovo began to improve gradually, but political risks and a shortage of skilled and educated labour force have limited the full impact and benefits of these investments on the economy of Kosovo (Gashi, 2017).

Despite these circumstances, FDI in Kosovo experienced steady growth, with the annual value reaching nearly 43 million euros in 2004 and surpassing 107 million euros in 2005 (CBK Report, 2011). Also, the annual average of FDI inflows as a percentage of GDP increased from 0.8% in 2004 to 3.6% in 2005 (Topalli *et al*., 2021; CBAK Report, 2008). Furthermore, FDI in Kosovo was estimated at over 266 million euros in 2006. In 2007, FDI inflows experienced a substantial rise, exceeding 440 million euros, representing one of the highest annual rates during that period (CBAK Report, 2008; Riinvest, 2014). During the period 2004 - 2007, FDI inflows grew consistently, marking a brief but significant period of substantial investment increase in Kosovo (World Bank Report, 2021/a). The rise of FDI was closely linked to the privatization of former state- and socially-owned enterprises in Kosovo and this process successfully attracted a significant amount of foreign investment capital from EU countries and Turkey (Gashi, 2017). In addition to foreign investments from privatization, companies with foreign capital in Kosovo reinvested their profits, which amounted to 42.9 million euros only during 2007 (CBAK Report, 2008).

Figure 1
Dynamics of FDI inflows and FDI / GDP in Kosovo (2004 - 2023)



Source: CBK Reports 2007, 2013, 2024 & World Bank (Online Data)

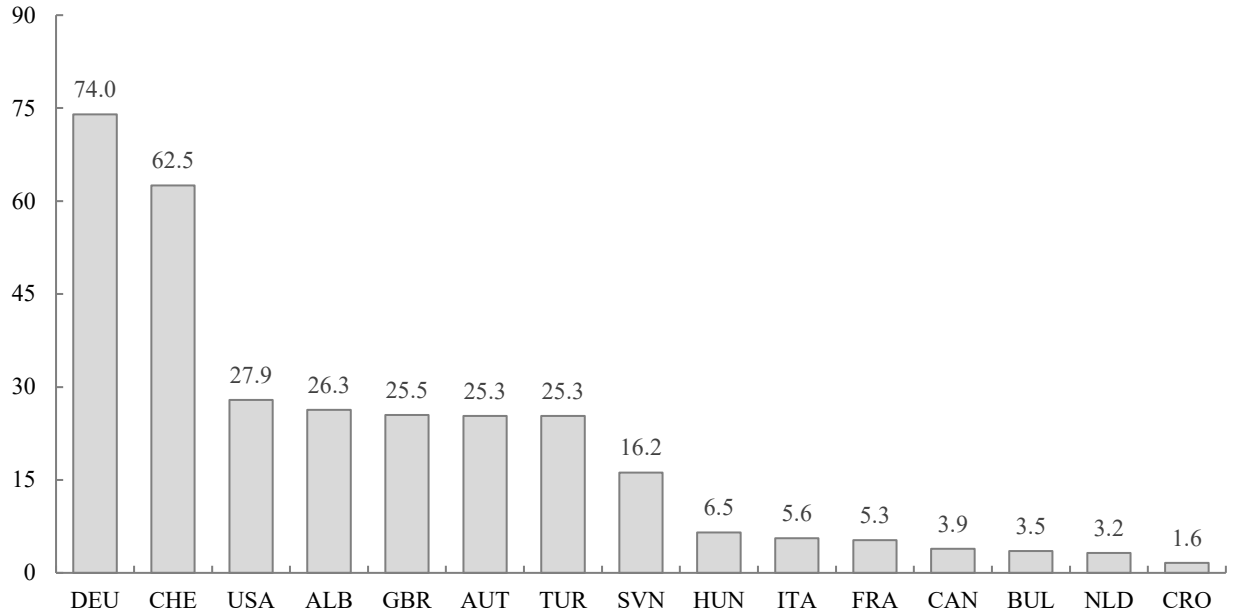
However, the global financial crisis (2008) led to decreased FDI in Kosovo, where these investments experienced annual fluctuations. However, a modest recovery in FDI started to take shape in 2010 and 2011 (OECD Report, 2013). A study by (Hajrizi & Hasani, 2013) has argued that Kosovo's privatization of public enterprises has drawn increased FDI during this recovery phase, though the scale of these investments remains smaller than in neighbouring countries. Despite these circumstances, FDI in financial services, information and communication, agriculture, wholesale and retail trade has notably decreased. However, these investments in the production sector have risen significantly from 6% in 2008 to 22.5% in 2010, primarily driven by new Greenfield projects in Kosovo (CBK Report, 2023/a; OECD Report, 2013).

Between 2012 and 2019, the level of FDI in Kosovo has remained low annually due to various factors, including economic fluctuations in Eurozone countries, political instability, super dividends (where the value of the dividends exceeds company profits), and the sale of securities by foreign firms to local companies (CBK Report, 2013; CBK Report, 2015; CBK Report, 2020; D4D Report, 2017).

During this same period, the ratio of FDI inflows to GDP and GDP per capita has significantly decreased, marking the lowest figures for Kosovo compared to other Western Balkan countries (D4D Report, 2017). Despite the reduction of FDI in Kosovo, most FDI has been directed towards financial services, real estate, retail trade, and construction sectors. However, these investments have primarily boosted domestic consumption rather than fostering growth in Kosovo's production sector between 2012 and 2019 (CBK Report, 2023/a; OECD Report, 2021). In 2020, FDI in Kosovo increased by over 34% from the previous year, with notable growth in economic activities such as financial services, energy, mining, and quarrying sectors (CBK Report, 2021). According to (EBRD Report, 2022) foreign investments in Kosovo showed improved annual growth in 2020, but their contribution remained limited and insufficient to significantly enhance the country's economic competitiveness. However, FDI continued to grow annually, reaching over 420 million euros in 2021 and the real estate, construction, and information and communication sectors saw improved economic activity, while the electricity and mining sectors experienced a notable decline (CBK Report, 2022).

Figure 2

Annual Average of FDI inflows by countries in Kosovo 2007 - 2023 (millions €)



In 2022, FDI experienced a substantial increase, rising by over 730 million euros, or 85% more than the previous year. This growth was largely driven by the Kosovo diaspora's substantial investments in the real estate sector, which accounted for 67.3% of total FDI. Additionally, the financial, insurance, and construction

sectors also played a key role in this investment surge (CBK Report, 2023/b). Also, FDI in Kosovo advanced significantly in 2023 compared to the previous year, demonstrating that FDI inflows have remained strong and sustained throughout 2023 (see Figure 1) (CBK Report, 2023/c). Thus, Kosovo's institutions have recognized the vital role of FDI in the country's economy. Consequently, Kosovo has implemented a series of reforms to enhance the business climate and has consistently worked to improve its business environment and stimulate economic activity in recent years (Bajrami & Krasniqi, 2019; Knuth *et al*., 2022; World Bank Report, 2020/a). In the medium term, Kosovo's economy could attract more FDI by establishing closer "*near-shoring*" partnerships with European and global multinational enterprises (IMF Report, 2023/b). In terms of FDI inflows by non-resident countries, most FDI in Kosovo come from Western European countries, followed by investments from Albania, the USA, the UK, Turkey and other countries (see Figure 2).

Undoubtedly, FDI in Kosovo has made a remarkable contribution to economic growth, bringing significant benefits across various areas crucial for the country's development. These investments have enhanced technology and innovation, developed human capital, facilitated knowledge transfer, increased market competition, advanced management practices and other positive contributions (Ziberi & Gashi, 2021). Also, Kosovo has made significant progress in enhancing quality infrastructure and protecting intellectual and industrial property, and recent years have seen increased investments in improving and developing economic zones, business parks, and business incubators (Bajrami & Krasniqi, 2019). As a result of these circumstances, Kosovo has demonstrated potential for FDI outflows, with a total value of 175.5 million euros in 2022, while FDI outflows reached 145.2 million euros between January and September 2023, up from 121.2 million euros in the same period of the previous year (CBK Report, 2023/c). Besides the increase in FDI inflows, Kosovo has also enhanced net FDI inflows as a percentage of GDP in recent years (World Bank, 2020/b). According to the EBRD Report (2022/b) and GAP Institute (2023) the energy sector will be a key investment priority in Kosovo, with the goal of improving the current energy situation and accelerating the transition to green energy.

According to (World Bank Report, 2017/a), Kosovo should focus on policies that attract more FDI flows, boost export promotion, and enhance areas such as property rights, licensing and inspections, trade regulations, etc. FDI and export promotion are crucial for Kosovo's economic growth and labour market, they enhance employment rates, improve productivity and offer higher wages for employees compared to local companies and the domestic economy (World Bank Report, 2021/b). Then, Kosovo needs to adopt policies that enhance its competitiveness for FDI relative to other regional countries, including strengthening regulatory quality, reducing the infrastructure and human capital gap, improving access to international markets, and maintaining low tax rates and these factors are identified as key strengths for attracting and boosting FDI (World Bank Report, 2021/a). Consequently, developing and strengthening regional supply chains will help reduce economic disparities between Kosovo and Western Balkan countries. These supply chains will also generate useful and positive effects from the FDI of multinational enterprises/companies (Krasniqi *et al*., 2022). However, Kosovo can enhance FDI by utilizing its natural resources, skilled labour and access to major markets, but it must overcome substantial challenges to become more appealing for higher FDI inflows (Bajrami & Krasniqi, 2019).

The Establishment and Strengthening of the Legal Infrastructure for Foreign Investments

To ensure economic development in the post-war period in Kosovo, international institutions have offered substantial support in crafting development strategies, policies, and reforms as well as strengthening the legal framework to establish a well-functioning market economy and create a favourable environment for investment activities (EU Report, 2009). Thus, the United Nations Mission in Kosovo (UNMIK) approved the regulation (Regulation No. 2001/3), which established legal guarantees to ensure a secure environment for attracting foreign investments to Kosovo (UNMIK Regulation, 2001). In 2005, Kosovo's provisional self-government institutions enacted the Law on Foreign Investments (Law No. 02/L-33), which aims to attract and encourage foreign investors by providing essential legal rights and guarantees that align with both Kosovo's laws and international standards (Assembly of Kosovo, 2005). Then, the Assembly of the Republic of Kosovo approved the Law on Foreign Investments (Law No. 04/L-220), where the primary goal was to enhance the regulation, protection, and promotion of foreign investment in Kosovo, ensuring that such investments receive fair and equitable treatment consistent with contemporary international practices and standards (Assembly of Kosovo, 2013).

In 2017, the Assembly of Kosovo enacted the Law on Strategic Investments (Law No. 05/L-079), which enables foreign investors to utilize the property of Kosovo for their strategic investment activities and grants them strategic investor status and other considerable facilities to attract and encourage international companies and businesses to invest in Kosovo (Assembly of Kosovo, 2017). Subsequently, the Assembly of Kosovo approved the Law on Business Organizations (Law No. 06/L-016), which governs the rights and obligations of shareholders, owners, directors, and other key stakeholders within the management structure of foreign business organizations. This law also addresses the initial registration, requirements, conditions, procedures, and deregistration of foreign business representative offices and branches in Kosovo, where the articles and amendments of this law are in full accordance with the directives of the European Parliament and Council (Assembly of Kosovo, 2018; OECD Report, 2021). Recently, the Government of Kosovo approved the draft Law on Sustainable Investments (Decision No. 02/118), which aims to enhance and strengthen the promotion, support, and protection of investment activities and exports in the Republic of Kosovo (Assembly of Kosovo, 2023).

The Main Obstacles, Barriers, Investment Risk and Business Climate of FDI in Kosovo

Despite efforts by Kosovo's institutions to advance the legal framework and reforms for attracting FDIs, and improve the doing business and its environment, Kosovo has not managed to attract more FDI than other countries (Sahiti *et al*., 2020). A study by Mehmeti (2011) has argued that export activities and FDI inflow in Kosovo have not improved enough. Kosovo continues to experience energy insecurity, including an unreliable energy supply, an overloaded system, and inefficient distribution, which have imposed substantial costs on households and businesses. This energy issue is also recognized as one of the biggest obstacles to attracting high-quality FDI in Kosovo (World Bank Report, 2017/a). Additionally, insufficient law enforcement, inadequate public infrastructure, Kosovo's lack of EU integration, an unstable business climate, and limited access to financial incentives are identified as other obstacles to attracting more foreign investments in Kosovo (EBRD Report, 2022/a; Kida, 2015). A study by (Conahan *et al*., 2021) has also identified political instability, corruption and geographical distance as the main challenges for many foreign multinational enterprises to invest in Kosovo. In recent years, the political tensions among Balkan countries have posed another obstacle to increasing the FDI in these countries (D4D Report, 2017; World Bank Report, 2017/b).

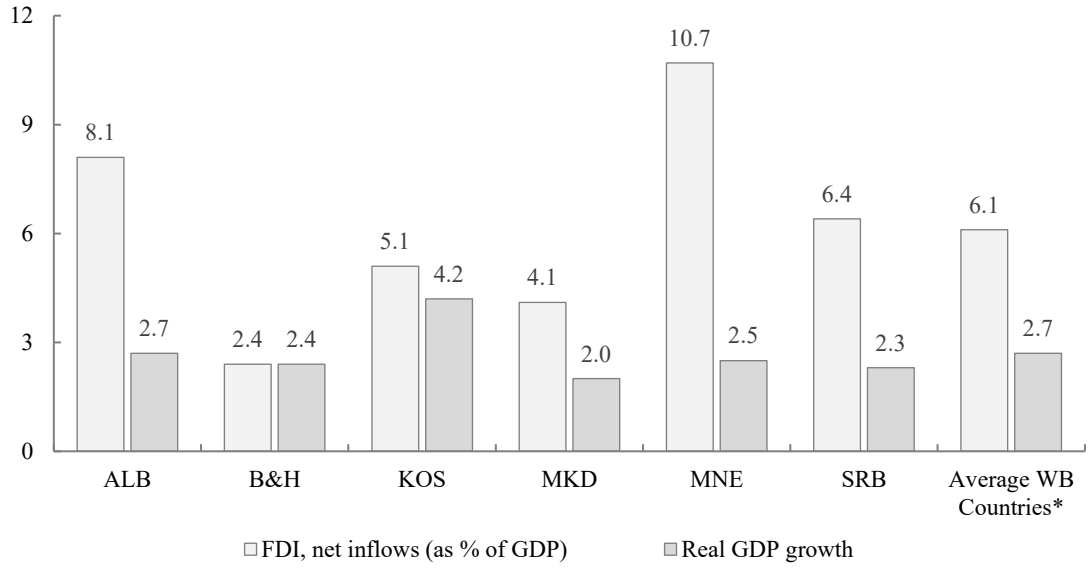
In 2002, the Riinvest Institute conducted a survey of various companies/businesses, including those with foreign investment in their capital structure. The findings indicated that corruption, high tax rates and inadequate investment guarantees were some of the highest barriers to FDI in Kosovo, while high customs duties, limited experience in attracting FDI, and insufficient promotional support were identified as minor barriers. (Riinvest, 2002). Over the past decade, Kosovo has offered economic zones, industrial parks, business parks, and low labour costs. Despite these incentives, FDI inflows into Kosovo's manufacturing sector have remained below 2%, whereas neighbouring countries have managed to increase FDI, resulting in growth in their manufacturing sectors (EBRD Report, 2022/a; Kida, 2015). Then, Kosovo provides a limited market size (approximately 1.8 million inhabitants), which makes it less appealing to foreign investors (Sklias & Roukanas, 2007). According to (IMF Report, 2023/a), the prolonged dialogue process with Serbia for a final agreement may negatively impact foreign investors' perception of investing in Kosovo. Consequently, Kosovo is substantially behind other former Yugoslav countries in attracting FDI, with less than 10% of the total cumulative FDI by 2016 (Deichmann *et al*., 2022). Also, Kosovo's average annual FDI net inflows (as a percentage of GDP were lower than those of most Western Balkans countries between 2011 and 2022 (see Figure 3).

During the last decade, Kosovo's average annual real GDP growth has been strong, but its FDI stock per capita was 50% below the Western Balkan average in 2020 (EBRD Report, 2022/a). Despite having the youngest population in Europe and a population three times larger than Montenegro's, Kosovo has not managed to attract as much FDI as other Balkan countries (Conahan *et al*., 2021). Despite its low labour costs, Kosovo's status as one of Europe's poorest economies may restrict purchasing power for foreign entrepreneurs and businesses, which could be a risk to their investments (Jensen, 2018). Moreover, FDI in Kosovo has had limited connections with efficiency-seeking sectors, such as foreign investments and export promotion. Investments in these areas could enhance access to export markets, boost labour productivity, increase business competitiveness, and improve integration into regional and global value chains (World Bank Report, 2021/a). A study from (Bajrami & Krasniqi, 2019) has argued that Kosovo faces a "*psychological distance*" due to its history of war and political instability, which has diminished its

attractiveness for FDI. According to (World Bank Report, 2021/b), Kosovo's economy is insufficiently integrated into international markets, and the number of businesses with foreign capital is notably lower compared to the EU and Balkan countries.

Figure 3

Average annual of FDI inflows and GDP in the Western Balkan countries 2011 – 2022



Source: Eurostat (Online Data), EU Report 2023, World Bank (Online Data) & (*) author calculations

In addition to these circumstances, foreign investors in Kosovo encounter several challenges that significantly hinder their investment activities, including unfair market competition, unreliable energy supply, high-interest loans, inadequate business infrastructure, and imbalanced competition between foreign investments and the informal economy (Hajrizi & Hasani, 2013). Despite the improvement of foreign investments in Kosovo in recent years, these foreign investments experienced instability, primarily due to fluctuations in the mining, transport, and communication sectors, leading to a decline in their quality in Kosovo from 2009 to 2014 (Sahiti *et al*., 2020). To analyse the impact of the business environment on foreign investment in Kosovo, the Riinvest Institute conducted another survey of various companies and businesses in Kosovo and their results highlighted an unfavourable business environment. Their results also showed that 54% of these businesses experienced declining sales and only 11% of them were engaged in export markets, thus, these issues contribute to a discouraging climate for potential foreign investors, ultimately reducing FDI flows (Riinvest, 2014; Riinvest, 2013).

Conclusions

After a prolonged and difficult transition path in the former Yugoslav Federation and then, under the Serbian state, Kosovo began from scratch to establish its institutions and political and economic systems, but it faced various challenges during the post-war period. Given these circumstances, FDI has been crucial, making a significant contribution to many sectors of Kosovo's economy over the past two decades.

Thus, FDI in Kosovo has enhanced the business environment, market competition, service quality, knowledge, technology, welfare, and employment, and they also reduced the economic disparities between Kosovo and the countries of the region. Between 2007 and 2022, foreign investors primarily concentrated their investments in real estate (49.6%), finance and insurance (14.8%), manufacturing, wholesale, and retail trade (9.2%), construction (7.1%), etc. Then, FDI inflows in Kosovo are primarily led by investors from Germany, Switzerland, the USA, Albania, Austria, Great Britain, and other countries. In terms of the legal framework,

international institutions and then, the institutions of Kosovo have approved a series of regulations and laws that meet international standards, creating favourable conditions for foreign investors to carry out their investment projects. However, energy insecurity, geographical distance, a limited market size (purchasing power), political instability, regional tensions, and the lack of integration into international markets and the EU are identified as some of the main obstacles and barriers for foreign investors. Finally, Kosovo's institutions should implement proactive policies to boost FDI flows, enhance the investment environment and business climate, promote their opportunities to international companies, attract prominent investors, develop investment opportunities in less appealing sectors, strengthen regional economic stability, etc.

References

Assembly of Kosovo (2005). *Law on Foreign Investment (Law no. 02/L-33)*. Prishtina: The Assembly of the Republic of Kosovo. Retrieved from: http://old.kuvendikosoves.org/common/docs/ligjet/2005_02-L33_en.pdf

Assembly of Kosovo (2013). *Law on Foreign Investment (Law No. 04/L-220). Decree No. DL-059-2013*. Prishtina: The Assembly of the Republic of Kosovo. Retrieved from: https://gzk.rks-gov.net/ActDetail.aspx?ActID=8982

Assembly of Kosovo (2017). *Law on Strategic Investment in the Republic of Kosovo (Law No. 05/L-079). Decree no. DL-009-2017*. Prishtina: The Assembly of the Republic of Kosovo. Retrieved from: http://old.kuvendikosoves.org/common/docs/ligjet/05-L-079%20a.pdf

Assembly of Kosovo (2018). *Law No. 06/L-016 on Business Organizations*. Prishtina: Assembly of the Republic of Kosovo. Retrieved from: https://gzk.rks-gov.net/ActDetail.aspx?ActID=164 26&langid=2

Assembly of Kosovo (2023). *Draft Law on Sustainable Investment (Decision No.02/118)*. Prishtina: The Assembly of the Republic of Kosovo. Retrieved from: https://kryeministri.rks-gov.net/wp-content/uploads/2023/01/Projektligj-per-Investime-te-Qendrueshme.pdf

Bajrami, H. & Krasniqi, L. (2019). Business Environment and Foreign Direct Investment in Kosovo: An Overview of the Relationship between Institutional Reforms and FDI. *Economic Research Guardian*. *9*(2), 99–108. https://www.ecrg.ro/files/p2019.9(2)4y3.pdf

CBAK Report (2008). *Annual Report 2007*. Prishtina: Central Bank Authority of Kosovo. Retrieved from: https://bqk-kos.org/repository/docs/2010/Annual%20Report%202007.pdf

CBK Report (2011). *Monthly Statistics Bulletin No 118: Quarterly Assessment*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/repository/docs/2011/MSB%20 118.pdf

CBK Report (2013). *Annual Report 2012*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/repository/docs/2013/CBK-AR-2011.pdf

CBK Report (2015). *Macroeconomic Developments Report (Nr. 4)*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/repository/docs/2015/Raporti%20i%20 Zhvillimeve %20Makroekonomike.pdf

CBK Report (2020). *Annual Report 2019*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/wp-content/uploads/2020/10/CBK_AR_2019.pdf

CBK Report (2021). *Annual Report 2020*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/wp-content/uploads/2021/07/CBK_AR_2020.pdf

CBK Report (2022). *Annual Report 2021*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/wp-content/uploads/2022/07/CBK_AR_2021.pdf

CBK Report (2023/a). *Monthly Statistics Bulletin No 257*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/wp-content/uploads/2023/03/BQK_BMS_257_ Al.pdf

CBK Report (2023/b). *Financial Stability Report No 19*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/wp-content/uploads/2023/08/BQK_FSR_19-1.pdf

CBK Report (2023/c). *Monthly Statistics Bulletin No 265*. Prishtina: Central Bank of the Republic of Kosovo. Retrieved from: https://bqk-kos.org/wp-content/uploads/2023/11/BQK_BMS_265_ Sq.pdf

Conahan, K., Deichmann, J. I., Krasniqi, B. & Peci, F. (2021). FDI in Kosovo. In: Deichmann, J.I. (Eds). *Foreign Direct Investment in the Successor States of Yugoslavia*. Economic Geography (pp. 195–212). Springer. DOI: https://doi.org/10.1007/978-3-030-55739-3_8

D4D Report (2017). *Foreign Direct Investments and Exports: Kosovo and the Western Balkans*. Series: Policy Analysis and Research No. 5. Prishtina: Democracy for Development Institute. Retrieved from: https://d4d-ks.org/wp-content/uploads/2018/03/D4D_Analize_5_ENG_FIN.pdf

Deichmann, J. I., Grubaugh, S. & Scholten, P. (2022). FDI Propensity and Geo-cultural Interaction in Former Yugoslavia: Pairwise Analysis of Origin and Destination Countries. *Eurasian Economic Review: A Comparative Economic Geography 25 Years Later*. *12*(3), 479–505. DOI: https://doi.org/10.1007/s40822-022-00204-w

Deichmann, J. I., Grubaugh, S. & Scholten, P. (2022). FDI Propensity and Geo-cultural Interaction in Former Yugoslavia: Pairwise Analysis of Origin and Destination Countries. *Eurasian Economic Review*. *12*(3), 479–505. DOI: https://doi.org/10.1007/s40822-022-00204-w

Deichmann, J. (2021). Overview of Foreign Direct Investment in Former Yugoslavia and Related Scholarly Literature. In: Deichmann, J.I. (Eds). *Foreign Direct Investment in the Successor States of Yugoslavia: A Comparative Economic Geography 25 Years Later*. Economic Geography (pp. 1–21). Springer. DOI: https://doi.org/10.1007/978-3-030-55739-3_1

EBRD Report (2022/a). *Kosovo Country Diagnostic: Private Investment Challenges and Opportunities 2022*. London: European Bank for Reconstruction and Development. Retrieved from: https://www.ebrd.com/publications/country-diagnostics

EBRD Report (2022/b). *The EBRD in Kosovo: Results Snapshot*. London: European Bank for Reconstruction and Development (EBRD).

ESI Report (2003). *The Kosovo General Government 2003 Budget*. Berlin / Vienna: European Stability Initiative (ESI). Retrieved from: https://www.esiweb.org/pdf/bridges/kosova/2/18.pdf

Estrin, S. & Uvalic, M. (2016). Foreign Direct Investment in the Western Balkans: What Role Has it Played During Transition? *Comparative Economic Studies*. *58*(3), 455–483. DOI: https://doi.org/10.1057/ces.2016.10

EU Report (2004). *European Economy. The Western Balkans in Transition*. Occasional Papers No 5/2004. Brussels: European Commission. Retrieved from: https://ec.europa.eu/economy_finance /publications/pages/publication1014_en.pdf

EU Report (2009). *Retrospective Evaluation of CARDS Programmes in Kosovo*. Final Evaluation Report No 160709. Brussels: European Commission. Retrieved from: https://neighbourhood-enlargement.ec.europa.eu/system/files/2018-12/05-fr_cards_kosova_160709.pdf

GAP Institute (2023). *Economic Payoffs of Energy Efficiency in Kosovo*. Prishtina: Institute for Advanced Studies GAP. Retrieved from: https://www.institutigap.org/documents/58261_eficienca_ energjise_EN_(draft3).pdf

Gashi, P. (2017). Free Trade and FDI in Kosovo: Prospects for Integration into the EU and Turkish Production Networks. *Turkish Economic Review*. *4*(1), 86–95. DOI: https://doi.org/10.1453/ter.v4i1.1134

Hajrizi, E. & Hasani, M. (2013). Kosovo Investment Climate and Foreign Investors' Perception. *IFAC Proceedings Volumes*. *46*(8), 219–224. DOI: https://doi.org/10.3182/20130606-3-XK-4037.00040

IMF Report (2001). *Kosovo - Progress in Institution-Building and the Economic Policy Challenges Ahead*. Washington, D.C.: International Monetary Fund. Retrieved from: https://www.imf.org/ external/np/eu1/kosova/2001/eng/120601.pdf

IMF Report (2023/a). *Republic of Kosovo: 2022 Article IV Consultation-Press Release; Staff Report and Statement by the Executive Director for the Republic of Kosovo*. IMF Country Report No. 23/54. Washington, D.C.: International Monetary Fund.

IMF Report (2023/b). The *Republic of Kosovo. IMF Country Report No. 23/200*. Washington, D.C.: International Monetary Fund. Retrieved from: https://doi.org/10.5089/9798400244940.002

Jensen, J. D. (2018). An Analysis and Evaluation of Foreign Direct Investment in Kosovo. *International Journal of Business Administration*. *9*(5), 88–95. DOI: https://doi.org/10.5430/ijba.v9n5p88

Kida, N. (2015). Obstacles Encountered by Foreign Investors in Kosovo. *International Conference on Issues in Business Administration and Economics* (25-26 Nov 2015). Paris. Retrieved from: http://erpub.org/siteadmin/upload/2166E1115085.pdf

Knuth, A., Salopiata, M.-A., Rexhebeqaj, V. & Hajra, A. (2022). *Improving the Business Climate - Boosting Investment. Proposals from German Business in Kosovo*. Policy Study Kosovo No 2. Berlin: German Economic Team. Retrieved from: https://rexconsulting-ks.com/wp-content/uploads/2022/12/FINAL_GET_KOS_PS_02_en_ 2022-2.pdf

Kovachev, G., Velkovska, I., Garvanlieva, V. & Nikolov, M. (2020). Attracting Foreign Investments in the Western Balkans Region and State Aid: Race to the Bottom or Necessity? *MPRA Paper 101715*. University Library of Munich. Retrieved from: https://mpra.ub. uni-muenchen.de/101715/1/0.-STUDIJA-FINAL-State-Aid-and-FDI-designed-ENG.pdf

Krasniqi, B., Ahmetbasić, J. & Bartlett, W. (2022). Foreign Direct Investment and Backward Spillovers in the Western Balkans: The Context, Opportunities and Barriers to the Development of Regional Supply Chains. *South-eastern Europe (SEEU)*. *46*(1), 1–22. Retrieved from: https://eprints.lse.ac.uk/115391/1/Foreign_Direct_Investment_Backward_Spillovers_Western_Balkans_2022.pdf

Mehmeti, J. (2011). Kosovo: New Country, Old Problems. *Journal for Labour and Social Affairs in Eastern Europe*. *14*(2), 265–276. Retrieved from: http://www.jstor.org/stable/43293419

OECD Report (2013). *Assessment of the Kosovo* Innovation System. Privat Sector Development (Project Insights)*. Paris: Organization for Economic Co-operation and Development. Retrieved from: https://www.oecd.org/south-east-europe/programme/Kosova%20Innovation% 20Report%20English%20Version.pdf

OECD Report (2021). Chapter 22 Kosovo Profile. In *Competitiveness in South East Europe 2021: A Policy Outlook*. Paris: OECD Publishing. DOI: https://doi.org/10.1787/dcbc2ea9-en

Perez, C. A. (2003). *Do US Interventions Affect FDI Flows?* Virginia: Center for Naval Analyses. Retrieved from: https://www.cna.org/archive/CNA_Files/pdf/d0008438.a1.pdf

Radenkovic - Jocic, D. (2004). Role of Direct Foreign Investment in the Development of Balkan Countries (The Case of Serbia). *South-Eastern Europe Journal of Economics*. *2*(2), 101–118. Retrieved from: http://www.asecu.gr/Seeje/issue03/radenkovic.pdf

Radenković, I. (2016). *Foreign Direct Investments in Serbia*. Research Paper Series No 6. Belgrade: Rosa Luxemburg Stiftung Southeast Europe. Retrieved from: https://rosalux.rs/wp-content/uploads/ 2022/04/108_foreign_direct_investments_in_serbia_ivan_radenkovic_rls_2016.pdf

Riinvest (2002). *Foreign Direct Investment in Kosovo: Policy Environment and Promotional Strategy*. Prishtina: Riinvest Institute. Retrieved from: https://www.riinvestinstitute.org/uploads/files/2016/ October/17/anglisht1476705589.pdf

Riinvest (2013). *The Performance, Barriers, and Trust of Businesses in Kosovo [Numratori Ekonomik]*. Publisher: Institute for Development Research Riinvest (Kosovë).

Riinvest (2014). *Business Climate in Kosovo. A Cross-Regional Perspective*. Prishtina: Riinvest Institute. Retrieved from: https://www.riinvestinstitute.org/uploads/files/2016/September/23/ Business_Climate_in_Kosova1474619815.pdf

Sahiti, A., Ahmeti, A. & Sahiti, A. (2020). FDI Trends and Characteristics in Kosovo. *Baltic Journal of Real Estate Economics and Construction Management*. *8*(1), 12–21. DOI: https://doi.org/10.2478/bjreecm-2020-0002

Sklias, P. & Roukanas, S. (2007). Development in Post-Conflict Kosovo. *South-Eastern Europe Journal of Economics*. *5*(2), 267–287. Retrieved from: http://www.asecu.gr/Seeje/issue09/sklias.pdf

Topalli, M., Papavangjeli, M., Ivanaj, S.& Ferra, B. (2021). The Impact of Foreign Direct Investments on Poverty Reduction in the Western Balkans. *Economics*. *15*(1), 129–149. DOI: https://doi.org/10.1515/econ-2021-0008

UNCTAD Report (2013). *Global Value Chains: Investment and Trade for Development: World Investment Report 2013*. New York and Geneva: UNCTAD (United Nations Conference on Trade and Development). Retrieved from: https://unctad.org/system/files/official-document/wir2013_en.pdf

UNMIK Regulation (2001). *Regulation on Foreign Investments in Kosovo: UNMIK Regulation No. 2001/3*. Prishtina: The United Nations Mission in Kosovo (UNMIK).

Uvalic, M. & Cvijanović, V. (2018). *Towards A Sustainable Economic Growth and Development in the Western Balkans (Analysis Report)*. Bonn: Friedrich-Ebert-Stiftung. Retrieved from: https://library.fes.de/pdf-files/bueros/kroatien/14688.pdf

World Bank Report (2017/a). *Republic of Kosovo: Systematic Country Diagnostic (P151814) Report No. 114618-XK*. Washington D.C.: The World Bank Group. Retrieved from: https://documents1.world bank.org/curated/en/282091494340650708/pdf/Kosova-SCD-FINAL-May-5-C05052017.pdf

World Bank Report (2017/b). *Faster Growth Brings More Jobs to the Western Balkans. Western Balkans Regular Economic Report No.11*. Washington D.C.: The World Bank

World Bank Report (2020/a). *Doing Business 2020. Comparing Business Regulation in 190 Economies*. Washington, D.C.: IBRD / The World Bank Group. Retrieved from: https://ms.hmb.gov.tr/uploads/sites/2/2019/10/Doing_Business_2020.pdf

World Bank Report (2020/b). *Western Balkans Regular Economic Report No 18. Kosovo - An Uncertain Recovery*. Washington D.C.: International Bank for Reconstruction and Development / The World Bank Group. Retrieved from: https://documents1.worldbank.org/curated/en/315 821603298747435/pdf/An-Uncertain-Recovery-Kosova-Country-Note.pdf

World Bank Report (2021/a). *Boosting Foreign Direct Investment: Kosovo Country Economic Memorandum*. Washington D.C.: IBRD / The World Bank. Retrieved from: https://openknowledge. world bank.org/server/api/core/bitstreams/0811785f-b1a9-546d-9183-0b6133680f30/content

World Bank Report. (2021/b). *Kosovo Country Economic Memorandum, November 2021: Raising Firm Productivity*. Washington, D.C.: World Bank Group. Retrieved from: http://hdl.handle.net/10986/36897

Ziberi, B. & Gashi, Rr. (2021). Foreign Direct Investment Legislation: A Precondition for Creating a Favourable Investment Climate in the Case of Kosovo. *Baltic Journal of Real Estate Economics and Construction Management*. *9*(1), 33–41. DOI: https://doi.org/10.2478/bjreecm-2021-0003

Transformacijska dinamika kosovskega gospodarstva: Pregled zgodovine in razvoja neposrednih tujih naložb

Izvleček

Ta članek prikazuje poglobljen pregled neposrednih tujih naložb (NTI) kosovskega gospodarstva za obdobje več kot dvajsetih let. NTI so imele ključno vlogo in so se izkazale za nepogrešljive pri razvoju kosovskega gospodarstva. NTI so v glavnem usmerjene h gospodarskim dejavnostim, kot so nepremičnine, finance, proizvodnja, gradbeništvo itd. Kar zadeva pravni okvir, je Kosovo sprejelo vrsto predpisov in zakonov s primarnim ciljem zaščititi, privabiti in spodbujati tuje vlagatelje k naložbam. Vendar pa so ovire, kot so politična nestabilnost, energetska negotovost, zamude pri integraciji v EU in politične napetosti v regiji, prepoznane kot glavne ovire, ki vplivajo na NTI v Kosovu. Kosovo bi moralo razviti ustrezne politike za izboljšanje svoje konkurenčnosti na področju naložb, privabiti multinacionalna podjetja k naložbenim priložnostim in dati prednost manj privlačnim gospodarskim sektorjem za naložbe NTI..

Ključne besede: poslovno okolje, prilivi NTI, tuji vlagatelji, gospodarska rast, Kosovo

Is There a Relationship between Macroeconomic Variables and Stock Market Indices in Bosnia and Herzegovina?

Adem Abdić[*a], Ademir Abdić[b], Lejla Lazović-Pita[a], Fahir Kanlić[c]
[a] *Department of Finance, School of Economics and Business, University of Sarajevo, Sarajevo, Bosnia and Herzegovina*
[b] *Department of Quantitative Economics, School of Economics and Business, University of Sarajevo, Sarajevo, Bosnia and Herzegovina*
[c] *Agency for Statistics of Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina*
adem.abdic@efsa.unsa.ba, ademir.abdic@efsa.unsa.ba, lejla.lazovic@efsa.unsa.ba, fahir.kanlic@bhas.gov.ba

ARTICLE INFO

Original Scientific Article

Article history:
Received June 2024
Revised September 2024
Accepted September 2024

JEL Classification
C32, E44, G10

Keywords:
Stock market indices
Macroeconomic variables
BiH,
VECM model
Granger causality test

UDK: 330.101.541:336.76(497.6)
DOI: 10.2478/ngoe-2024-0016

Cite this article as: Abdić, A., Abdić, A., Lazović-Pita, L., & Kanlić, F. (2024). Is there a relationship between macroeconomic variables and stock market indices in Bosnia and Herzegovina. *Naše gospodarstvo/Our Economy, 70*(3), *48-70*. DOI: 10.2478/ngoe-2024-0016

Abstract

The economic growth and development of a country are reflected in many aspects, one of them being the stock market indices. The purpose of the article is to examine and determine the relationship between selected macroeconomic variables and stock market indices in Bosnia and Herzegovina (BiH). Using quarterly data over the 2010q1-2019q4 period, a cointegration analysis was applied to model this relationship. The Vector Error Correction Model (VECM) was used to explore the short-run relationship as well as the long-run relationship. The article examined the predictive ability among variables of interest by applying the Granger causality test. The results indicate a stable long-run relationship between the analysed macroeconomic variables and stock market indices in BiH, while no short-run relationship was found. The results contribute to the scientific discussions about the relationship between selected macroeconomic variables and representative stock market indices in BiH which considers their direction and strength.

Introduction

Stock markets have long played an important role in economic life but the deepness/liquidity and level of sophistication of modern financial markets are arguably a contemporary phenomenon (Van Nieuwerburgh, Buelens & Cuyvers, 2006). Intuitively, the relationship between stock markets and the economic indicators are considered in two ways: *a) Leading or Lagging Indicator:* This perspective views the stock market as either a leading or lagging indicator of a country's economic activities. In this context, the stock market can provide early signals or delayed responses to changes in the broader economy; *b) Impact of Market-Oriented Parameters:* The second perspective considers how stock markets can be influenced by the gradual development or growth of market-oriented factors. This viewpoint focuses on how changes in factors such as market regulations, investor sentiment, and economic policies could impact the stock market.

[*] *Corresponding author*

From the first perspective, authors such as Adjasi & Biekpe (2006), Enisan & Olufisayo (2009), Khan & Khan (2018) consider that a robust and developed stock market plays a vital role in stimulating economic activity which then contributes to the economic growth and economic development. The financial development of the stock market can underpin economic growth through several mechanisms, as identified by Levine (2005): a) Reduce information costs and improve resource allocation; b) Monitor investments and implement corporate governance measures following financing; c) Support trading, diversification, and risk management activities; d) Aggregate and mobilize savings; e) Facilitate the exchange of goods and services. With the rapid transformation of economic structures, policies, and institutions on a global scale most recently, the role of capital markets as intermediary between investors an entrepreneurs is becoming more prominent in developing economies (Bayezid Ali, 2011).

Proponents of the second perspective such as Davidson & Froyen (1982), Dhakal, Kandil & Sharma (1993), La Porta et al. (1997), Bekaert & Harvey (2000), Svaleryd & Vlachos (2002), Masulis & Lakshmanan (2002), El-Wassal (2005), Carvajal & Elliott (2007), Yartey (2010), Pilinkus (2010), Finter, Niessen-Ruenzi & Ruenzi (2011), Şükrüoğlu & Nalin (2014), Arouri et al. (2016), Bayar (2016), Ho (2019), Asravor & Fonu (2021) evaluate how a stock market can be significantly influenced by various market-oriented factors, exploring the following evolving nature of the factors over time: a) *Changes in market regulations and economic policies* implemented by regulatory authorities can have a profound impact on stock markets; b) *Investor sentiment* plays a crucial role in stock market movements; c) *Government economic policies*, such as fiscal and monetary policies, taxation, and trade policies, can directly affect the stock market; d) *Changes in the structure of the market itself*, including the introduction of new trading platforms, the emergence of high-frequency trading, or advancements in technology, can impact stock market behaviour; e) *Global economic conditions*, such as recessions, economic growth, or geopolitical tensions, can reverberate through stock markets worldwide. Cross-border trade, international investment, and global economic interdependencies mean that events in one country can have spillover effects on stock markets in others.

At this juncture, it is important to emphasize that, according to Stulz (2001), there is no direct relation between a country's economic development and its financial structure. The author argues that, for example, Japan and the United States or Germany and England exhibit significantly different financial structures despite being at similar levels of economic development. Hence, Stulz (2001) concludes that it is not possible to state that the financial structure is entirely determined endogenously.

Thus, there is a general agreement that economic growth and financial markets are connected, but the disagreement lies in whether the financial market drives economic growth (supply-side argument) or whether economic growth leads to the development of the financial market (demand-side argument). It's an ongoing debate about the cause and the effect in the context of economic development and financial markets.

According to Pilinkus (2010), the stock market performance is supposed to illustrate the state of the country's economy: if stock prices start to fall economic depression is likely to take place and, conversely, rising stock prices show possible economic growth.

BiH is a small (post)transition country with underdeveloped financial markets. The two stock exchanges in BiH were established in Sarajevo and Banja Luka in the early 21st century (in 2001). Since the establishment, both stock markets have actively participated in the privatization process in BiH with several varieties of traded securities (stocks, government bonds, treasury bills, etc). These two exchanges operate on the same regulatory principles. *The Sarajevo Stock Exchange* (SASE) calculates and publishes the following stock indices[1]: a) SASX-10: Sarajevo Stock Exchange Index 10 – which tracks the performance of the 10 largest companies in the domestic market, measured by market capitalization and trading frequency; b) SASX-30: Sarajevo Stock Exchange Index 30 – which monitors the price movements of the 30 most liquid stocks from the Free Market of SASE; c) SASX Islamic: SASX-Islamic is an index created in collaboration with the local Bosnia Bank International. *The Banja Luka Stock Exchange* (BLSE) calculates and publishes the BIRS index[2]: The Stock Exchange Index of the Republic of Srpska – which tracks the movement of 5 to 30 issuers whose stocks are included in the composition of BIRS, depending on the number of issuers on the official stock market and the number of issuers meeting the criteria for inclusion in BIRS.

[1] See more at Sarajevo Stock Exchange website: http://www.sase.ba/v1/Tr%C5%BEi%C5%A1te/Op%C4%87e-Informacije/Indexi-SASE (accessed: 03/04/2024)

[2] See more at Banka Luka Stock Exchange website: https://www.blberza.com/Pages/indexlist.aspx (accessed: 03/04/2024)

According to Kumalić (2013), the financial market in BiH is bank-centric and structurally underdeveloped. The banking sector falls into the category of moderately developed with a high concentration of key aggregates, which makes it more sensitive and risk-prone. The capital market is underdeveloped both in terms of volume and the number of instruments, and it is characterized by a multi-layered organization, lack of functionality, and poor coordination.

Bearing in mind the current academic dilemma together with the underdeveloped financial markets in BiH and, the complex constitutional organization of the country reflected in the slow transition process with weak macroeconomic indicators, in this article, we wish to examine if there is a relationship between macroeconomic variables and stock market indices. Hence, we define two research questions:

1. *Is there a relationship between the macroeconomic variables and stock market indices in the BiH in the long and/or in the short run?*
2. *What is the direction of the relationship between macroeconomic variables and stock indices?*

After the introduction and literature review, the article is divided into the following sections: research design and methodology, results and discussion, and conclusion. Before concluding, we emphasize the significance of the obtained results.

Literature Review

Academic literature recognizes supply and demand side arguments in the examination and evaluation of the relationship between economic growth and financial markets. Theoretical causality between financial markets and economic growth are explained by the two main hypotheses defined by Patrick (1966): the supply-leading hypothesis and a demand-following hypothesis. *The supply-leading hypothesis* suggests that the development of financial markets and institutions drives economic growth. In this scenario, deliberately creating financial institutions and markets increases the availability/supply of financial services, consequently stimulating real economic growth. Some theoretical and empirical studies (Neusser & Kugler, 1998; Calderón & Liu, 2003) have provided evidence supporting the supply-leading phenomenon. *The demand-following hypothesis* suggests that economic growth leads to the development of financial markets and institutions. As the real economy expands, there is an increasing demand for financial services, which, in turn, drives the growth of the financial sector. Essentially, the financial sector reacts passively to economic growth. Some theoretical and empirical studies (Gurley & Shaw, 1955; Goldsmith, 1969; Stern, 1989; Romer, 1990) have provided evidence supporting the demand-following hypothesis.

Researchers have employed various theoretical frameworks to establish relationships and dynamic interactions between fluctuations in macroeconomic variables and fluctuations in stock market returns. On one hand, in line with the supply-leading hypothesis, these frameworks incorporate concepts such as the frictionless Arrow-Debreu economic world (1954), where there is no incentive for financial intermediation, alongside different types of financial contracts, markets, and institutions. On the other, following the demand-following hypothesis, these frameworks encompass concepts such as the EMH, as formulated by Fama (1970), and/or the Arbitrage Pricing Theory (APT), which was developed by Ross (1976). According to Fama (1970, p. 383), "*Semi-strong form of EMH, in which the concern is whether prices efficiently adjust to other information that is publicly available are considered*". Thus, as for the effect of macroeconomic variables such as GDP growth rate, money supply, interest rate, industrial production, FDI and exchange rate on stock prices, the EMH proposes that in a well-functioning market with profit-maximizing investors, all the pertinent information known about changes in the macroeconomic variables are fully reflected in market stock prices, so that investors will not be able to earn extra profit through prediction of future stock market movement (Chong & Goh, 2003). Contrary to the conclusions drawn by the EMH, substantial evidence spanning nearly a half-century has built up, indicating that essential macroeconomic variables play a role in predicting the time series of stock returns. The challenge to the conclusions derived from the EMH can be traced back to early studies by Nelson (1976), and Jaffe & Mandelker (1976), all of which affirm that macroeconomic variables indeed exert influence on stock returns. Similarly, according to Bhuiyan & Chowdhury (2020), a host of works that used the APT framework includes Chen, Roll & Ross (1986), Poon & Taylor (1991), Hamao (1988), Martinez & Rubio (1989), Ferson & Harvey (1991) and find a significant relationship between stock market returns and money supply, interest rate, and real economic activity questioning the validity of the EMH.

However, the introduction of cointegration by Engle & Granger (1987) provided an alternative approach to studying long-run equilibrium relationships between

variables without concerns about spurious correlations. Regressions within the APT framework involving non-stationary variables were susceptible to such correlations. Since the development of cointegration analysis, a host of literature, including studies by Mukherjee & Naka (1995), Nasseh & Strauss (2000), Ratanapakorn & Sharma (2007), Humpe & Macmillan (2009), Kumar & Sahu (2017), Al-Kandari & Abul (2019), Tulcanaza-Prieto & Lee (2019), Bhuiyan & Chowdhury (2020) have examined and found significance in macroeconomic variables when explaining stock market returns, further challenging the validity of the EMH.

Although there is a solid theoretical foundation linking financial markets and key macroeconomic factors, empirical assessments show significant variation in their findings. According to Levine (2005) and Beck (2012) the sign of this relationship and the question of lead-lag effect have been subject to debate.

It can be concluded that economists hold different opinions on the nature of the relationship between macroeconomic variables and stock market development. However, most studies examining the relationship between stock markets and macroeconomic variables are primarily grounded in the APT which connects the returns of individual assets and portfolios to a range of independent macroeconomic variables. Authors such as Fama (1981), Gjerde & Sættem (1999), Merikas & Merika (2006), and Bekhet & Matar (2013) have found that key factors that influence stock prices include inflation, interest rates, industrial production, and exchange rates. Conversely, there are also studies, such as those conducted by Flannery & Protopapadakis (2002) and Maio & Philip (2015) that have been unable to establish a significant relationship between macroeconomic indicators and stock returns. Due to a vast academic interest in the topic, most recently, several authors such as Ruhani et al. (2018), Verma & Bansal (2021) or Chaurasia & Debnath (2023) have provided a systematic literature review on the effects and the impact between macroeconomic variables and stock markets/prices. Several macroeconomic variables have been repeatedly deployed such as GDP, FDI (foreign direct investments), foreign institutional investment, interest rates, exchange rates, money supply, etc. In terms of systematic research methods used in analyzing and predicting stock markets, authors such as Nti, Adekoya, & Weyori (2020) and Bustos & Pomares-Quimbaya (2020) have used machine and deep learning methods in the systematic literature reviews.

While the relationship between macroeconomic variables and stock market indices has been well documented and investigated in developed countries, there are a few similar empirical studies in developing and (post)transition countries.

Using the Panel Vector Error Correction Model (PVECM) Mojanoski (2022) explored the long-run and short-run relationship between the values of the stock market indices (MBI10, CROBEX, SASX-10 and BELEX 15) and the selected macroeconomic variables in BiH, Croatia, North Macedonia and Serbia. The results of PVECM between the values of the selected stock indices and independent variables (industrial production index, average monthly gross wages) show the existence of conditionality in the long run, while the independent variable Harmonized Index of Consumer Prices is excluded from the model. Similarly, Ligocká (2023) has investigated the relationship between selected macroeconomic variables (CPI, GDP, and M3) and the values of representative stock market indices for Central and Eastern European countries in the period 2004q1-2021q4. The application of VECM estimations and the Granger causality test indicate that the selected macroeconomic variables affect the values of European stock market indices in the long term rather than in the short term.

The relationship between the CROBEX index and relevant macroeconomic variables in Croatia has been examined by Hsing (2011). Applying the GARCH model, this paper finds that the CROBEX index is positively associated with real GDP, the M1/GDP ratio, the German stock market index and the euro area government bond yield and is negatively influenced by the ratio of the government deficit to GDP, the domestic real interest rate, the HRK/USD exchange rate, and the expected inflation rate. Similarly, Backović et al. (2023) have analysed the constitution of the emerging Montenegrin stock exchange. The results of four tests (ADF test, run test, ACF test, and Hurst test) conducted in this study do not provide empirical evidence supporting the random walk theory and its returns on aggregated shocks in the Montenegrin stock exchange market.

Djedović and Djedović (2018) conducted an ARDL model to investigate the long-run relationship between the macroeconomic variables in BiH and the stock market index (SASX-30). The results show that volatility of the exchange rate has a significant impact on stock index return. Furthermore, the results show that the deposit

(interest) rate and IPI have a slightly negative significant long-term impact on stock index return. The other macroeconomic variables did not show any significant impact on the SASX-30 return.

The aforementioned studies did not include indices from BiH, except the work by Djedović and Djedović (2022), which assessed the long-term impact of the exchange rate, deposit interest rate, and industrial production index (IPI) exclusively on the SASX-30 index. Therefore, this study aims to fill the literature gap by investigating the stock market indices in both entities of BiH (SASX-10 and BIRS), which is relatively poorly researched with macroeconomic variables. Furthermore, the study will address the use of deseasonalized time series and the inclusion of new macroeconomic variables in the model, such as GDP, money supply, trade balance and interest rates on short-term liabilities. In terms of regional implications of the research, the inclusion of macroeconomic variables has been previously recognized as a research limitation in the works of Backović et al. (2023) in the case of the Montenegrin stock exchange and we try to fill in this literature gap too. As we use VECM, the article investigates the short-term and long-term relationship between selected macroeconomic variables and the values of both stock market indices in BiH.

Furthermore, a more comprehensive examination of the literature, including authors, variables, methods and obtained results is presented in Table 1.

Table 1
The comprehensive literature review

Study Authors	*Data-Country*	*Dependent variable*	*Independent variables*	*Estimation method*	*Results*
Mukherjee and Naka (1995)	(1971:M1-1990:M12) Japan	TSE index	exchange rate, money supply, inflation, industrial production, long-term government bond rate, call money rate	VECM model	A cointegrating relation indeed exists and stock prices contribute to this relation.
Wongbangpo and Sharma (2002)	(1985-1996) (monthly) Indonesia, Malaysia, Philippines, Singapore, and Thailand	JCSPI index, KLSE index, PSE index, SES index, SET index	GNP, the consumer price index, the money supply, the interest rate, and the exchange rate	Johansen cointegration, VECM model	The Granger causality tests detect the causal relationships from the macroeconomic variables to stock prices in all five ASEAN stock markets. The findings indicate that the past values of macroeconomic variables in these ASEAN countries can predict future changes in their stock price indices.
Maysami, Howe and Hamzah (2004)	(1989:M1-2001:M12) Singapore	STI index	The short and long-term interest rates, industrial production, price levels, exchange rate and money supply	Granger causality test, Johansen cointegration, VECM model	The study concludes that Singapore's stock market and the property index form an integrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

Table 1
The comprehensive literature review (continued)

Study Authors	*Data-Country*	*Dependent variable*	*Independent variables*	*Estimation method*	*Results*
Nishat, Shaheen and Hijazi (2004)	(1973:Q1-2002:Q4) Pakistan	KSE index	industrial production index, the consumer price index, money supply (M1), and interest rate	Granger causality test, Johansen cointegration, VECM model	They find that these five variables are cointegrated and two long-term equilibrium relationships exist among these variables. Analysis of their results indicates that industrial production is the largest positive determinant of Pakistani stock prices, while inflation is the largest negative determinant.
Mehrara (2006)	(1994:Q1-2005:Q4) Iran	TEPIX index	money supply, value of trade balance, and industrial production	Granger causality test	The results show unidirectional long-run causality from macroeconomic variables to the stock market.
Ratanapakorn and Sharma (2007)	(1975:M1-2005:M4) USA	S&P500 index	long-term interest rates, the money supply, IP, inflation, the exchange rate and the short-term interest rate	VECM model	They observe a negative relationship between stock prices and long-term interest rates, and a positive relation between stock prices and the money supply, IP, inflation, the exchange rate and the short-term interest rate.
Abugri (2008)	(1986:M1-2001:M8) Argentina, Brazil, Chile, and Mexico	Stock returns	exchange rates, interest rates, industrial production and money supply, MSCI world index and the U.S. 3-month T-bill yield	VAR model	Using a six-variable vector autoregressive (VAR) model, the study finds that the global factors are consistently significant in explaining returns in all the markets. The country variables are found to impact the markets at varying significance and magnitudes.
Humpe and Macmillan (2009)	(1965:M1-2005:M6) USA and Japan	S&P500 index / NKY225 index	IP, CPI, M1, the real 10-year US T-Bond yield, the real official discount rate (lending rate) in Japan	VECM model	Using US data, they found evidence of a single cointegration vector between stock prices, IP, inflation and the long-term interest rate. In Japan, they found two cointegrating vectors. One normalized on the stock price provided evidence that stock prices are positively related to IP but negatively related to the money supply. They also found that for our second vector, normalized on IP, that IP was negatively related to the interest rate and the rate of inflation.

Table 1
The comprehensive literature review (continued)

Study Authors	*Data-Country*	*Dependent variable*	*Independent variables*	*Estimation method*	*Results*
Karagöz, Ergün and Karagöz (2009)	(1998:M1-2008:M12) Turkey	ISE index	interest rate, inflation (consumer price index), industrial production index, money supply (M1), growth (GDP) and real exchange rate	Johansen cointegration, VECM model	The results reveal that all variables have a statistically meaningful impact on the stock index except the real economic activity (IPI). It seems that consumer prices (INF) have a positive effect on stock prices. The results show that interest rates (INT) have a negative relationship with stock prices. Money supply (MS) has also the same effect on stock prices. Real exchange rates also affect the ISE index positively which means that a depreciation of the currency leads to higher real stock market returns.
Trivedi and Behera (2012)	(1997:M1-2011:M12) India	BSE Sensex index	IIP, WPI, interest rates, money supply, FIIs, MSCI world index	VECM, VAR, impulse response, variance decomposition	There is a positive reaction of the stock market due to IIP, money supply, FIIs and MSCI world index while negative reaction due to WPI and interest rate.
Osamwonyi and Evbayiro-Osagie (2012)	(1975-2005) Nigeria	Stock market index	interest rates, inflation rates, exchange rates, fiscal deficit, GDP and money supply	VECM	The major finding is that macroeconomic variables influence the stock market index in Nigeria.
Basci and Karaca (2013)	(1996:M1-2011:M10) Turkey	ISE 100 index	Exchange, Gold, Import, Export and ISE 100 Index	VAR model	At the end of the established VAR equation, it was specified that series' impact lags were successful in explaining the share price index.
Singh (2016)	(2007-2014) (monthly) India	BSE Sensex index	IIP, money supply, exchange rate, WPI, T-bill rate	Johansen cointegration, VECM	Money supply, WPI and interest rate exert a positive relation while the rest shows a negative relation.
Kumar and Sahu (2017)	2006-2015 (monthly) India	DJIIM index	WPI, interest rate (365-day T-bill rate), money supply (M3), exchange rate	Johansen cointegration, VECM, VAR, Granger causality test	WPI and money supply show a positive relation while interest indicated a negative relation
Al-Kandari and Abul (2019)	(2005-2018) Kuwait	Kuwaiti Stock Exchange index	M2, the three-month deposit interest rate, oil prices, the US Dollar vs Kuwaiti Dinar exchange rate and the inflation rate	Granger causality test, Johansen cointegration, VECM model	The study found that a long-run unidirectional relationship exists between the Kuwaiti Stock Exchange Index and the aforementioned macroeconomic variables. This study also confirmed the existence of a short-run relationship between oil prices and stock prices in Kuwait.

Table 1
The comprehensive literature review (continued)

Study Authors	*Data-Country*	*Dependent variable*	*Independent variables*	*Estimation method*	*Results*
Tulcanaza-Prieto and Lee (2019)	(1993-2017) Korea and Japan	Kospi index and Nikkei index	GDP growth, inflation rate, interest rate, exchange rate, crude oil WTI price, and gold price	Johansen cointegration, (VAR) model, VECM model	The results reveal that each stock market index, GDP growth, inflation rate, interest rate, exchange rate, crude oil WTI price, and gold price form a cointegration in the long term. In addition, GDP growth, interest rate, exchange rate, oil price, and gold price affect the Kospi short-run performance, while GDP growth, interest rate, and gold price affect Nikkei 225 in the short term.
Bhuiyan and Chowdhury (2020)	(2000-2018) US and Canada	S&P500 index	industrial production, money supply, long-term interest rate, and different sector indices	Granger causality test, Johansen cointegration, VECM model	Results suggest that there is a stable long-term relationship between the macroeconomic variables used in the study and different sector indices for the US but not for Canada. However, the US money supply and interest rate can explain the Canadian stock market.

Source: Authors

Research Design and Methodology

Research Design and Data

This study employs quarterly observations from 2010q1 to 2019q4 for stock indices (SASX-10 and BIRS) and macroeconomic variables for BiH. We selected the observed period between the two structural breaks in the economy namely the global financial crisis of 2008 and COVID-19. The data for the macroeconomic indicators such as GDP, IPI, STIR, TBC, and M1 are taken from the International Monetary Fund database and the Agency for Statistics of BiH. According to Liu & Chen (2017), Vychytilová et al. (2019) and Gokmenoglu, Azin & Taspinar (2015), both GDP and IPI are included in the study to improve the accuracy of the model because these variables contribute to different aspects of economic activity. Specifically, GDP reflects the overall economic situation, while the industrial production index provides additional insights into the manufacturing sector. This is particularly important for predicting stock market movements in BiH, given the structure of the SASX10 and BIRS indices, where over 90% of companies are involved in manufacturing activities. Consistent with the approach outlined by Humpe & Macmillan (2009), seasonally adjusted data[3] are utilized for all variables to account for their significant seasonality. Data on stock market composite indices for SASX-10 and BIRS are acquired from SASE and BLSE respectively with values based on the closing prices recorded on the final business day of each quarter. All index values and macroeconomic series are transformed into natural logarithmic form for analysis. The empirical section of the research was carried out using Stata 17.

Methodology and Model Specification

The selection of our methodology is guided by both data characteristics and existing literature. To identify the macroeconomic variables that impact the values of the selected stock indices, the APT framework is utilized, complemented by the application of analytical-synthetic and statistical methods for a comprehensive analysis. These combined approaches allow for a thorough identification of key variables and their influence on

[3] STL method is used. STL is a versatile and robust method for decomposing time series. STL is an acronym for "Seasonal and Trend decomposition using LOESS", while LOESS is a method for estimating nonlinear relationships. The STL decomposition assumes an additive relationship between the seasonal, trend, and residual components of the series, using a filtering algorithm based on LOESS regressions to accurately estimate these three components (Cleveland et al., 1990).

stock market indices. In line with the methodology applied in previous research (Mukherjee & Naka, 1995; Nasseh & Strauss, 2000; Tulcanaza-Prieto & Lee, 2019; Bhuiyan & Chowdhury, 2020), the structure of our study is as follows: firstly, the stationarity of all series was tested using the ADF test. Next, the order of integration for each series was determined to assess if they contained a unit root. The series is integrated of order one suggests the suitability of employing cointegration tests. Moving on, an unrestricted Vector Auto Regression (VAR) model was utilized to establish the lag length necessary for the cointegration tests. Subsequently, the Johansen cointegration tests were employed to ascertain whether the variables were cointegrated. According to the existing literature, if cointegration is detected, a stable long-run relationship is estimated. Following this, a VECM was employed to gauge the speed of adjustment for variables deviating from their long-run trajectory.

Given our interest in analyzing the long-run relationship between stock market indices and macroeconomic variables, the cointegration technique proposed by Johansen (1991) is opted for. This method is favoured due to its ability to address issues stemming from non-stationarity, such as spurious relationships. Concerns regarding reverse causality between variables are also mitigated by cointegration. The flexible functional form of the Johansen cointegration method treats all variables as endogenous, eliminating the need for an arbitrary choice of the dependent variable in the cointegrating equation. Thus, cointegration emerges as the more suitable approach for our analysis.

According to the results of the ADF test and Johansen cointegration test VECM model was estimated to evaluate the effects of macroeconomic variables on the stock indices:

$Index_t = f\ (GDP_t, IPI_t, M1_t, STIR_t, TBC_t)$
where is:

- $Index_t$ - stock market composite indices for SASX-10 index or BIRS index;
- GDP_t - Nominal quarterly Gross Domestic Product (in millions of BAM), expenditure approach, current prices;
- IPI_t - Industrial Production Index (QoQ);
- $M1_t$ - money supply M1 (in millions of BAM);
- $STIR_t$ - short-term interest rate (in percentage, annually);
- TBC_t - trade balance coverage (in thousands of BAM);
- Note: All the level series are in natural logarithmic form.

The descriptive statistics of the variables are presented in Table 2, while the correlation matrix of all included variables are displayed in Table 3.

Table 2
Descriptive statistics of variables of interest

Variables	*SASX-10 index*	*BIRS index*	*GDP*	*IPI*	*M1*	*STIR*	*TBC*
Mean	769.48	699.11	7298350.00	102.47	9385.07	6.11	0.58
Median	751.78	675.75	7243922.00	101.48	8191.14	6.26	0.57
Maximum	1104.41	1124.14	8271177.00	114.05	17813.87	8.47	0.68
Minimum	563.07	514.35	6615434.00	93.04	5612.65	3.65	0.49
Std. Dev.	128.27	144.33	518321.50	6.23	3526.34	1.71	0.05
Skewness	0.932	0.953	0.325	0.187	0.764	-0.185	0.285
Kurtosis	3.256	3.401	1.761	1.765	2.402	1.466	2.148
Observations	48	48	48	48	48	48	48

Source: Authors

When a set of time series variables are each integrated of the same order, and if a linear combination of these variables produces a series integrated of order zero, then the set of variables are considered to be cointegrated. Cointegration is a technique commonly used to investigate whether a stable long-run relationship among two or more variables exists. In the context of this study, if stock indices, short-term interest rate, money supply, and real economic activity are integrated of order one, and their combination yields a series integrated of order zero, it suggests the presence of a long-run relationship among these variables. If the variables are indeed cointegrated, a VECM model can be applied to analyze the dynamics among them. A VECM model is a specialized form of VAR model tailored for use with series that are both cointegrated and non-

stationary in their level form. Essentially, VECM is a VAR model adapted for variables that exhibit stationarity in their differences. Within the VECM framework, although short-term adjustments are permitted, the long-term behaviour of the endogenous variables is constrained to converge towards their cointegrating relationships.

Table 3

Correlation matrix of variables of interest

Correlation	*BIRS_SA*	*SASX-10_SA*	*GDP_SA*	*IPI_SA*	*M1_SA*	*STIR_SA*	*TBC_SA*
BIRS_SA	1.000000						

SASX-10_SA	0.628650	1.000000					
	0.0000	-----					
GDP_SA	-0.776043	-0.304433	1.000000				
	0.0000	0.0354	-----				
IPI_SA	-0.666027	-0.289744	0.695339	1.000000			
	0.0000	0.0458	0.0000	-----			
M1_SA	-0.678000	0.012431	0.838752	0.603708	1.000000		
	0.0000	0.9332	0.0000	0.0000	-----		
STIR_SA	0.715011	0.095919	-0.921024	-0.658843	-0.948250	1.000000	
	0.0000	0.5166	0.0000	0.0000	0.0000	-----	
TBC_SA	-0.734106	-0.121485	0.800423	0.708336	0.897064	-0.875879	1.000000
	0.0000	0.4108	0.0000	0.0000	0.0000	0.0000	-----

Source: Authors

The term representing cointegration in the VECM equation is explained by the error correction term. This term embodies the notion that deviations from long-run equilibrium are gradually rectified through a series of partial short-term adjustments. The multivariate VECM specified for this study is as follows:

$$\Delta Index_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta ndex_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta M1_{t-i} + \sum_{i=1}^{p} \beta_{5i} \Delta STIR_{t-i} + \sum_{i=1}^{p} \beta_{6i} \Delta TBC_{t-i} + \lambda_1 ECT_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta GDP_t = \eta_0 + \sum_{i=1}^{p} \eta_{1i} \Delta Index_{t-i} + \sum_{i=1}^{p} \eta_{2i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \eta_{3i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \eta_{4i} \Delta M1_{t-i} + \sum_{i=1}^{p} \eta_{5i} \Delta STIR_{t-i} + \sum_{i=1}^{p} \eta_{6i} \Delta TBC_{t-i} + \lambda_2 ECT_{t-1} + e_t \quad (2)$$

$$\Delta IPI_t = \gamma_0 + \sum_{i=1}^{p} \gamma_{1i} \Delta Index_{t-i} + \sum_{i=1}^{p} \gamma_{2i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \gamma_{3i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \gamma_{4i} \Delta M1_{t-i} + \sum_{i=1}^{p} \gamma_{5i} \Delta STIR_{t-i} + \sum_{i=1}^{p} \gamma_{6i} \Delta TBC_{t-i} + \lambda_3 ECT_{t-1} + \mu_t \quad (3)$$

$$\Delta M1_t = \theta_0 + \sum_{i=1}^{p} \theta_{1i} \Delta Index_{t-i} + \sum_{i=1}^{p} \theta_{2i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \theta_{3i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \theta_{4i} \Delta M1_{t-i} + \sum_{i=1}^{p} \theta_{5i} \Delta STIR_{t-i} + \sum_{i=1}^{p} \theta_{6i} \Delta TBC_{t-i} + \lambda_4 ECT_{t-1} + \omega_t \quad (4)$$

$$\Delta STIR_t = \varphi_0 + \sum_{i=1}^{p} \varphi_{1i} \Delta Index_{t-i} + \sum_{i=1}^{p} \varphi_{2i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \varphi_{3i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \varphi_{4i} \Delta M1_{t-i} + \sum_{i=1}^{p} \varphi_{5i} \Delta STIR_{t-i} + \sum_{i=1}^{p} \varphi_{6i} \Delta TBC_{t-i} + \lambda_5 ECT_{t-1} + \upsilon_t \quad (5)$$

$$\Delta TBC_t = \rho_0 + \sum_{i=1}^{p} \rho_{1i} \Delta Index_{t-i} + \sum_{i=1}^{p} \rho_{2i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \rho_{3i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \rho_{4i} \Delta M1_{t-i} + \sum_{i=1}^{p} \rho_{5i} \Delta STIR_{t-i} + \sum_{i=1}^{p} \rho_{6i} \Delta TBC_{t-i} + \lambda_6 ECT_{t-1} + \tau_t \quad (6)$$

where:

- $\Delta Index_t$ - changes in composite indices from one time period to the next;
- ΔGDP_t - changes in gross domestic product from one time period to the next;
- ΔIPI_t - changes in industrial production from one time period to the next;
- $\Delta M1_t$ - changes in money supply from one time period to the next;
- $\Delta STIR_t$ - changes in the short-term interest rate from one time period to the next;
- ΔTBC_t - changes in the trade balance coverage from one time period to the next;
- p - the number of lagged differences;

- ECT_{t-1} - the error correction term;
- ε_t, e_t, μ_t, ω_t, υ_t, and τ_t - represent error terms;
- The coefficient λ of the error correction term quantifies the speed of adjustment when a deviation from equilibrium occurs;
- The coefficient vectors β, η, γ, θ, φ and ρ capture the short-run dynamics among the variables.

Results and Discussion

Our analysis begins by presenting the results of both descriptive statistics and a correlation matrix, as illustrated in Tables 2 and 3 (Appendix 1), respectively.

From Table 1, we can determine that the mean value of SASX-10 index over 2010q1-2019q4 period was 769.48 index points, with a standard deviation of 128.27 index points. The lowest value of SASX-10 index amounted to 563.07 index points on 2017q4, while the highest value was 1104.41 index points on 2011q1. Over 2010q1-2019q4, the mean value of BIRS index was 699.11 index points with standard deviation of 144.33 index points. The lowest value of 514.35 index points BIRS index was on 2018q4 and the highest value of 1124.14 index points was on 2011q1.

The correlation matrix results reveal a positive correlation coefficient between BIRS index and STIR, and a negative correlation coefficient were between BIRS index and GDP, IPI, M1 and TBC. Similarly, there is a positive correlation coefficient between SASX-10 index and STIR and M1, and a negative correlation coefficient between SASX-10 index and GDP, IPI, and TBC.

Table 4
Unit root tests for all variables for 2010-2019

Variables	ADF test		PP test	
	Level	First Difference	Level	First Difference
Indices				
SASX-10 index	-1.299	-6.311***	-1.005	-7.314***
BIRS index	-1.777	-6.178***	-1.789	-6.147***
Macroeconomic Variables				
GDP	-2.586	-6.989***	-2.775	-9.604***
IPI	-2.667	-7.915***	-2.663	-7.915***
M1	-1.274	-6.428***	-1.272	-6.421***
STIR	-1.299	-7.619***	-1.384	-7.610***
TBC	-2.025	-10.063***	-1.715677	-11.300***

Notes: The numerical values represent ADF test statistic. ***p ⩽ 0.001, **p ⩽ 0.005, *p ⩽ 0.01. All the level series are in natural logarithmic form.
Source: Authors

In this study, ensuring that all time series variables are integrated of order one is mandatory. Before proceeding with VAR/VECM estimation, it is important to assess the stationarity of the time series. Both the Augmented Dickey Fuller (ADF) test and the Philips-Perron (PP) test were utilized to detect the presence of a unit root. Results of both tests for stock indices and macroeconomic variables are presented in Table 4. The ADF tests and PP test were conducted under the null hypothesis of a unit root with a constant and a time trend, selected based on the trending behavior of all the series. The *p-values* of both tests exceed the 5% significance level, indicating that the time series have a unit root, and thus, they are non-stationary.

Table 4 reveals that all macroeconomic series together with both BiH's stock market indices exhibit unit root behaviour in level, indicating non-stationary processes. However, the first difference of all series appears to be stationary.

The second crucial aspect of VAR/VECM estimation is the determination of the optimal number of lags. Selecting the appropriate lag length involves subjective judgment and consideration of factors such as the study's context and both theoretical and empirical evidence. Following the approach presented by Ivanov and Kilian (2001), lag lengths from 1 to 4 were tested, and the SIC was used to identify the optimal lag length, as the mentioned authors suggest it is the most accurate criterion for quarterly series with fewer than 120 observations. The results, as shown in Table 5, reveal the optimal number of lags. According to the SIC, our models should incorporate only one lag for both indices (Table 5).

Table 5
Information criteria results for number of lags

VAR Model: *SASX-10 GDP IPI M1 STIR TBC*						
Lag	*LogL*	*LR*	*FPE*	*AIC*	*SIC*	*HQC*
1	508.7718	NA	1.61e-19	-26.26510	-24.68158*	-25.71241
2	543.0428	45.69464	2.04e-19	-26.16904	-23.00201	-25.06366
3	587.0187	43.97595	2.02e-19	-26.61215	-21.86159	-24.95408
4	661.1356	49.41127	7.04e-20*	-28.72976*	-22.39568	-26.51899*
VAR Model: *BIRS GDP IPI M1 STIR TBC*						
Lag	*LogL*	*LR*	*FPE*	*AIC*	*SIC*	*HQC*
1	513.4096	NA	1.24e-19	-26.52276	-24.93924*	-25.97007
2	547.2435	45.11189	1.61e-19	-26.40242	-23.23538	-25.29704
3	598.5271	51.28352	1.06e-19	-27.25150	-22.50095	-25.59343
4	679.4482	53.94743*	2.54e-20*	-29.74712*	-23.41305	-27.53636*

Notes: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: final prediction error.
Source: Authors.

Table 6
Short-Run Wald Tests for variables of interest

Dependent variable: D(SASX-10)				*Dependent variable: D(BIRS)*			
Excluded	*Chi-sq*	*df*	*Prob.*	*Excluded*	*Chi-sq*	*df*	*Prob.*
D(GDP)	1.051362	1	0.3052	D(GDP)	4.144521	1	0.0418
D(IPI)	0.032263	1	0.8575	D(IPI)	0.996946	1	0.3181
D(M1)	0.493458	1	0.4824	D(M1)	0.074561	1	0.7848
D(STIR)	1.663245	1	0.1972	D(STIR)	0.634440	1	0.4257
D(TBC)	1.457600	1	0.2273	D(TBC)	6.079672	1	0.0137
All	4.257740	5	0.5129	All	7.181068	5	0.2075

Notes: D() indicates that these variables have been differenced; Null hypothesis: X does not Granger cause Y.
Source: Authors

Further, in Table 6 we present the results of Granger Causality/Block Exogeneity Wald Tests. Based on Table 6 and the results presented in the left panel, we cannot to reject the null hypothesis indicating no Granger causality from any observed variables to SASX-10, even at a significance level of 10%.

Similarly, in the right panel, we cannot reject the null hypothesis suggesting no Granger causality from IPI, M1 and STIR to BIRS at the 10% significance level. However, we can reject the null hypothesis suggesting no causality from GDP and TBC to BIRS at the 5% significance level. The *p-values* associated with the joint tests are 0.5129 for the SASX-10 index and 0.2075 for the BIRS index. These values suggest that, in the short-run, jointly, the independent variables do not exhibit statistically significant Granger causality with the dependent variable at the predetermined level of significance.

This finding suggests that past values of observed variables offer little predictive value for future movements in both indices in the short-run. The results imply that changes in observed variables do not Granger-cause changes in either index. The absence of Granger causality suggests that historical observed variables may not reliably signal forthcoming changes in either index. For financial and macroeconomic stakeholders, this underscores the importance of exercising caution when relying on historical data of observed variables to forecast movements in SASX-10 and BIRS indices. Such reliance may necessitate adjustments in trading and risk management strategies.

The Johansen cointegration test is employed to explore the existence of a long-run relationship between the stock indices and GDP, IPI, M1, STIR and TBC. The *Trace statistic* and the *Maximum eigenvalue statistic* are compared with the critical value at a 5% level of significance, and the cointegration relation results are presented in Table 7 (SASX-10) and Table 8 (BIRS).

Table 7
Cointegration Test for SASX-10 and Macroeconomic Variables for 2010-2019

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	*Eigenvalue*	*Trace Statistic*	*0.05 Critical Value*	*Prob.***
None *	0.770147	146.1653	95.75366	0.0000
At most 1 *	0.623697	90.29326	69.81889	0.0005
At most 2 *	0.566134	53.15360	47.85613	0.0146
At most 3	0.295827	21.42288	29.79707	0.3318
At most 4	0.160219	8.095112	15.49471	0.4553
At most 5	0.037686	1.459756	3.841466	0.2270
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	*Eigenvalue*	*Max-Eigen Statistic*	*0.05 Critical Value*	*Prob.***
None *	0.770147	55.87206	40.07757	0.0004
At most 1 *	0.623697	37.13966	33.87687	0.0197
At most 2 *	0.566134	31.73073	27.58434	0.0138
At most 3	0.295827	13.32776	21.13162	0.4225
At most 4	0.160219	6.635356	14.26460	0.5331
At most 5	0.037686	1.459756	3.841466	0.2270

Notes: Trace test indicates 3 cointegrating equations at the 0.05 level. Max-eigenvalue test indicates 3 cointegrating equations at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values.
Source: Authors

Table 8
Cointegration Test for BIRS and Macroeconomic Variables for 2010-2019

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	*Eigenvalue*	*Trace Statistic*	*0.05 Critical Value*	*Prob.***
None *	0.795854	155.0284	95.75366	0.0000
At most 1 *	0.607175	94.64951	69.81889	0.0002
At most 2 *	0.516890	59.14264	47.85613	0.0031
At most 3 *	0.463904	31.49720	29.79707	0.0315
At most 4	0.148525	7.806371	15.49471	0.4863
At most 5	0.043664	1.696556	3.841466	0.1927
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	*Eigenvalue*	*Max-Eigen Statistic*	*0.05 Critical Value*	*Prob.***
None *	0.795854	60.37887	40.07757	0.0001
At most 1 *	0.607175	35.50686	33.87687	0.0317
At most 2 *	0.516890	27.64545	27.58434	0.0491
At most 3 *	0.463904	23.69083	21.13162	0.0213
At most 4	0.148525	6.109815	14.26460	0.5992
At most 5	0.043664	1.696556	3.841466	0.1927

Notes: Trace test indicates 4 cointegrating equations at the 0.05 level. Max-eigenvalue test indicates 4 cointegrating equations at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values.
Source: Authors

Both the *Trace test* and *Maximum Eigenvalue test* reject the null hypothesis of a rank of two for SASX-10 index and all observed variables, supporting the existence of a three cointegrating vector between the indices and the macroeconomic variables. This implies a long-run relationship among SASX-10, GDP, IPI, M1, LTIR, and TBC. Similar conclusions are drawn for the BIRS index. There are at least four cointegrated equations between the five variables and the BIRS index, indicating a prolonged association with GDP, IPI, M1, STIR and TBC. Therefore, all six variables are cointegrated, indicating that there is a long-run equilibrium relationship between the both

stock market index, GDP, IPI, M1, STIR and TBC in BiH.

Table 9

Normalized cointegrating coefficients for the SASX-10 index

SASX-10	GDP	IPI	M1	STIR	TBC	Const.
1.000	-18.409	-0.365	4.522	0.260	2.718	246.239
	(1.617)	(0.368)	(0.335)	(0.188)	(0.405)	

Note: Standard errors in ( )

Source: Authors

Table 9 presents normalized cointegrating coefficients for the SASX-10 index. These values represent long-run elasticity at the same time, due to logarithmic transformation of the series. So, the long-run equilibrium relationship (cointegration equation) can be expressed as:

$$SASX10_{t-1} = 18.409 \cdot GDP_{t-1} + 0.365 \cdot IPI_{t-1} - 4.522 \cdot M1_{t-1} - 0.260 \cdot STIR_{t-1} - 2.718 \cdot TBC_{t-1} - 246.239 \quad (7)$$

Furthermore, to examine the short-run causality between variables VECM with SASX-10 index as target variable (results are provided in Appendix 1) is estimated:

$$\Delta SASX10_t = \underset{(0.020)}{-0.012} + \underset{(0.174)}{0.194} \cdot \Delta SASX10_{t-1} + \underset{(0.441)}{0.079} \cdot \Delta IPI_{t-1} - \underset{(2.016)}{2.067} \cdot \Delta GDP_{t-1} + \underset{(0.888)}{0.624} \cdot \Delta M1_{t-1} + \underset{(0.406)}{+0.490} \cdot \Delta TBC_{t-1} - \underset{(0.266)}{0.343} \cdot \Delta STIR_{t-1} - \underset{(0.142)}{2.63} \cdot ECT_t + \varepsilon_t \quad (8)$$

The estimated error correction term is ECT_{t-1} = -0.263. This coefficient represents the speed of adjustment towards equilibrium. The adjustment coefficients show that SASX-10 index are corrected in -26.3% in each period. Furthermore, we revealed that the sign of ECT_{t-1} is negative and significant at the 5% level (t = -1.85). We can conclude that there is a long-run causality running from GDP, IPI, M1, STIR and TBC to the SASX-10 index. The long-run equations for the SASX-10 index indicate a significant negative relationship, at least at the 5% level, between M1 and TBC in the t-1 period with the SASX-10 in the same period. On the contrary, the GDP from the previous period has a significant positive impact on the SASX-10. The variables IPI and STIR do not show significant effects. A short-run causality is not evident in any analyzed case, at standard significance levels.

Normalized cointegrating coefficients for the BIRS index displayed in Table 10 represent long-run elasticity at the same time, due to logarithmic transformation of the series. So, the long-run equilibrium relationship (cointegration equation) can be expressed as:

$$BIRS_{t-1} = 11.502 \cdot GDP_{t-1} - 0.615 \cdot IPI_{t-1} - 3.521 \cdot M1_{t-1} - 0.520 \cdot STIR_{t-1} - 0.800 \cdot TBC_{t-1} - 140.105 \quad (9)$$

Table 10

Normalized cointegrating coefficients for the BIRS index

BIRS	GDP	IPI	M1	STIR	TBC	Const.
1.000	-11.502	0.615	3.521	0.520	0.800	140.105
	(1.339)	(0.309)	(0.280)	(0.156)	(0.337)	

Note: Standard errors in ( )

To examine the short-run causality between variables VECM with BIRS index as target variable (results are provided in Appendix 2) is estimated:

$$\Delta BIRS_t = \underset{(0.019)}{0.011} + \underset{(0.173)}{0.373} \cdot \Delta BIRS_{t-1} + \underset{(0.396)}{0.396} \cdot \Delta IPI_{t-1} - \underset{(1.631)}{3.321} \cdot \Delta GDP_{t-1} + \underset{(0.721)}{0.197} \cdot \Delta M1_{t-1} + \underset{(0.318)}{+0.784} \cdot \Delta TBC_{t-1} + \underset{(0.247)}{0.197} \cdot \Delta STIR_{t-1} - \underset{(0.139)}{0.503} \cdot ECT_t + \varepsilon_t \quad (10)$$

The estimated error correction term is ECT_{t-1} = -0.503. The adjustment coefficients show that BIRS are corrected in -50.3% in each period. Furthermore, we found that the sign of ECT_{t-1} is negative and significant at the 5% level (t = -3.62). We can conclude that there is a long-run causality running from GDP, IPI, M1, LTIR and TBC to the BIRS index. The long-run equations for BIRS reveal that IPI, M1, STIR and TBC in t-1 period have a significant negative (at least 5% level) relationship with the BIRS index in t-1 period, while the GDP has a significantly positive effect on the BIRS index. A short-run causality is evident in the case of BIRS, GDP, and TBC, at least at the 5% significance level. While the coefficient for IPI is positive in the BIRS equation and negative in the SASX-10 equation, this suggests that industrial production may have a different impact on these two stock indices. Theoretically, from an economic point of view, it is possible that the higher growth of industrial production in the FBiH has a negative impact on the movement of BIRS in the RS, but this depends on the wider context and economic relations between the two entities. However, in order to confirm the above hypothesis, it is necessary to additionally investigate the dynamics of trade relations between the two entities, industrial competitiveness, and capital and investment flows within BiH.

Our findings are consistent with previous studies. In BiH, we found a significantly negative a cointegration between the stock market indices and M1. This aligns with studies by Mukherjee & Naka (1995), Wongbangpo & Sharma (2002), Maysami, Howe & Hamzah (2004), Nishat, Shaheen & Hijazi (2004), Ratanapakorn & Sharma (2007), Karagöz, Ergün & Karagöz (2009), Singh (2016), and Bhuiyan & Chowdhury (2020), but contrasts with Abugri (2008), Humpe and Macmillan (2009), Kumar & Sahu (2017) and Kandari & Abul (2019).

The empirical results suggest that macroeconomic activity do rationally signal changes in the stock market indices in terms of GDP. This result is in line with the theoretical expectation and general finding of related literature. This result aligns with the findings of Karagöz, Ergün & Karagöz (2009) and Tulcanaza-Prieto & Lee (2019). However, Osamwonyi and Evbayiro-Osagie (2012) obtained different results.

The long-run relation between stock market indices and the IPI is positive, similar to results reported in Chen, Roll & Ross (1986), Mukherjee & Naka (1995), Maysami, Howe & Hamzah (2004), Nishat, Shaheen & Hijazi (2004), Abugri (2008), Humpe and Macmillan (2009), and Singh (2016). The next effect is from TBC. In our paper, we have found evidence of this positive long-run relationship between TBC and the stock market indices. Similar results were obtained by Basci & Karaca (2013).

The results are mixed for the cointegration between the stock market indices and STIR. While the long-run relation between the BLSE and STIR is negative, the long-run relation between the SASX-10 and STIR isn't exist. Maysami, Howe & Hamzah (2004), Ratanapakorn & Sharma (2007), Karagöz, Ergün & Karagöz (2009), and Al-Kandari & Abul (2019) achieve a significantly positive effect from the interest rate. Mukherjee & Naka (1995), Wongbangpo & Sharma (2002), Nishat, Shaheen & Hijazi (2004), Abugri (2008), Singh (2016), Kumar & Sahu (2017), and Tulcanaza-Prieto & Lee (2019) obtained opposite results.

Comparing findings of this study with similar studies from the region, such as research by Mojanoski (2022) and Ligocká (2023), it could be concluded that stock markets in BiH are influenced by similar macroeconomic factors as markets in neighboring countries. Both studies, using VECM and Granger causality tests, show that macroeconomic variables have a long-term effect on stock index values, while the short-term effects are weaker. Also, the results of Hsing (2011) regarding the Croatian CROBEX index emphasize the importance of real GDP and monetary aggregates in the formation of the index value, which is also confirmed in analysis for BiH. A similar pattern can be seen in the research of Backović et al. (2023) on the Montenegrin market, which suggests similarities between stock markets in the Balkans.

Conclusions

Based on the presented conceptual framework, in which the theoretical and empirical aspects of the role and importance of financial markets are elaborated, the relationship between stock markets and the economy in the real world can generally be understood in two ways: on one hand, the development of the stock market is seen as a means to mobilize savings towards potentially productive projects, evaluating the efficiency and productivity of investments, and facilitating the redistribution of financial resources among individuals, corporations, and governments. On the other hand, the stock market is not isolated but rather interconnected with a broader ecosystem of market-oriented factors. This perspective focuses on how these factors, whether through gradual development or sudden shifts, can influence stock market performance and behavior. Understanding these dynamics is crucial for investors, policymakers, and market participants to make informed decisions in a complex and dynamic financial environment.

It is important to note that the relationship between these macroeconomic variables and the stock market is complex and can vary based on the specific circumstances of each country and market. Traders and investors use these variables as indicators to make informed decisions, but many other factors can also influence stock prices, including market sentiment, geopolitical events, and technological advancements.

This study identifies key macroeconomic variables that are cointegrated with the SASX-10 and BIRS stock indices in Bosnia and Herzegovina using the Vector Error Correction Model (VECM). The analysis demonstrates the existence of long-run relationships between the stock indices and five main macroeconomic variables: GDP, IPI, M1, STIR, and TBC. For the SASX-10 index, the normalized cointegrating coefficients indicate a long-run equilibrium relationship. The error correction term (ECT) of -0.263 suggests a correction of 26.3% of deviations from the long-term equilibrium in each period. The results show a significant long-run negative relationship between the SASX-10 index and the variables M1 and TBC, while GDP has a significant positive impact. The IPI and STIR variables do not show significant effects on the

SASX-10 index in the long-run. No significant short-run causality among the analyzed variables was found. For the BIRS index, the normalized cointegrating coefficients indicate a long-term equilibrium relationship. The error correction term of -0.503 run analysis reveals significant negative relationships between the BIRS index and the variables IPI, M1, STIR, and TBC, while GDP has a significant positive impact. In the short-run, significant causality was observed among the BIRS index, GDP, and TBC, at least at the 5% significance level.

These findings highlight significant long-run relationships between stock indices in BiH and key macroeconomic variables, emphasizing the importance of GDP, money supply, and trade balance coverage. Policymakers should consider these findings to enhance stock market development, focusing on maintaining economic stability and promoting factors that positively influence stock indices. Further research should focus on the specific mechanisms of these interactions to better understand and support stock market growth in transitional economies.

The stock market is significantly influenced by various market-oriented factors that evolve over time. Changes in market regulations and policies implemented by regulatory authorities can profoundly impact stock markets, influencing market behavior through increased transparency and investor protection. Investor sentiment, driven by economic optimism or pessimism, plays a crucial role in stock price movements, either boosting or declining prices. Government economic policies, such as fiscal and monetary measures, taxation, and trade policies, directly affect stock markets by influencing investor behavior and market activity. Structural changes in the market, including new trading platforms and technological advancements, alter trading dynamics, affecting volumes, liquidity, and information processing speed. Moreover, global economic conditions, such as recessions or geopolitical tensions, create interconnectedness among stock markets globally, where events in one country can spill over to impact markets in others.

In this paper, the signs of the long-run elasticity coefficients of the macroeconomic variables on stock prices are generally consistent with the hypothesized equilibrium relations. This study has significant value from several aspects. First, for policy makers, because it provides an insight into how their decisions can affect stock market indices in Bosnia and Herzegovina. Second, for investors, who need to understand how the market will react to changes in the macroeconomic environment. Third, this study is unique in the aspect that it covers both indices in BiH and compares how important macroeconomic variables influence those indices. By paying attention to the asymmetry in the market across the FBiH and RS, long-term investors could make a better decision for their investments. Therefore, knowledge of this relationship and the ability to predict future trends can be a valuable tool for investors in their efforts to achieve greater profits, and for authorities in preserving the stability of financial markets. However, it is important to note that the number of observations may represent a potential limitation of the study when applying cointegration methods. For future research, analyzing sector-specific stock market indices will be useful, as the composite index can mask the sensitivity of individual sectors. A sector-wise analysis will provide clearer insights into the direction and strength of each sector's movements in response to changes in macroeconomic variables.

References

Abugri, B. A. (2008). Empirical relationship between macro-economic volatility and stock returns: Evidence from Latin American Markets. *International Review of Financial Analysis*, *17*(2), 396–410. DOI: https://doi.org/10.1016/j.irfa.2006.09.002

Adjasi, C. K. D., & Biekpe, N. B. (2006). Stock market development and economic growth: The case of selected African countries. *African Development Review*, *18*(1), 144–161. DOI: 10.1111/j.1467-8268.2006.00136.x

Al-Kandari, A. M., & Abul, S. J. (2019). The impact of macroeconomic variables on stock prices in Kuwait. *International Journal of Business and Management*, *14*(6), 99–112. DOI: 10.5539/ijbm.v14n6p99

Arouri, M., Estay, C., Rault, C., & Roubaud, D. (2016). Economic policy uncertainty and stock markets: Long-run evidence from the US. *Finance Research Letters*, *18*(C), 136–141. DOI: https://doi.org/10.1016/j.frl.2016.04.011

Arrow, K. J., & Debreu, G. (1954). Existence of an Equilibrium for a Competitive Economy. *Econometrica*, *22*(3), 265–290. DOI: https://doi.org/10.2307/1907353

Asravor, R. K., & Fonu, P. D.-D. (2021). Dynamic relation between macroeconomic variable, stock market returns and stock market development in Ghana. *International Journal of Finance & Economics*, 1–10. DOI: 10.1002/ijfe.1925

Backović, T., Karadžić, V., Gričar, S. & Bojnec, Š. (2023). Montenegrin Stock Exchange Market on a Short-Term Perspective. *Journal of Risk and Financial Management, 16*, 315. DOI: https://doi.org/10.3390/jrfm16070315

Basci, E. S., & Karaca, S. S. (2013). The Determinants of stock market index: VAR approach to Turkish stock market. *International Journal of Economics and Financial Issues*, *3*(1), 63–71.

Bayar, Y. (2016). Macroeconomic Determinants of Stock Market Development: Evidence From Borsa Istanbul. *Financial studies*, *20*(1), 69–89.

Bayezid Ali, M. (2011). Impact of Micro and Macroeconomic Variables on Emerging Stock Market Return: A Case on Dhaka Stock Exchange (DSE). *Interdisciplinary Journal of Research in Business*, *1*(5), 8–16.

Beck, T. (2012). The role of finance in economic development-benefits, risks, and politics. In D. C. Mueller (Ed.), *Oxford handbook of capitalism* (pp. 118–151). Oxford: University Press

Bekaert, G., & Harvey, C. (2000). Foreign speculators and emerging equity markets. *Journal of Finance*, *55*(2), 565–614. DOI: https://doi.org/10.1111/0022-1082.00220

Bekhet, H. A., & Matar, A. (2013). Co-integration and causality analysis between stock market prices and their determinates in Jordan. *Economic Modelling*, *35*, 508–514. DOI: http://dx.doi.org/10.1016/j.econmod.2013.07.012

Bhuiyan, E. M., & Chowdhury, M. (2020). Macroeconomic variables and stock Market indices: Asymmetric Dynamics in the US and Canada. *The Quarterly Review of Economics and Finance*, *77*, 62–74. DOI: https://doi.org/10.1016/j.qref.2019.10.005

Bustos, O., & Pomares-Quimbaya, A. (2020). Stock market movement forecast: A systematic review. *Expert Systems with Applications*, *156*. DOI: 10.1016/j.eswa.2020.113464

Calderón, C., & Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics*, *72*, 321–334. DOI: 10.1016/S0304-3878(03)00079-8

Carvajal, A., & Elliott, J. E. (2007). Strengths and Weaknesses in Securities Market Regulation: A Global Analysis. *IMF Working Paper No. 07/259*, 1–49. DOI: 10.5089/9781451868227.001

Chaurasia, A., & Debnath, P. (2023). Macroeconomic Determinants of Stock Market Development: A Systematic Literature Review. *Jurnal Multidisiplin Madani*, *3*(8), 1800–1807. DOI: https://doi.org/10.55927/mudima.v3i8.3667

Chen, N. F., Roll, R., & Ross, S. (1986). Economic forces and the stock market. *Journal of Business*, *59*(3), 383–403. DOI: http://dx.doi.org/10.1086/296344

Chong, C., & Goh, K. (2003). *Linkages of economic activity, stock prices and monetary policy: the case of Malaysia*. Universiti Utara Malaysia Sintok.

Cleveland, R. B., Cleveland, W. S., McRae, J. E., & Terpenning, I. J. (1990). STL: A seasonal-trend decomposition procedure based on Loess. *Journal of Official Statistics*, *6*(1), 3–33.

Davidson, L. S., & Froyen, R. T. (1982). Monetary policy and stock returns: are stock markets efficient? *Federal Reserve Bank of St. Louis Review*, *64*(3), 3–12.

Dhakal, D., Kandil, M., & Sharma, S. C. (1993). Causality between the Money Supply and Share Prices: A VAR Investigation. *Quarterly Journal of Business and Economics*, *32*(3), 52–74.

Djedović, E. & Djedović, I. (2018). Impact of macroeconomic variables on stock market index in Bosnia and Herzegovina. *Zbornik radova Pravnog fakulteta u Tuzli*, *4*(2), 100–125.

El-Wassal, K. A. (2005). Understanding the Growth in Emerging Stock Markets. *Journal of Emerging Market Finance*, *4*(3), 227–261. DOI: https://doi.org/10.1177/097265270500400302

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction representation: estimation and testing. *Econometrica*, *55*(2), 251–276. DOI: https://doi.org/10.2307/1913236

Enisan, A. A., & Olufisayo, A. O. (2009). Stock market development and economic growth: Evidence from seven sub-Sahara African countries. *Journal of Economics and Business*, *61*, 162–171. DOI: https://doi.org/10.1016/j.jeconbus.2008.05.001

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance*, *25*(2), 383–417.

Fama, E. F. (1981). Stock returns, real activity, inflation and money. *The American Economic Review*, *71*(4), 545–565.

Ferson, W. E., & Harvey, C. R. (1991). The variation of economic risk premiums. *Journal of Political Economy, 99*(2), 385–415.

Finter, P., Niessen-Ruenzi, A., & Ruenzi, S. (2011). The Impact of Investor Sentiment on the German Stock Market. *CFR Working Paper, No. 10-03 [rev.]. University of Cologne, Centre for Financial Research (CFR)*, 1–43.

Flannery. M. J., & Protopapadakis, A. A. (2002). Macroeconomic Factors Do Influence Aggregate Stock Returns. *The Review of Financial Studies*, *15*(3), 751–782. DOI: https://doi.org/10.1093/rfs/15.3.751

Gjerde, O., & Sættem, F. (1999). Causal Relations among Stock Returns and Macroeconomic Variables in a Small, Open Economy. *Journal of International Financial Markets, Institutions and Money*, *9*, 61–74. DOI: https://doi.org/10.1016/S1042-4431(98)00036-5

Gokmenoglu, K., Azin, V., & Taspinar, N. (2015). The Relationship between Industrial Production, GDP, Inflation and Oil Price: The Case of Turkey. *Procedia Economics and Finance*, *25*, 497–503. DOI: https://doi.org/10.1016/S2212-5671(15)00762-5

Goldsmith, R. W. (1969). *Financial Structure and Development*. Yale University Press.

Gurley J., & Shaw, E. (1955) Financial Aspects of Economic Development. *American Economic Review, 45*(4), 515–538.

Hamao, Y. (1988). An empirical examination of the arbitrage pricing theory. *Japan and the World Economy*, *1*(1), 45–61. DOI: https://doi.org/10.1016/0922-1425(88)90005-9

Ho, S-Y. (2019). Macroeconomic determinants of stock market development in South Africa. *International Journal of Emerging Markets, 14*(2), 322–342. DOI: https://doi.org/10.1108/IJoEM-09-2017-0341

Hsing, Y. (2011). Macroeconomic variables and the stock market: The case of Croatia. *Economic research - Ekonomska istraživanja*, *24*(4), 41–50.

Humpe, A., & Macmillan, P. (2009). Can macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan. *Applied Financial Economics, 19*(2), 111–119. DOI: https://doi.org/10.1080/09603100701748956

Ivanov, V., & Kilian, L. (2001). A practitioner's guide to lag-order selection for vector autoregressions. *CEPR Discussion Papers, 2685*.

Jaffe, F., & Mandelker, G. (1976). The Fisher effect for risky assets: An empirical investigation. *The Journal of Finance, 31*(2), 447–458. DOI: https://doi.org/10.2307/2326616

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica*, *59*, 1551–1580. DOI: https://doi.org/10.2307/2938278

Karagöz, K., Ergün, S., & Karagöz, M. (2009). Impact of Macroeconomic Factors on Stock Market: Evidence from Istanbul Stock Exchange. *Proceedings of the 1. International Symposium on Sustainable Development*, June 9-10, Sarajevo, 122–130.

Khan, I., & Khan, J. (2018). The Impact of Macroeconomic Variables on Stock Prices: A Case Study of Karachi Stock Exchange. *Journal of Economics and Sustainable Development, 9*(13), 15–25.

Kumalić, I. (2013). Razvijenost finansijskog tržišta u Bosni i Hercegovini. *Časopis za ekonomiju i tržišne komunikacije / Economy and Market Communication Review*, *3*(1), 57–72. DOI: https://doi.org/10.7251/EMC1301057K

Kumar Verma, R., & Bansal, R. (2021). Impact of macroeconomic variables on the performance of stock exchange: a systematic review. *International Journal of Emerging Markets*, *16*(7), 1291–1329. DOI: https://doi.org/10.1108/IJOEM-11-2019-0993

Kumar, K. K., & Sahu, B. (2017). Dynamic linkages between macroeconomic factors and Islamic stock indices in a non-Islamic country India. *The Journal of Developing Areas*, *51*(1), 193–205. DOI: https://doi.org/10.1353/jda.2017.0011

Ligocká, M. (2023). The relationship between macroeconomic variables and stock market indices: evidence from Central and Eastern European countries. *Eastern Journal of European Studies*, *14*(2), 76–107. DOI: 10.47743/ejes-2023-0204

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1997). Legal determinants of external finance. *Journal of Finance*, *52*, 1131–1150. DOI: 10.1111/j.1540-6261.1997.tb02727.x

Levine, R. (2005). Finance and Growth: Theory, Evidence, and Mechanisms, In P. Aghion & S. Durlauf (Eds.), *Handbook of Economic Growth* (pp. 191–215). Amsterdam: North-Holland Elsevier Publishers. DOI: https://doi.org/10.1016/S1574-0684(05)01012-9

Liu, H. Y., & Chen, X. L. (2017). The imported price, inflation and exchange rate pass-through in China, *Cogent Economics & Finance*, *5*(1), 1–13. DOI: https://doi.org/10.1080/23322039.2017.1279814

Maio, P., & Philip, D. (2015). Macro variables and the components of stock returns. *Journal of Empirical Finance*, *33*(C), 287–308. DOI: http://dx.doi.org/10.2139/ssrn.2021885

Martinez, M. A., & Rubio, G. (1989). Arbitrage pricing with macroeconomic variables: an empirical investigation using Spanish data. *Working Paper, Universidad del Pais Vasco*.

Masulis, R. W., & Lakshmanan, S. (2002). Does Market Structure Affect the Immediacy of Stock Price Responses to News? *Journal of Financial and Quantitative Analysis*, *37*(4), 617–648. DOI: https://doi.org/10.2307/3595014

Maysami, R. C., Howe, L. C. & Hamzah, M. A. (2004). Relationship between Macroeconomic Variables and Stock Market Indices: Cointegration Evidence from Stock Exchange of Singapore's All-S Sector Indices. *Journal of Pengurusan*, *24*, 47–77.

Mehrara, M. (2006). The Relationship between Stock Market and Macroeconomic Variables: a Case Study for Iran. *Iranian Economic Review*, *10*(17), 138–148.

Merikas, A. G., & Merika, A. A. (2006). Stock prices response to real economic variables: The case of Germany. *Managerial Finance*, *32*(5), 446–450. DOI: 10.1108/03074350610657454

Mojanoski, G. (2022). Long-run and short-run causality between sock price indices and macroeconomic variables: Evidence of panel VECM analysis from Bosnia and Herzegovina, Croatia, North Macedonia and Serbia. *Economic Review: Journal of Economics and Business*, *20*(2), 3–14. DOI: 10.51558/2303-680X.2022.20.2.3

Mukherjee, T. K., & Naka, A. (1995). Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of a Vector Error Correction Model. *Journal of Financial Research*, *18*(2), 223–237. DOI: https://doi.org/10.1111/j.1475-6803.1995.tb00563.x

Nasseh, A., & Strauss, J. (2000). Stock prices and domestic and international macroeconomic activity: a cointegration approach. *The Quarterly Review of Economics and Finance, 40*(2), 229–245. DOI: https://doi.org/10.1016/S1062-9769(99)00054-X

Nelson, C. (1976). Inflation and rates of return on common stocks. *The Journal of Finance*, *31*(2), 471–487. DOI: https://doi.org/10.1111/j.1540-6261.1976.tb01900.x

Neusser, K., & Kugler, M. (1998). Manufacturing Growth and Financial Development: Evidence from OECD Countries. *The Review of Economics and Statistics, 80*, 638–646. DOI: https://doi.org/10.1162/003465398557726

Nishat, M., Shaheen, R., & Hijazi, S. T. (2004). Macroeconomic factors and the Pakistani equity market. *The Pakistan Development Review, 43*(4), 619–637.

Nti, I. K., Adekoya, A. F., & Weyori, B. A. (2020). A systematic review of fundamental and technical analysis of stock market predictions. *Artificial Intelligence Review*, *53*(4), 3007–3057. DOI: https://doi.org/10.1007/s10462-019-09754-z

Osamwonyi, I. O., & Evbayiro-Osagie, E. I. (2012). The Relationship between Macroeconomic Variables and Stock Market Index in Nigeria. *Journal of Economics, 3*(1), 55–63.

Patrick H. T. (1966). Financial Development and Economic Growth in Underdeveloped countries. *Economic Development and Cultural Change,* 14(1), 174–189. DOI: http://dx.doi.org/10.1086/450153

Pilinkus, D. (2010). Macroeconomic indicators and their impact on stock market performance in the short and long run: The case of the Baltic States. *Technological and Economic Development of Economy, 16*(2), 291–304. DOI: https://doi.org/10.3846/tede.2010.19

Poon, S., & Taylor, J. (1991). Macroeconomic Factors and the UK Stock Market. *Journal of Business Finance & Accounting*, *18*(5), 619–636. DOI: https://doi.org/10.1111/j.1468-5957.1991.tb00229.x

Ratanapakorn, O., & Sharma, S. C. (2007). Dynamic analysis between the US stock returns and the macroeconomic variables. *Applied Financial Economics, 17*(5), 369–377.

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*, 71–102.

Ross, S. A. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory*, *13*, 341–360. DOI: http://dx.doi.org/10.1016/0022-0531(76)90046-6

Ruhani, F., Islam, M. A., Ahmad, T. S. T., & Quddus, M. R. (2018). Effects of financial market variables on stock prices: a review of the literature. *Journal of Modern Accounting and Auditing*, *14*(11), 597–610. DOI: 10.17265/1548-6583/2018.11.002

Singh, G. (2016). The impact of macroeconomic fundamentals on stock prices revised: a study of Indian stock market. *Journal of International Economics, 7*(1), 76–91.

Stern, N. (1989). The economics of development: A survey. *The Economic Journal, 100*, 597-685. DOI: https://doi.org/10.2307/2233764

Stulz, R. (2001). Does Financial Structure Matter for Economic Growth? A Corporate Finance Perspective. *In* A. Demirgüç-Kunt, & R. Levine (Eds.), *Financial Structure and Economic Growth A Cross-Country Comparison of Banks,*

Markets, and Development (pp. 143–188). London: Massachusetts Institute of Technology. DOI: 10.7551/mitpress/3001.003.0008

Şükrüoğlu, D., & Nalin, H. T. (2014). The Macroeconomic Determinants of Stock Market Development in Selected European Countries: Dynamic Panel Data Analysis. *International Journal of Economics and Finance*, *6*(3), 64–71. DOI: 10.5539/ijef.v6n3p64

Svaleryd, H., & Vlachos, J. (2002). Markets for risk and openness to trade: how are they related? *Journal of International Economics, 57*, 369–395. DOI: 10.1016/S0022-1996(01)00153-2

Trivedi, P., & Behera, S. R. (2012). Macroeconomic Fundamentals as Determinants of Equity Prices: An Empirical Analysis for India. *The IUP Journal of Applied Finance*, *18*(3), 5–30.

Tulcanaza-Prieto, A. B., & Lee, Y. (2019). Determinants of Stock Market Performance: VAR and VECM Designs in Korea and Japan, *Global Business & Finance Review*, *24*(4), 24–44. DOI: https://doi.org/10.17549/gbfr.2019.24.4.24%0A

Van Nieuwerburgh, S., Buelens, F., & Cuyvers, L. (2006). Stock market development and economic growth in Belgium. *Explorations in Economic History*, *43*(1), 13–38. DOI: 10.1016/j.eeh.2005.06.002

Verma, R. K., & Bansal, R. (2021). Impact of macroeconomic variables on the performance of stock exchange: a systematic review. *International Journal of Emerging Markets*, *16*(7), 1291–1329. DOI: https://doi.org/10.1108/IJOEM-11-2019-0993

Vychytilová, J., Pavelková, D., Pham, H., & Urbánek, T. (2019). Macroeconomic factors explaining stock volatility: multi-country empirical evidence from the auto industry. Economic Research-Ekonomska Istraživanja, *32*(1), 3333–3347. DOI: https://doi.org/10.1080/1331677X.2019.1661003

Wongbangpo, P., & Sharma, S. C. (2002). Stock Market and Macroeconomic Fundamental Dynamic Interactions: ASEAN-5 Countries. *Journal of Asian Economics, 13*(1), 27–51. DOI: https://doi.org/10.1016/S1049-0078(01)00111-7

Yartey, C. A. (2010). The institutional and macroeconomic determinants of stock market development in emerging economies. *Applied Financial Economics*, *20*(21), 1615–1625. DOI: 10.1080/09603107.2010.522519

Appendix 1. Vector Error Correction Estimates (SASX-10)

Sample (adjusted): 2010Q3 2019Q4
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	*CointEq1*
LOG(SASX-10_SA(-1))	1.000000
LOG(GDP_SA(-1))	-18.40899
	(1.61699)
	[-11.3848]
LOG(IPI_SA(-1))	-0.364510
	(0.36771)
	[-0.99129]
LOG(M1_SA(-1))	4.522277
	(0.33495)
	[13.5015]
LOG(STIR_SA(-1))	0.260182
	(0.18849)
	[1.38037]
LOG(TBC_SA(-1))	2.718114
	(0.40500)
	[6.71142]
C	246.2390

Error Correction:	*D(LOG(SASX-10_SA))*	*D(LOG(GDP_SA))*	*D(LOG(IPI_SA))*	*D(LOG(M1_SA))*	*D(LOG(STIR_SA))*	*D(LOG(TBC_SA))*
CointEq1	-0.262554	0.043957	0.079129	-0.053175	0.083439	-0.063116
	(0.14195)	(0.01730)	(0.05651)	(0.02756)	(0.08449)	(0.06893)
	[-1.84961]	[2.54022]	[1.40018]	[-1.92937]	[0.98758]	[-0.91572]
D(LOG(SASX10_SA(-1)))	0.194003	0.015458	-0.109332	0.082969	-0.251199	0.182432
	(0.17430)	(0.02125)	(0.06939)	(0.03384)	(0.10374)	(0.08463)
	[1.11307]	[0.72753]	[-1.57560]	[2.45176]	[-2.42143]	[2.15562]
D(LOG(GDP_SA(-1)))	-2.067356	-0.058702	-0.140956	-1.085584	0.774972	-0.769717
	(2.01623)	(0.24579)	(0.80269)	(0.39146)	(1.20004)	(0.97899)
	[-1.02536]	[-0.23883]	[-0.17560]	[-2.77314]	[0.64579]	[-0.78623]
D(LOG(IPI_SA(-1)))	0.079283	0.051276	-0.240399	0.051356	-0.448649	0.300339
	(0.44140)	(0.05381)	(0.17573)	(0.08570)	(0.26272)	(0.21432)
	[0.17962]	[0.95294]	[-1.36802]	[0.59925]	[-1.70773]	[1.40133]
D(LOG(M1_SA(-1)))	0.623751	0.136848	0.059397	0.452958	-1.221403	0.930634
	(0.88795)	(0.10824)	(0.35351)	(0.17240)	(0.52850)	(0.43115)
	[0.70247]	[1.26426]	[0.16802]	[2.62736]	[-2.31108]	[2.15850]
D(LOG(STIR_SA(-1)))	-0.343354	0.027261	0.071612	-0.069919	-0.222210	0.271428
	(0.26623)	(0.03246)	(0.10599)	(0.05169)	(0.15846)	(0.12927)
	[-1.28967]	[0.83996]	[0.67563]	[-1.35263]	[-1.40230]	[2.09966]
D(LOG(TBC_SA(-1)))	0.489831	-0.023094	-0.006830	0.147695	-0.427493	-0.138256
	(0.40572)	(0.04946)	(0.16152)	(0.07877)	(0.24148)	(0.19700)
	[1.20731]	[-0.46693]	[-0.04229]	[1.87493]	[-1.77029]	[-0.70180]
C	-0.012194	0.003040	0.002948	0.017436	0.001197	-0.007733
	(0.02048)	(0.00250)	(0.00815)	(0.00398)	(0.01219)	(0.00995)
	[-0.59536]	[1.21758]	[0.36151]	[4.38451]	[0.09821]	[-0.77755]
R-squared	0.176010	0.378276	0.290041	0.342511	0.369108	0.421367
Adj. R-squared	-0.016254	0.233207	0.124384	0.189097	0.221900	0.286353
Sum sq. resids	0.167222	0.002485	0.026504	0.006304	0.059239	0.039425
S.E. equation	0.074660	0.009101	0.029723	0.014496	0.044437	0.036252
F-statistic	0.915460	2.607557	1.750855	2.232595	2.507389	3.120911
Log likelihood	49.17474	129.1465	84.17307	111.4602	68.89175	76.62809
Akaike AIC	-2.167091	-6.376134	-4.009109	-5.445273	-3.204829	-3.612005
Schwarz SC	-1.822336	-6.031379	-3.664354	-5.100518	-2.860074	-3.267250
Mean dependent	-0.004065	0.005207	0.002127	0.022364	-0.018621	0.002982
S.D. dependent	0.074060	0.010394	0.031764	0.016097	0.050376	0.042913
Determinant resid covariance (dof adj.)		4.85E-20				
Determinant resid covariance		1.17E-20				
Log likelihood		548.4036				
Akaike information criterion		-26.02124				
Schwarz criterion		-23.69415				
Number of coefficients		54				

Source: Authors.

Appendix 2. Vector Error Correction Estimates (BIRS)

Sample (adjusted): 2010Q3 2019Q4
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	*CointEq1*
LOG(BIRS_SA(-1))	1.000000
LOG(GDP_SA(-1))	-11.50183
	(1.33911)
	[-8.58913]
LOG(IPI_SA(-1))	0.614637
	(0.30892)
	[1.98963]
LOG(M1_SA(-1))	3.520821
	(0.28049)
	[12.5524]
LOG(STIR_SA(-1))	0.519638
	(0.15613)
	[3.32821]
LOG(TBC_SA(-1))	0.799709
	(0.33678)
	[2.37458]
C	140.1048

Error Correction:	*D(LOG(BIRS_SA))*	*D(LOG(GDP_SA))*	*D(LOG(IPI_SA))*	*D(LOG(M1_SA))*	*D(LOG(STIR_SA))*	*D(LOG(TBC_SA))*
CointEq1	-0.502784	0.031318	-0.057229	-0.088216	0.118560	0.088610
	(0.13870)	(0.02083)	(0.06512)	(0.03015)	(0.09903)	(0.07993)
	[-3.62490]	[1.50383]	[-0.87885]	[-2.92618]	[1.19717]	[1.10859]
D(LOG(BIRS_SA(-1)))	0.371558	-0.001871	0.002718	0.037051	-0.152141	0.012850
	(0.17249)	(0.02590)	(0.08098)	(0.03749)	(0.12316)	(0.09940)
	[2.15412]	[-0.07226]	[0.03356]	[0.98828]	[-1.23536]	[0.12927]
D(LOG(GDP_SA(-1)))	-3.321094	-0.218442	-1.357589	-1.119546	0.518053	0.605622
	(1.63134)	(0.24494)	(0.76588)	(0.35457)	(1.16477)	(0.94009)
	[-2.03581]	[-0.89183]	[-1.77258]	[-3.15746]	[0.44477]	[0.64421]
D(LOG(IPI_SA(-1)))	0.395773	0.039825	-0.208049	0.084095	-0.461272	0.250199
	(0.39638)	(0.05951)	(0.18609)	(0.08615)	(0.28301)	(0.22842)
	[0.99847]	[0.66916]	[-1.11799]	[0.97611]	[-1.62986]	[1.09534]
D(LOG(M1_SA(-1)))	0.196963	0.221709	0.329864	0.366298	-1.064645	0.663206
	(0.72132)	(0.10830)	(0.33865)	(0.15678)	(0.51502)	(0.41568)
	[0.27306]	[2.04712]	[0.97407]	[2.33639]	[-2.06719]	[1.59548]
D(LOG(STIR_SA(-1)))	0.196648	0.029872	0.094217	-0.031153	-0.323644	0.258402
	(0.24688)	(0.03707)	(0.11591)	(0.05366)	(0.17627)	(0.14227)
	[0.79652]	[0.80587]	[0.81287]	[-0.58056]	[-1.83602]	[1.81625]
D(LOG(TBC_SA(-1)))	0.784386	0.022967	0.165117	0.100718	-0.352336	-0.313527
	(0.31812)	(0.04776)	(0.14935)	(0.06914)	(0.22714)	(0.18332)
	[2.46570]	[0.48084]	[1.10557]	[1.45665]	[-1.55121]	[-1.71024]
C	0.011000	0.001933	0.004392	0.020235	-0.003136	-0.010134
	(0.01864)	(0.00280)	(0.00875)	(0.00405)	(0.01331)	(0.01074)
	[0.59027]	[0.69078]	[0.50198]	[4.99589]	[-0.23571]	[-0.94369]
R-squared	0.354320	0.264838	0.230436	0.357752	0.292331	0.364706
Adj. R-squared	0.203661	0.093301	0.050871	0.207894	0.127208	0.216471
Sum sq. resids	0.130344	0.002938	0.028729	0.006158	0.066448	0.043286
S.E. equation	0.065915	0.009897	0.030946	0.014327	0.047063	0.037985
F-statistic	2.351802	1.543907	1.283303	2.387275	1.770384	2.460321
Log likelihood	53.90844	125.9623	82.64135	111.9058	66.70975	74.85311
Akaike AIC	-2.416234	-6.208540	-3.928492	-5.468726	-3.089987	-3.518585
Schwarz SC	-2.071479	-5.863785	-3.583737	-5.123971	-2.745232	-3.173830
Mean dependent	-0.007796	0.005207	0.002127	0.022364	-0.018621	0.002982
S.D. dependent	0.073865	0.010394	0.031764	0.016097	0.050376	0.042913

Determinant resid covariance (dof adj.)	6.22E-20
Determinant resid covariance	1.50E-20
Log likelihood	543.6982
Akaike information criterion	-25.77359
Schwarz criterion	-23.44650
Number of coefficients	54

Source: Authors

Ali obstaja povezava med makroekonomskimi spremenljivkami in borznimi indeksi v Bosni in Hercegovini?

Izvleček

Gospodarska rast in razvoj države se odražata v številnih vidikih, med drugim tudi v borznih indeksih. Namen tega članka je preučiti in določiti povezavo med izbranimi makroekonomskimi spremenljivkami in borznimi indeksi v Bosni in Hercegovini (BiH). Za modeliranje te povezave je bila uporabljena analiza kointegracije s četrtletnimi podatki v obdobju od prvega četrtletja leta 2010 do zadnjega četrtletja leta 2019. Za raziskovanje kratkoročne in dolgoročne povezave je bil uporabljen vektorski model korekcije napak (VECM). Članek je preučil napovedno sposobnost med izbranimi spremenljivkami z uporabo Grangerjevega testa vzročnosti. Rezultati kažejo na stabilno dolgoročno povezavo med analiziranimi makroekonomskimi spremenljivkami in borznimi indeksi v BiH, medtem ko kratkoročne povezave ni bilo mogoče ugotoviti. Rezultati prispevajo k znanstvenim razpravam o povezavi med izbranimi makroekonomskimi spremenljivkami in reprezentativnimi borznimi indeksi v BiH, pri čemer upoštevajo njihovo smer in moč.

Ključne besede: indeksi borznega trga, makroekonomske spremenljivke, BiH, model VECM, Grangerjev test vzročnosti

Transformative Economic Challenges: The Impact of COVID-19 and the War in Ukraine on the European Union

Ivan Todorov[*] [a], Gergana Angelova[a], Aleksandar Aleksandrov[b]
[a] *South-West University "Neofit Rilski", Faculty of Economics, Blagoevgrad, Bulgaria*
[b] *University of National and World Economy, Faculty of Business, Sofia, Bulgaria*
ivank.todorov@swu.bg, gergana.angelova@swu.bg, a.aleksandrov@unwe.bg

ARTICLE INFO

Original Scientific Article

Article history:
Received May 2024
Revised July 2024
Accepted August 2024

JEL Classification
E63, H56, I15

Keywords:
European Union
COVID-19
War in Ukraine
Economic effects

UDK: 33:005.931.1(4-6EU)
DOI: 10.2478/ngoe-2024-0017

Cite this article as: Todorov, I., Angelova, G. & Aleksandrov, A. (2024). Transformative Economic Challenges: The Impact of COVID-19 and the War in Ukraine on the European Union. *Naše gospodarstvo/Our Economy, 70*(3), *71-82*. DOI: 10.2478/ngoe-2024-0017

Abstract

This paper aims to explore the economic effects of the COVID-19 pandemic and the war in Ukraine on the twenty-seven European Union (EU) member states, known as the EU-27. A vector autoregression (VAR) of quarterly data for the period 2020–2022 was employed to study the impact of the coronavirus and the Russian invasion of Ukraine on growth, unemployment and inflation in the EU-27. The results from the empirical analysis indicated that the war in Ukraine lowered growth and raised inflation and unemployment, while the COVID-19 pandemic did not affect growth, increased unemployment and decreased inflation in the EU-27. It may be concluded that the war in Ukraine shifted the EU aggregate supply curve to the left, whereas the coronavirus pandemic resulted in inflation-unemployment trade-off in the EU.

Introduction

The occurrence of a black swan (an unexpected event with significant and wide-ranging consequences) complicates the work of policymakers in national economies and regional economic unions. When black swans are more than one and have different characteristics, the formulation and implementation of appropriate macroeconomic policies is extremely difficult and of key importance for utilizing the opportunities and neutralizing the threats created by the black swans.

The goal of this research was to investigate the economic influence of two black swans (the COVID-19 pandemic and the war in Ukraine) on the EU-27. The purpose of the study was achieved by the fulfilment of the following tasks:

- ✓ Systematize the theoretical fundamentals of black swans (section 1);
- ✓ Review the literature on the COVID-19 pandemic and the war in Ukraine and their economic impact on the EU;

[*] *Corresponding author*

- ✓ Empirically estimate the effects of the two black swans on growth, unemployment and inflation in the EU;
- ✓ Formulate advisable macroeconomic policies for overcoming the negative consequences of the pandemic and the war (conclusion).

A vector autoregression (VAR) was applied to quarterly data over the period 2020–2022 to examine the influence of the coronavirus pandemic and the Russian invasion of Ukraine on growth, unemployment and inflation in the EU-27. The results from the empirical investigation showed that the war in Ukraine is a supply-side shock, whereas the COVID-19 pandemic is a demand-side shock to the EU economy.

Theoretical Foundations of Black Swans

The theory of black swans originally arose in the field of economics and in particular the financial markets, but subsequently, it became clear that it is fully applicable in all other fields. The theory, created and named by Nassim Nicholas Taleb, is based on the story of the arrival of the first explorers in Australia in the 17th century when all swans were believed to be white. The existence of swans with black feathers was considered impossible, and the discovery of such birds was an incredible event that changed people's perceptions (Taleb, 2007b). By using the term "black swan", Taleb questioned the use of economic analysis based on extrapolation of past events to make predictions, because sudden and, completely unexpected events could completely change the course of the future. He described black swan events as expectations, outside of the normal standards, because within their limits nothing indicates the reality of the occurrence of such events (Bourgon, 2009).

The black swan theory is used as a metaphor, mostly in the field of economics, to describe events that happen unexpectedly, such as ones that no one predicted because their occurrence was considered unlikely or even impossible, and which had a huge, in most cases negative impact and large-scale consequences over a long period or even forever (Taleb, 2007b). Taleb added that the failure to occurrence of an event that was considered certain also qualifies as a "black swan" because of its unexpected and highly impactful nature, which subsequently could have been predicted (Taleb, 2007a).

Taleb (2007b) identified three requirements for an event to be defined as a black swan:

- The event must be unexpected – nothing from the past provides evidence for it, it must be unlikely or even considered impossible;
- It must have a strong impact – the power and scope of impact must be very large, with the direction of impact most often being negative, but positive development is not excluded;
- The event must be retrospectively foreseeable – after the event has occurred, analysts must be able to find evidence that the event could have been foreseen and prevented. From this requirement also follows the characterization of events defined as black swans that they no longer recur, since the necessary measures have been taken to prevent the same scenarios. This is also a prerequisite for the impossibility of modelling them for future periods.

Over the years, various authors have looked at black swan events and interpreted the term. Aven (2013) identified two approaches as the most appropriate for the interpretation of the "black swan": first, as a rare incident with extraordinary consequences; second, as an exceptional incident, unexpected from the point of view of the current state of knowledge.

Aven & Krohn (2014) attempted to categorize "black swan" events for financial markets; however, this categorization is generally valid for national and international economies. There are three main categories:

a) Unknown unknowns - these are events that are completely unknown, improbable, unpredictable and unthinkable. Their consequences are very large and extreme and can be both positive and negative. An example of this type of event is the emergence of a new type of virus in society (COVID-19).
b) Unknown knowns – these are events that cannot be measured or estimated and it is not known when they are likely to occur, but when they do occur, the events or influencing factors can be clearly defined. It is rarely accepted that these types of events happen by chance and were not foreseen or there was no prior information about them. An example of this type of "black swan" is the 9/11 terrorist attack in the USA.
c) Known knowns - these are events that are known and can be measured and estimated, but are

ignored because the probability of their occurrence is considered to be negligible. However, when these types of events occur, they are very impactful. An example of such a black swan is Brexit.

Heinonen (2013) notes that the word „black" used in the term does not have a negative connotation, but only aims to emphasize the unexpectedness of the event. This statement supports the thesis that both black swan events and their resulting consequences can be both negative and positive. According to Heinonen, black swan events challenge the current state of knowledge and can quickly and unexpectedly change it. Events of this kind can occur in any sphere: in nature, economy, politics and culture. They can be the unintended result of one's accidental actions as well as intentional and deliberate actions. According to Robert Jervis (2009), an impulse for black swans can also be human beliefs. People's interpretations and understandings of the actions of others, and the inferences they draw from them, account for their behavior. Jervis argues that conclusions about the black swan concept must be made based on people's thoughts and judgments about others. Whether or not a black swan event will occur depends on how people respond to signs of the event that may occur.

According to Castles (2010), black swan events can be defined as those that are „sudden and unexpected national and international emergencies – the „black swans" of war, economic depression, hyperinflation and, more prospectively and topically, mass epidemics, terrorist incidents and environmental catastrophes" that have a significant impact on the nature of actions taken by policymakers and the development of national economies.

However, black swan events are most commonly used in risk assessment and analysis in financial markets, with Manhire (2018) highlighting that despite the different approaches used to estimate the probability of a black swan event occurring, accurately predicting the moment of occurrence of such an event is practically impossible. According to Zhao et al. (2011), precisely black swans are the reason for the strong volatility of share prices in the financial markets, and these black swans arise from factors in the economic situation in the country such as the level of inflation, return on capital, market sentiments, etc. Similar studies on national stock markets are conducted by Peša & Brajkovic (2016) for Croatia, Cristiano & Murhadi (2016) for Indonesia, Lin & I-Chun (2019) and Stavrova, Paskaleva & Stoikova (2020) for the Chinese stock market, etc.

Estrada (2009) proves that the actual impact that black swans have on long-term performance is very strong, referring to large swings daily that have a strong long-term impact and that were initially unexpected but later turned out to be easily predictable. According to Krupa & Jones (2013) „black swans" are often caused by the illusory sense of control and understanding of a particular situation on the part of people. The retrospective predictability of these events is also based on this.

Although by definition „black swans" are quite rare events, in today's increasingly complex and interconnected world, their frequency is increasing and they are becoming more widespread, and this affects their consequences, which are also becoming more - wide-ranging and longer-lasting (Wildman, 2015).

COVID-19 and the War in Ukraine as Black Swans

The Impact of COVID-19 on the EU Economies

The pandemic of COVID-19 and the war in Ukraine are categorized as black swan events having an immense impact on the economies of the twenty-seven European Union (EU) member states. Almeida et al. (2021) revealed that discretionary fiscal policy measures significantly cushioned the adverse effects of the pandemic by reducing income loss, inequality, and poverty. Conversely, the International Labor Organization (ILO) highlighted another aspect of the crisis in 2020: a severe reduction in working hours, with Europe experiencing the sharpest decline. This contrast illustrates that, while fiscal policies were effective in some areas, labour market challenges persisted.

Similarly, the International Monetary Fund (IMF) underscored the pandemic's impact on global supply chains, leading to prolonged supply interruptions and fueling inflation in various countries (Congressional Research Service, 2021). In response, De la Porte & Heins (2022) documented how EU countries implemented income substitution, short-term work schemes, and other social policies to support disrupted work and family lives. Nonetheless, these measures also resulted in significant budget deficits, thereby highlighting a trade-off between immediate support and long-term fiscal stability.

Furthermore, G20 countries mirrored this approach by adopting government-funded short-time work and wage subsidy programs to sustain firms' liquidity and mitigate

job losses (ILO & OECD, 2020). In contrast, Yeyati & Filippini (2021) argued that the macroeconomic crisis caused by the pandemic was characterized more by prolonged fiscal deficits and missed growth opportunities than by liquidity concerns, indicating differing perspectives on the primary economic challenges. Moreover, EU Member States enacted various fiscal measures to counteract the immediate impacts of government restrictions, such as decreased demand, production, and employment (De Vet et al., 2021). Sulun (2020) observed that governments swiftly introduced temporary measures such as income assistance and subsidies to cushion the pandemic's shock and curb unemployment. This rapid response was crucial in mitigating the immediate economic fallout.

Conversely, the Economist Impact Research (2023) projected significant economic losses for countries with high COVID-19 infection rates and productivity levels, potentially hindering GDP growth and development. This projection was echoed by Pavolova et al. (2022), who identified notable disparities in GDP, unemployment rates, and trade among EU countries during the pandemic, thereby underscoring the uneven economic impact. Additionally, Nicola et al. (2020) presented divergent forecasts for economic recovery, with some experts predicting a swift rebound and others anticipating prolonged economic inactivity. Pekhnyk & Borzak (2022) argued that counteracting the pandemic's economic effects in the EU required stimulating demand, production, and overall economic activity to avoid long-term stagnation and negative multiplier effects, thereby emphasizing the need for proactive economic policies.

Table 1

Findings on COVID-19 Impact upon the EU Economies

Author/s	*Finding/s*
Almeida et al. (2020)	Discretionary fiscal policies mitigated income loss, inequality, and poverty during the pandemic.
ILO and OECD study (2020)	G20 countries adopted emergency measures to support firms and minimize job losses.
Sulun (2020)	Governments implemented temporary measures to alleviate the shock of the pandemic and mitigate unemployment.
Nicola et al. (2020)	Divergent predictions exist regarding the shape of economic recovery.
Petraskevicius et al. (2020)	Strong pre-crisis economic conditions influenced the economic performance during the pandemic.
Congressional Research Service (2021)	Global supply chain disruptions led to extended supply interruptions and inflationary pressures.
De la Porte & Heins (2021)	EU countries implemented income substitution and social policies, resulting in budget deficits.
UN Conference on Trade and Development (2021)	The surge in inflation may necessitate a shift towards reversing stimulus measures.
Pavolova et al. (2021)	Significant disparities were observed in GDP, unemployment rates, and trade among EU countries.
Yeyati and Filippini (2021)	The macroeconomic crisis was characterized by enduring fiscal losses and missed growth opportunities.
Pekhnyk & Borzak (2022)	Stimulating demand and overall economic activity is essential to prevent long-term stagnation.
Sazmaz et al. (2022)	Some European countries experienced a robust labour market recovery despite the pandemic.
Smit et al. (2023)	SMEs and start-ups should adopt digitalization and sustainable practices.
Zuleeg (2023)	Inflation and addressing the debt crisis are important considerations in the post-COVID world.
Szekely (2020-2022)	Europe lags in digitalizing its economy, particularly within the SME sector.

Source: Own processing

Economic performance varied among EU countries, with those possessing stronger pre-crisis economic conditions experiencing less deceleration (Petraskevicius et al., 2022). Meanwhile, Sazmaz et al. (2021) noted that, while the pandemic negatively impacted unemployment rates, some European

countries experienced a robust labour market recovery, thereby highlighting the importance of pre-existing economic strengths. However, at the UN Conference on Trade and Development (2021), it was noted that rising inflation led to a shift toward reversing the COVID-19 stimulus measures. This more restrictive fiscal and monetary stance might suppress economic activity and weaken global demand, thereby posing additional challenges for developing nations, indicating a complex balancing act for policymakers.

Looking ahead, Smit et al. (2023) proposed that future crises could be mitigated by encouraging SMEs and start-ups to adopt more productive digital business models and sustainable practices. Similarly, Szekely (2020) emphasized that Europe lags behind its main competitors in digitalizing its economy, particularly within the SME sector, suggesting an area for potential improvement. Finally, Zuleeg (2020) suggested that the post-COVID world might experience changes in its relationship with inflation, acknowledging the persistent threat of deflation and the need for a certain level of inflation to manage a debt crisis. This perspective underlines the ongoing challenges and adjustments required in economic policy post-pandemic.

In conclusion, while discretionary fiscal policies alleviated some pandemic impacts, supply chain disruptions exacerbated inflation. EU countries implemented various supportive measures but faced budget deficits, thereby illustrating the complexity of balancing immediate relief with long-term fiscal health. The path to economic recovery remains uncertain, necessitating efforts to stimulate demand and bolster SMEs. Rising inflation may prompt stricter fiscal policies, and addressing the debt crisis will be crucial in the post-COVID era.

The Impact of the War in Ukraine on the EU Economies

Examining the effect of the war in Ukraine on European stock markets, Ahmed et al. (2022) discovered a negative reaction across these markets. However, considerable variation was observed across industries, countries, and company sizes in the magnitude of stock price changes, indicating a nuanced impact that depended heavily on specific market conditions. Similarly, Chen (2022) found that the conflict negatively impacted GDP per capita by constraining both local and international trading benefits. This impact can be attributed to three main components: the loss of life, damage to physical and human capital, and a direct decline in per capita GDP. This highlights the multifaceted economic repercussions of the war.

Further emphasizing the broad scope of the conflict's impact, Celi et al. (2022) highlighted cascading effects on sectors including energy, raw materials, technology, security and defence, food and agriculture, and migration. This was compounded by sociopolitical transformations, existing political and economic instability, poverty, and growing international migration caused by mass unemployment, as noted by Tsvetanova (2022).

In the Netherlands, the war-induced uncertainty regarding energy supply led to significant price increases for oil and gas, exacerbating pre-existing constraints in the supply and transportation of raw materials and goods still recovering from pandemic restrictions. Consequently, product prices soared, resulting in high inflation (Berben et al., 2022). The war in Ukraine disrupted the global post-pandemic economic rebound, manifesting in two key areas: disturbances in international trade and supply chains, and shifts in commodity prices resulting in inflation (Congressional Research Service, 2022). Eurochambers (2022) further indicated that high inflation levels were exacerbated by short-term increases in natural gas, oil, and food prices, posing a threat to economic recovery as inflation remained high in the long term. Guenette et al. (2022) supported this, arguing that inflation would likely stay elevated in the near term as demand and supply shocks influenced wage and price-setting processes.

The global supply chain was significantly impacted by the war, leading to disruptions in energy and trade supplies. This disruption was reflected in a sudden rise in energy costs, goods, and food prices, which contributed to heightened inflation in multiple countries (Kalogiannidis et al., 2022). Korosteleva et al. (2022) predicted that the war would accelerate the EU's greening transition, central to its twin objective of sustainable development encompassing digital and green transformations towards a 'zero carbon, zero waste' economy. Moreover, Skaliotou (2022) suggested that the pace of digitalization of the EU economy could be expedited to mitigate risks from supply chain disruptions, steering the economy towards technological and green transitions and reducing reliance on oil. Garicano (2022) concurred, noting that the energy crisis from the war provided an opportunity to accelerate the green transition and reduce fossil fuel dependency.

Contrastingly, the OECD (2022) projected that global growth in most OECD countries in 2023 would revert to pre-pandemic rates, anticipating full employment and inflation converging to policy objectives. However, Prohorovs (2022) found that the Russian war in Ukraine

and subsequent trade restrictions significantly drove up inflation and aggravated existing economic problems. Lastly, deliberations at the United Nations Conference on Trade and Development in March 2022 centred on the vulnerability of developing nations and least-developed countries to the conflict's effects on trade expenses, commodity rates, and financial markets. Given the precarious state of the global economy and the developing world due to the COVID-19 pandemic, concerns were raised about potential social unrest, food scarcity, and economic downturns triggered by inflation.

Table 2

Findings on Ukraine War Impact upon the EU Economies

Author/s	*Finding/s*
Ahmed et al. (2022)	European stock markets displayed a tendency to react negatively to the war in Ukraine. Considerable variation in stock price changes observed across industries, countries, and company sizes.
Chen (2022)	The war had a negative impact on GDP per capita by limiting local and international trading benefits. Three main components to consider: loss of life and damage to physical and human capital, as well as a direct decline in per capita GDP.
Celi et al. (2022)	The war had cascading impacts on various sectors including energy, raw materials and technology, security and defence, food and agriculture, and migration.
Berben et al. (2022)	In the Netherlands, the war caused uncertainty in energy supply, leading to steep price increases for oil and gas. Constraints in the supply and transportation of other raw materials and goods were intensified, contributing to high inflation.
CRC (2022)	The war disrupted international trade and supply chains, as well as resulted in shifts in commodity prices and inflation, posing challenges to the post-pandemic economic recovery.
Eurochambers (2022)	Short-term increases in natural gas, oil, and food prices intensified high inflation levels, threatening economic recovery in many countries in the long term.
Guenette et al. (2022)	Inflation is expected to remain elevated in the near term due to demand and supply shocks affecting wage and price-setting processes.
Kalogiannidis (2022)	The war disrupted the global supply chain, leading to disruptions in energy and trade supply, resulting in a sudden rise in energy costs, goods and food prices, and heightened inflation in multiple countries.
Korosteleva et al. (2022)	The war between Russia and Ukraine is predicted to accelerate the greening transition of the EU, aligning with its sustainable development goals for a 'zero carbon, zero waste' economy.
Skaliotou (2022)	The pace of digitalization in the EU economy could be expedited to mitigate supply chain disruptions and reduce reliance on oil.
Garicano (2022)	The energy crisis resulting from the war in Ukraine provided an opportunity to accelerate the green transition and reduce reliance on fossil fuels.
OECD (2022)	Global growth is expected to return to pre-pandemic rates in 2023, with full employment anticipated. Inflation is projected to converge on policy objectives.
Prohorovs (2022)	The war and subsequent trade restrictions significantly increased inflation and aggravated existing economic problems.
UNCTD (2022)	Concerns were raised about social unrest, food scarcity, and inflation-induced economic downturns due to the fragile global economy and the impact of the COVID-19 pandemic.

Source: Own processing

In conclusion, the war in Ukraine had wide-ranging effects on European stock markets, GDP, and various economic sectors. While some regions faced severe disruptions and inflation, others saw potential opportunities for accelerated digital and green transitions. The conflict's impact on global supply chains and inflation underscores the complex and interconnected nature of modern economies, highlighting the need for coordinated policy responses to navigate these challenges effectively.

Empirical Analysis of the Economic Effects of COVID-19 and the War in Ukraine on the European Union

Impact on Growth: Methodology and Data

The influence of COVID-19 and the war in Ukraine on economic growth in the EU-27 was estimated via a vector autoregression (VAR), which included the following variables:

$GDPGR_{ij}$ – real output growth rate in country i in quarter j (in percent); $TTCGR_{ij}$ – total COVID cases growth rate in country i in quarter j (in percent); WAR_j – binary dummy variable for the war in Ukraine (1 means war and 0 means peace in quarter j).

Quarterly Eurostat data on real economic growth and total COVID-19 cases growth rate in the 27 EU member states for the period 2020-2022 were used in the VAR.

Impact on Growth: Results

The unit root test indicated that GDPGR and TTCGR were integrated of order zero (see Tables 3 and 4), which allowed the application of an unrestricted VAR.

The test for the optimum number of lags in the VAR (see Table 5) showed that this number was one according to the Schwarz information criterion, therefore the VAR was estimated with one lag.

The equation for the target variable in the VAR GDPGR was

$$GDPGR_{ij} = \alpha_0 + \alpha_1 * GDPGR_{i,j-1} + \alpha_2 * TCCGR_{i,j-1} + \alpha_3 WAR_{j-1} + \sigma_{ij} \quad (1)$$

where α_0 was a constant, α_1, α_2 and α_3 were regression coefficients and σ_{ij} was an error term.

Table 3
Unit Root Test on the Level Values of GDPGR

Method	*Statistic*	*Probability*	*Cross-sections*	*Observations*
Null: Unit root (assumes common unit root process)				
Levin, Lin and Chu t-statistic	-54.5865	0.0000	27	249
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-statistic	-36.2159	0.0000	27	249
ADF-Fisher Chi-square	477.341	0.0000	27	249
PP-Fisher Chi-square	316.126	0.0000	27	270

Source: Own processing with EViews

Table 4
Unit Root Test on the Level Values of TTCGR

Method	*Statistic*	*Probability*	*Cross-sections*	*Observations*
Null: Unit root (assumes common unit root process)				
Levin, Lin and Chu t-statistic	-13.4592	0.0000	27	237
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-statistic	-6.02584	0.0000	27	237
ADF-Fisher Chi-square	131.274	0.0000	27	237
PP-Fisher Chi-square	180.797	0.0000	27	243

Source: Own processing with EViews

Table 5
Optimum Number of Lags in the VAR

Lag number	*Schwarz information criterion*
0	19.80594
1	18.81235*
2	18.81579

Note: * Indicates lag order selected by the criterion
Source: Own processing with EViews

Real economic growth in the EU-27 was negatively influenced by the war (a fall of 2.01 percent with a lag of one quarter) but unaffected by the coronavirus (see Table 6). These estimates could be considered accurate and reliable for Equation (1) adequately reflected the relationship between the dependent and the independent variables (its determination coefficient and probability of F-statistic were respectively 0.53 and 0.00).

Table 6
Results from the Estimation of Equation (1)

Variable	*Coefficient*	*Standard Error*	*t-Statistic*	*Probability*
C	*2.838288*	*0.188731*	*15.03883*	*0.0000*
GDPGR(-1)	*-0.423915*	*0.028254*	*-15.00348*	*0.0000*
TCCGR(-1)	*3.97E-05*	*0.000381*	*0.104417*	*0.9169*
WAR(-1)	*-2.011157*	*0.344036*	*-5.845770*	*0.0000*

Source: Own processing with EViews

Impact on Unemployment: Methodology and Data

The influence of COVID-19 and the war in Ukraine on unemployment in the EU-27 was estimated via a vector autoregression (VAR), which included the following variables: $UNEMPL_{ij}$ – the unemployment rate in country i in quarter j (in percent); $TTCGR_{ij}$– total COVID cases growth rate in country i in quarter j (in percent); WAR_j – binary dummy variable for the war in Ukraine (1 means war and 0 means peace in quarter j).

Quarterly Eurostat data on the unemployment rate and total COVID cases growth rate in the 27 EU member states for the period 2020-2022 were used in the VAR.

Impact on Unemployment: Results

The unit root test indicated that UNEMPL and TTCGR were integrated of order zero (see Tables 5 and 7), which allowed the application of an unrestricted VAR.

Table 7
Unit Root Test on the Level Values of UNEMPL

Method	*Statistic*	*Probability*	*Cross-sections*	*Observations*
Null: Unit root (assumes common unit root process)				
Levin, Lin and Chu t-statistic	-17.6296	0.0000	27	230
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-statistic	-3.34891	0.0004	27	230
ADF-Fisher Chi-square	124.568	0.0000	27	230
PP-Fisher Chi-square	214.661	0.0000	27	243

Source: Own processing with EViews

The test for the optimum number of lags in the VAR (see Table 8) showed that this number was two according to the Schwarz information criterion, therefore the VAR was estimated with two lags.

The equation for the target variable in the VAR UNEMPL was

$$UNEMPL_{ij} = \beta_0 + \beta_1*UNEMPL_{i,j-1} + \beta_2*UNEMPL_{i,j-2} + \beta_3*TCCGR_{i,j-1} + \beta_4*TCCGR_{i,j-2} + \beta_5*WAR_{j-1} + \beta_6*WAR_{j-2} + \sigma_{ij} \quad (2)$$

where β_0 was a constant, β_1 to β_6 were regression coefficients and σ_{ij} was an error term.

Unemployment in the EU-27 was adversely affected by the war (a rise of 0.19 percent with lags of one and two quarters) and the coronavirus (an increase of 0.000215 percent per 1 percent rise in TCCGR with a lag of one quarter) as indicated in Table 7. These estimates could be considered accurate and reliable since Equation (2) adequately reflected the relationship between the dependent and the independent variables (its determination coefficient and probability of F-statistic were respectively 0.98 and 0.00).

Table 8
Optimum Number of Lags in the VAR

Lag number	*Schwarz information criterion*
0	20.95975
1	16.33204
2	16.32758*

Note:* Indicates lag order selected by the criterion
Source: Own processing with EViews

Table 9
Results from the Estimation of Equation (2)

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-0.090958	0.072597	-1.252907	0.2116
UNEMPL(-1)	0.813532	0.044960	18.09452	0.0000
UNEMPL(-2)	0.145842	0.043729	3.335149	0.0010
TCCGR(-1)	0.000215	7.42E-05	2.895536	0.0042
TCCGR(-2)	2.89E-05	6.87E-05	0.419907	0.6750
WAR(-1)	0.189389	0.082234	2.303063	0.0223
WAR(-2)	0.189161	0.105454	1.793770	0.0743

Source: Own processing with EViews

Impact on Inflation: Methodology and Data

The influence of COVID-19 and the war in Ukraine on inflation in the EU-27 was estimated via a vector autoregression (VAR), which included the following variables: $INFL_{ij}$ – inflation rate in country i in quarter j (in percent); $TTCGR_{ij}$ – total COVID cases growth rate in country i in quarter j (in percent); WAR_j – binary dummy variable for the war in Ukraine (1 means war and 0 means peace in Ukraine in quarter j).

Quarterly Eurostat data on the inflation rate and total COVID cases growth rate in the 27 EU member states for the period 2020-2022 were used in the VAR.

Impact on Inflation: Results

The unit root test indicated that INFL and TTCGR were integrated of order zero (see Tables 10 and 4), which allowed the application of an unrestricted VAR. The test for the optimum number of lags in the VAR (see Table 11) showed that this number was one according to the Schwarz information criterion, therefore the VAR was estimated with one lag.

The equation for the target variable in the VAR INFL was

$$INFL_{ij} = \gamma_0 + \gamma_1 * INFL_{i,j-1} + \gamma_2 * TCCGR_{i,j-1} + \gamma_3 * WAR_{j-1} + \sigma_{ij} \quad (3)$$

where γ_0 was a constant, γ_1 to γ_4 were regression coefficients and σ was an error term.

Table 10
Unit Root Test on the Level Values of INFL

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin and Chu t-statistic	-18.5638	0.0000	27	224
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-statistic	-3.71506	0.0001	27	224
ADF-Fisher Chi-square	140.784	0.0000	27	224
PP-Fisher Chi-square	144.150	0.0000	27	243

Source: Own processing with EViews

Table 11
Optimum Number of Lags in the VAR

Lag number	Schwarz information criterion
0	19.72273
1	18.96380*
2	18.99626

Note: * Indicates lag order selected by the criterion
Source: Own processing with EViews

Inflation in the EU-27 was decreased by the COVID-19 pandemic (by 0.000708 percent for a 1% rise in TCCGR with a lag of one quarter) but raised by the war in Ukraine (by 1.30 percent with a lag of one quarter), as indicated in Table 10. These estimates could be considered accurate and reliable since Equation (3) adequately

reflected the relationship between the dependent and the independent variables (its determination coefficient and probability of F-statistic were respectively 0.32 and 0.00).

Table 12
Results from the Estimation of Equation (3)

Variable	*Coefficient*	*Standard Error*	*t-Statistic*	*Probability*
C	1.333756	0.177198	7.526940	0.0000
INFL(-1)	0.179888	0.090293	1.992273	0.0476
TCCGR(-1)	-0.000708	0.000322	-2.200831	0.0288
WAR(-1)	1.298224	0.390267	3.326507	0.0010

Source: Own processing with EViews

Conclusion

This research has important implications for macroeconomic policy in the EU-27. Its results provided evidence that the war in Ukraine hit the EU-27 as an adverse shock in aggregate supply, while the COVID-19 pandemic affected the EU-27 as a negative shock in aggregate demand. The simultaneous manifestation of supply and demand disturbances requires both long-term supply-side measures (investments in new energy sources and energy supply diversification) and short-run demand-side policies (fine-tuning or aggregate demand management).

This study contributes to the literature by exploring the simultaneous and combined economic effects of two black swans (a pandemic and a war) on the EU-27, by drawing inferences about the type of prevailing economic disturbance (demand or supply shock) and by recommending macroeconomic policies, which match the type of dominating economic disorder.

References

Ahmed, S., Hasan, M. M., & Kamal, M. R. (2022). Russia-Ukraine crisis: The effects on the European stock market. *European Financial Management*, 1–41. DOI: https://doi.org/10.1111/eufm.12386

Almeida, V., Barrios, S., Christl, M., et al. (2021). The impact of COVID-19 on households' income in the EU. *Journal of Economic Inequality*, *19*, 413–431. DOI: https://doi.org/10.1007/s10888-021-09485-8

Aven, T. (2013). On the meaning of a black swan in a risk context. *Safety Science, 57*, 44–51. DOI: https://doi.org/10.1016/j.ssci.2013.01.016

Aven, T., & Krohn, B. (2014). A New Perspective on how to Understand, Assess and Manage Risk and The Unforeseen. *Reliability Engineering and System Safety, 121*, 1–10. DOI: https://doi.org/10.1016/j.ress.2013.07.005

Berben, R. et al. (2022). *Consequences of the war in Ukraine for the economy of the Netherlands*. Amsterdam: De Nederlandsche Bank N.V.

Bourgon, J. (2009). New Directions in Public Administration: Serving Beyond the Predictable. *Public Policy and Administration, 24*(3), 309–330. DOI: https://doi.org/10.1177/0952076709103813

Castles, F. G. (2010). Black swans and elephants on the move: the impact of emergencies on the welfare state. *Journal of European Social Policy, 20*(2), 91–101. DOI: https://doi.org/10.1177/0958928709358793

Celi, G., Guarascio, D., Reljic, J., Simonazzi, A., & Zezza, F. (2022). The Ripple Effects of the War in Ukraine*, Intereconomics, 57*(3), 141–147.

Chen (2022). The Impact of the Russia-Ukraine War on the European Economy. *Proceedings of the 2022 International Conference on Economics, Smart Finance and Contemporary Trade,* 619–626. DOI: https://doi.org/10.2991/978-94-6463-052-7_72

Christianto, E., & Murhadi, W. (2016). Pengujian Black Swan Anomalies. *Journal of Management and Business, 15*(1), 99–116.

Congressional Research Service (2022). *Russia's 2022 War Against Ukraine: Global Economic Effects*. Retrieved from https://crsreports.congress.gov/

Congressional Research Service (2021). *Global Economic Effects of Covid-19*. Retrieved from https://crsreports.congress.gov/

de la Porte, C., & Heins, E. (2022). Introduction: EU Constraints and Opportunities in the COVID-19 Pandemic: The Politics of NGEU: The Politics of NGEU. *Comparative European Politics, 20*(2), 135–143. DOI: https://doi.org/10.1057/s41295-022-00276-7

De Vet et al. (2021). *Impacts of the COVID-19 pandemic on EU industries*. Retrieved from https://www.europarl.europa.eu

Economist Impact (2023). Understanding the future economic consequences of the Covid-19 pandemic. Retrieved from https://impact.economist.com

Eurochambers (2022). Eurochambres flash survey on the economic impact of the war in Ukraine. Retrieved from https://www.eurochambres.eu/

Estrada, J. (2009). Black swans, market timing and the Dow. *Applied Economics Letters, 16*(11), 1117–1121. DOI: https://doi.org/10.2139/ssrn.1086300

Garicano, L., Rohner, D., & di Mauro, B. (2022). A silver lining: Increased urgency for the green transition in Europe. In *Global Economic Consequences of the War in Ukraine* (208–217). London: CEPR Press.

Guenette, J., Kenworthy, P., & Wheeler, C. (2022). Implications of the War in Ukraine for the Global Economy. World Bank Group. *Retrieved from https://thedocs.worldbank.org/en/doc/*.

Heinonen, S. (2013). The Dance of the Black Swans. The Concept and Manifestations. In Black Swans – What Will Change the World Next? *Entries from the writing contest of the Committee for the Future of the Parliament of Finland. Publish Ser Comm Future* 5, *20–40*.

ILO-OECD Paper (2020). *The impact of the COVID-19 pandemic on jobs and incomes in G20 economies*. Retrieved from *https://www.ilo.org/global/about-the-ilo/how-the-ilo-works/multilateral-system/g20/reports/WCMS_756331/lang--en/index.htm*

Kalogiannidis, S., Chatzitheodoridis, F., Kalfas, D., Kontsas, S., & Toska, E. (2022). The Economic Impact of Russia's Ukraine Conflict on the EU Fuel Markets. *International Journal of Energy Economics and Policy*, *12*(6), 37–49. DOI: https://doi.org/10.32479/ijeep.13493

Korosteleva, J. (2022). The Implications of Russia's Invasion of Ukraine for the EU Energy Market and Businesses. *British Journal of Management, 0*, 1–5. ol. 0, 1–5 (2022) DOI: https://doi.org/10.1111/1467-8551.12654

Krupa, J., & Jones, C. (2013). Black Swan Theory: Applications to energy market histories and technologies. *Energy Strategy Reviews, 1,* 286–290. DOI: https://doi.org/10.1016/j.esr.2013.02.004

Lin, W., Tsai, I. (2019). Black swan events in China's stock markets: Intraday price behaviors on days of volatility. *International Review of Economics & Finance, 59*(C), 395-411. DOI: https://doi.org/10.1016/j.iref.2018.10.005

Manhire, J. T. (2018). Measuring Black Swans in Financial Markets. *Journal of Mathematical Finance*, 8, 227–239. https://doi.org/10.4236/jmf.2018.81016

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., & Agha, R. (2020). The Socio-Economic Implications of the Coronavirus Pandemic (COVID-19): A Review. *International Journal of Surgery*, 78, 185–193. DOI: https://doi.org/10.1016/j.ijsu.2020.04.018

OECD (2022). *Economic and Social Impacts and Policy Implications of the War in Ukraine*. Retrieved from https://www.oecd-ilibrary.org/

Pavolová, H., Čulková, K., & Šimková, Z. (2022). Influence of COVID-19 Pandemic on the Economy of Chosen EU Countries. *World, 3*(3), 672–680. DOI: https://doi.org/10.3390/world3030037

Pekhnyk, A., & Borzak, Y. (2022). The impact of the COVID-19 pandemic on the European economy: A first glance and long-term perspectives. *Zeszyty Naukowe Wyższej Szkoły Bankowej w Poznaniu, 90*(3), 13–27. DOI: https://doi.org/10.26349/zn.wsb.w.poznaniu.0090.01

Petraškevičius, V., Ginevičius, R., Bracio, K., Menet, G., & Visokavičius, R. (2022). Impact of the COVID-19 pandemic on the economic development of EU countries. *Problems and Perspectives in Management, 20*(3), 204-214. DOI: https://doi.org/10.21511/ppm.20(3).2022.17

Pesa, A., & Brajkovic, A. (2016). Testing the 'Black Swan Effect' on Croatian Stock Market between 2000 and 2013. *EMAJ: Emerging Markets Journal, 6*(1), 1–16. DOI: https://doi.org/10.5195/emaj.2016.92

Prohorovs A. (2022). Russia's War in Ukraine: Consequences for European Countries' Businesses and Economies. *Journal of Risk and Financial Management*, *15*(7), 295. DOI: https://doi.org/10.3390/jrfm15070295

Sazmaz, E., Ozkok, E., Simsek, H., & Gulseven, O. (2021). *The Impact of COVID-19 on European Unemployment and Labor Market Slack*. Available at SSRN: https://ssrn.com/abstract=3766376 or http://dx.doi.org/10.2139/ssrn.3766376

Skaliotou, I. (2022). *Economic Impact of Russia's Invasion in Ukraine*. Retrieved from https://mof.gov.cy/assets/modules/wnp/articles/202209/1208/docs/impact_of_russia_invasionis.pdf

Smit, et al. (2023). *Social and Economic Consequences of COVID-19*. Retrieved from https://www.europarl.europa.eu

Stavrova, E., Paskaleva, M., & Stoykova, A. (2020). Black Swan Event: Evidence from China's Economics Effects. *International Conference on Innovations in Science and Education*. Prague: Czech Republic.

Sülün, D. (2020). The Impact of Covid-19 on France's Economy with an Overview on The European Economy. *Journal of Research in Economics, Politics & Finance, 5*(SI), 115– 136. DOI: https://doi.org/10.30784/epfad.810739

Székely, P. (2020). The Covid-19 pandemic and Europe. *Köz-gazdaság, 15*(2), 13–24. DOI: https://doi.org/10.14267/RETP2020.02.22

Taleb, N. (2007a). *Fooled by Randomness: The hidden role of chance in the markets and life*. New York, NY: Random House.

Taleb, N. (2007b). *The Black Swan: The Impact of the Highly Improbable*. The New York Times. Retrieved from https://www.nytimes.com/2007/04/22/books/chapters/0422-1st-tale.html

Tsvetanova, Y. (2022). *Professional Profile and Training of the Specialist Educator in France*. BON Publishing.

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (2022). Impact of the COVID-19 PANDEMIC on Trade and Development. Retrieved from https://unctad.org/publication/impact-covid-19-pandemic-trade-and-development-lessons-learned

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (2022). *The impact on trade and development of the war in Ukraine*. Retrieved from https://unctad.org/publication/impact-trade-and-development-war-ukraine

Wildman, D. (2015). Geopolitical Risk: The Butterfly Effect and Black Swans. *FTI Journal,* 2–5.Retrieved from https://www.garp.org/hubfs/Whitepapers/a1Z1W0000054xShUAI.pdf

Yeyati, E., & Filippini, F. (2021). *Social and economic impact of COVID-19*. Brookings Global Working Paper 158.

Zhao, X., Yang, J., Zhao, L., & Li, Q. (2011). The Impact of News on Stock Market: Quantifying the Content of Internet-based Financial News. *In The 11th International DSI and the 16th APDSI Joint Meeting, Taipei, Taiwan, July 12-16*.

Zuleeg, F. (2020). *The economic impact of COVID-19 on the EU: From the frying pan into the fire*. Retrieved from https://www.epc.eu

Transformacijski izzivi gospodarstva: Vpliv COVID-19 in vojne v Ukrajini na Evropsko unijo

Izvleček

Namen članka je raziskati gospodarske učinke pandemije covid-19 in vojne v Ukrajini na sedemindvajset držav članic Evropske unije (EU-27). Za preučevanje vpliva koronavirusa in ruske invazije na Ukrajino na rast, brezposelnost in inflacijo v EU-27 je bila uporabljena metoda vektorske avtoregresije (VAR) na četrtletnih podatkih za obdobje 2020–2022. Rezultati empirične analize so pokazali, da je vojna v Ukrajini zmanjšala gospodarsko rast ter povečala inflacijo in brezposelnost, medtem ko pandemija covid-19 ni vplivala na rast, povečala je brezposelnost in znižala inflacijo v EU-27. Zaključimo lahko, da je vojna v Ukrajini premaknila agregatno krivuljo ponudbe EU v levo, medtem ko je pandemija koronavirusa povzročila kompromis med inflacijo in brezposelnostjo v EU.

Ključne besede: Evropska unija, covid-19, vojna v Ukrajini, gospodarski učinki

Omissions by Design in a Survey: Is This a Good Choice when using Structural Equation Models?

Paula C. R. Vicente
Lusófona University, COPELABS, Intrepid Lab, Lisbon, Portugal
p951@ulusofona.pt

ARTICLE INFO

Original Scientific Article

Article history:
Received May 2024
Revised September 2024
Accepted September 2024

JEL Classification
C38, C63

Keywords:
Omissions by design
Structural Equation Model
Survey

UDK: 303.425
DOI: 10.2478/ngoe-2024-0018

Cite this article as: Vincente, P. C. R. (2024). Omissions by Design in a Survey: Is This a Good Choice when using Structural Equation Models? *Naše gospodarstvo/Our Economy, 70*(3), *83-91*. DOI: 10.2478/ngoe-2024-0018

Abstract

Missing observations can arise due to the effort required to answer many questions in long surveys and the cost required to obtain some responses. Implementing a planned missing design in surveys helps reduce the number of questions each respondent needs to answer, thereby lowering survey fatigue and cutting down on implementation costs. The three-form and the two-method design are two different types of planned missing designs. An important consideration when designing a study with omissions by design is to know how it will affect statistical results. In this work, a simulation study is conducted to analyze how the usual fit measures, root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI), and Tucker-Lewis index (TLI) perform in the adjustment of a Structural Equation Model. The results revealed that the CFI, TLI, and SRMR indices exhibit sensitivity to omissions with small samples, low factor loadings and large models. Overall, this study contributes to our understanding of the importance of considering omissions by design in market research.

Introduction

Incomplete or missing data is a common challenge in numerous studies across various fields, such as market research. Missing observations can arise not only due to the effort required to answer many questions in long surveys but also because of the cost required to obtain some responses. According to some authors, omissions represent one of the most significant statistical issues in research, with the usual practice being the exclusion of nonresponses from data modelling. Implementing a planned missing data design can help mitigate this problem by reducing the number of survey questions that each respondent must answer without reducing the total number of survey questions. The effort and cost that respondents must spend to complete the survey are thus also minimized, which increases the

quantity and quality of data collected in a study. In addition, planned missing designs allow to implementation of a survey while minimizing its overall cost. Two different types of planned missing design include the three-form design and the two-method design (Rioux, Lewin, Odejimi & Little, 2020; Graham, Taylor, Olchowski & Cumsville, 2006; Graham, Hofer & Mackinnon, 1996).

Researchers may be concerned that planning for a missing design could bias the results of the analysis. However, it is important to emphasize that this type of design can be handled appropriately by modern missing data techniques, such as Full Information Maximum Likelihood (FIML) and Multiple Imputation (MI) without erroneous analysis results (Little, Jorgensen, Lang & Moore, 2013; Enders, 2010; Azar, 2002; Arbuckle, 1996).

Structural Equation Models (SEM) include both measurement and structural models. The measurement model focuses on the relationship between latent and observed variables, while the structural model focuses on the relationship between latent variables (Bollen, 1989). This study considers a measurement model, which is crucial for examining a multidimensional concept and developing a scale.

When fitting a Structural Equation Model (SEM) to the data, multiple measures could be utilized to assess the compatibility of the theoretical model with the observed data, with the Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) being the most commonly used (Hair, Black, Babin, Anderson & Tatham, 2006; Bandalous & Finney, 2010; Nye, 2022).

According to Rioux, Lewin, Odejimi &Little (2020) and Little, Jorgensen, Lang & Moore (2013), an important consideration when designing a study with a planned missing design is to know how this will affect statistical results. In this way, Wu & Jia, 2021, Moore, Lang & Grandfield (2020), Rioux, Lewin, Odejimi & Little (2020), Rhemtulla & Hancock, 2016, Schoemann, Miller, Pornprasertmanit & Wu (2014) studies examined the impact of a planned missing data design on parameter estimate bias, standard error bias, model convergence, and power analysis.

In addition, Lawes, Schultze & Eid (2020) and Rhemtulla & Hancock (2016) in their studies highlighted the cost benefits of omissions by design. The importance of the size of the model and sample size has been emphasized by Kenny, Kanishan & McCoach, (2015) and Kenny & McCoach, (2003).

Given the importance of fit indices in assessing the adjustment of a SEM, this discussion explores how the usual fit measures behave when intentional omissions are incorporated into analyses conducted using a SEM.

Planned Missing Data Designs

Two different types of planned missing data designs include the three-form design and the two-method design (Rioux, Lewin, Odejimi & Little, 2020; Graham, Taylor, Olchowski & Cumsville, 2006). For these designs, the critical point is the random assignment of the questions to the respondents because the missing data mechanism must be known.

According to Rubin (1976), there are three types of missing data mechanisms: Missing Completely at Random (MCAR), Missing at Random (MAR) and Missing Not at Random (MNAR). MCAR is present when the probability of missing data on a variable is not related to observed or missing values for any of the variables. MAR happens when the probability of missing data on a variable is related to some other measured variable (or variables) in the study. Finally, MNAR occurs when the probability of missing data on a variable is related to the missing values themselves.

In a planned missing design, when a random assignment is done, the non-responses from a three-form design and a two-method design follow a Missing Completely at Random (MCAR) mechanism (Enders, 2010).

Three-Form Design

The three-form design is a particular example of a planned missing data design. With this design, the survey's questions are divided into four groups: X, A, B, and C. After completing the questions in the X block, each participant is randomly assigned to complete two of the remaining blocks (A, B, and C). As a result, among

all participants, one-third answered questions in set XAB, one-third answered XAC, and one-third answered XBC, rather than responding to questions in the four groups (see Table 1). Through this approach, the overall number of questions asked is not decreased, but the number of questions answered by each participant is decreased from 100% to 67%.

According to Graham, Taylor, Olchowski, and Cumsville (2006), questions in the X group are answered by all survey respondents, hence these should include the most crucial questions for the investigation.

Although in a more conservative approach, the questions in group X should be answered by all participants, most of the time are sociodemographic questions. According to Lang & al (2020) and Moore, Lang & Grandfield (2020), if there are 13 or more questions, the X block could contain scale and sociodemographic items randomly assigned. According to Schoemann, Miller, Pornprasertmanit & Wu (2014), each group may not always have the same number of questions. Different applications of a three-form design can be seen in Fürst (2020) and Roche & al. (2019).

Table 1

The three-form design

Question Set					
Form	*% of sample*	*X*	*A*	*B*	*C*
1	1/3	O	O	O	NA
2	1/3	O	O	NA	O
3	1/3	O	NA	O	O

Note: O-observed value, NA-not available

Source: Author's work

Two-Method Design

The two-method design is useful in situations in which researchers face a choice between two measures of a construct: i. a more expensive, more intrusive, or time-consuming measure, designated gold standard measure, and ii. a biased measure that is inexpensive, non-intrusive, or timesaving. The least expensive measure will be observed for all participants, but only a small proportion (e.g., 1/3) of participants will be randomly selected to receive the expensive measure (see Table 2). As such, given the same budget with a two-method design, it is possible to have more participants than in a complete data design using only the expensive measure (Wu & Jia, 2021; Lawes, Schultze & Eid, 2020).

Examples of applications can be found in Graham, Taylor, Olchowski & Cumsville (2006) and Garnier-Villareal, Rhemtulla & Little (2014). Such a situation can happen in market studies, when it is required to have expensive measures, including tests or observations of consumer behaviour.

The basic idea of the two-method design is that the subsample containing data on all measures can be used to usefully define the construct under study and to control the systematic bias of the cheap method (Figure 1). Conversely, having participants with only data on the expensive measures allows for an increase in the total sample size and the statistical power, while keeping the costs low.

Randomly assigning participants creates a missing data pattern that satisfies the MCAR assumption. Nevertheless, if the participants are selected according to a certain characteristic (e.g., to be an expert or their age), then the data omission mechanism is considered MAR (Wu & Jia, 2021).

Table 2

Two-method design

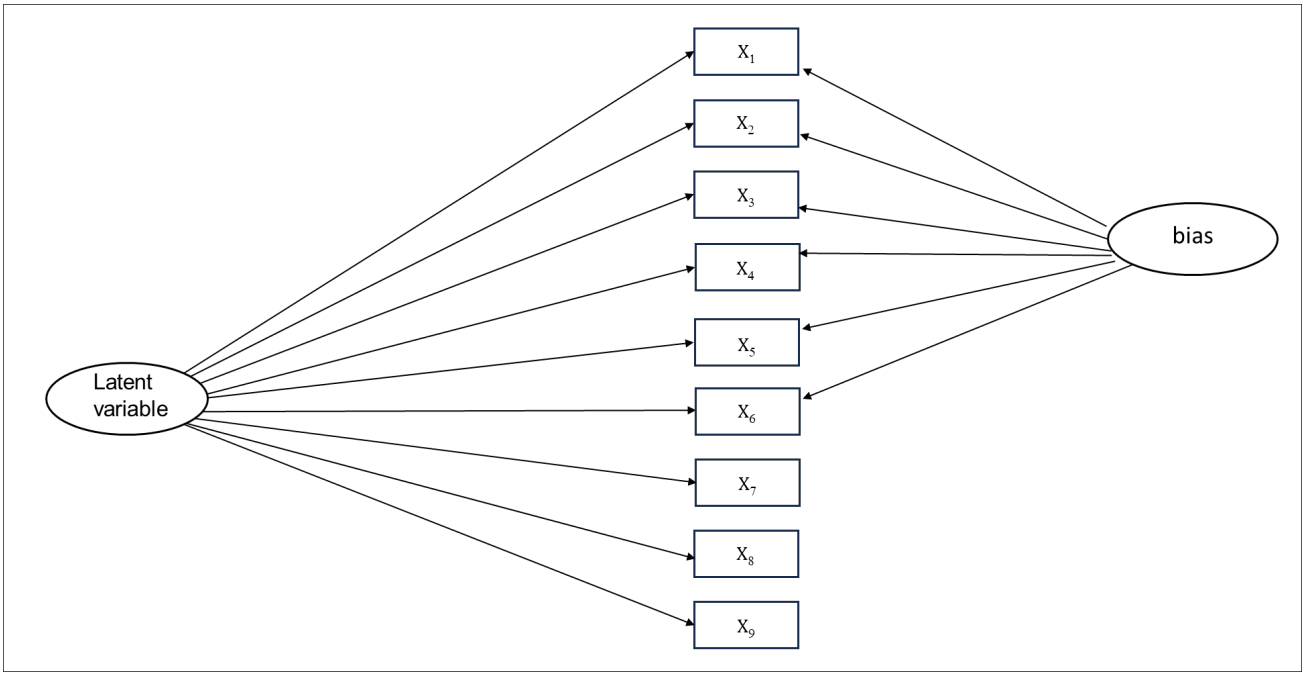
	Question set	
% of sample	*Cheap*	*Expensive*
1/3	O	O
2/3	O	NA

Note: O-observed value, NA-not available

Source: Author's work

Figure 1

Two-method design structure with three gold-standard measures (X_7 to X_9) and six (X_1 to X_6) cheap measures



Source: Author's work

Methods

Fit Measures

Quantifying the fit of a SEM is important to determine the best model and can be done using different fit indices, based on distinct criteria (Yuan, 2015). Although several fit indices are available for this purpose, the most utilized ones are RMSEA, SRMR, CFI, and TLI. On the other hand, most researchers agree that multiple fit indices should be used to ensure the reliability of model fit (Bandalous & Finney, 2010; Hair, Black, Babin, Anderson & Tatham, 2006). Given how often these fit indices are used, it is important to comprehend how well they perform when there are intentional omissions.

RMSEA (Steiger, 1990) and SRMR (Jöreskog & Sörbom, 2022) are absolute fit indices, and a better fit is indicated by lower values. When their values are below 0.05, it is considered a good fit (Hu & Bentler,1999; Kaplan, 2009; Kline, 2023).

The algebraic expression for RMSEA is

$$\text{RMSEA} = \sqrt{max\left\{\left(\frac{F(\boldsymbol{S},\boldsymbol{\Sigma}(\hat{\theta}))}{df} - \frac{1}{n-1}\right), 0\right\}} \qquad (1)$$

where F is the minimum value of a discrepancy function, **S** is the observed matrix and **∑** is the model implied matrix.

SRMR is calculated by

$$\text{SRMR} = \sqrt{\frac{\sum_{i=1}^{p}\sum_{j=1}^{i}\left[{}^{(s_{ij}-\hat{\sigma}_{ij})}/_{(s_{ii}s_{jj})}\right]^2}{{}^{p(p+1)}/_{2}}} \qquad (2)$$

with s_{ij} an element of **S**, $\hat{\sigma}_{ij}$ an element of $\boldsymbol{\Sigma}$ and p the number of observed variables.

CFI (Bentler, 1990) and TLI (Tucker & Lewis, 1973) are incremental fit indices, with higher values indicating a better fit. When obtained values are equal or exceed 0.95, a good fit is considered to have existed (Hu & Bentler,1999).

CFI and TLI have the following expressions

$$\text{CFI} = 1 - \frac{max[(\chi_t^2 - df_t), 0]}{max[(\chi_0^2 - df_0), 0]} \qquad (3)$$

and

$$\mathrm{TLI} = \frac{\left(\chi_0^2/df_0\right) - \left(\chi_t^2/df_t\right)}{\left(\chi_0^2/df_0\right) - 1} \quad (4)$$

χ_0^2 , χ_t^2 and df_0, df_t represent, for the baseline model and for the model under analysis, the chi-square statistic and the degrees of freedom.

Simulation Conditions

This work examines the impact of nonresponses on the SEM fit indices RMSEA, SRMR, CFI, and TLI due to different planned missing designs, three-form designs, and two-method designs. Three different sample sizes (small, medium, and large) of 200, 500, and 1000 observations are considered. Three different model sizes with 9 (small model), 18 (medium model), and 36 (large model) indicators. In Figure 2, a measurement model containing 9 indicators, is displayed.

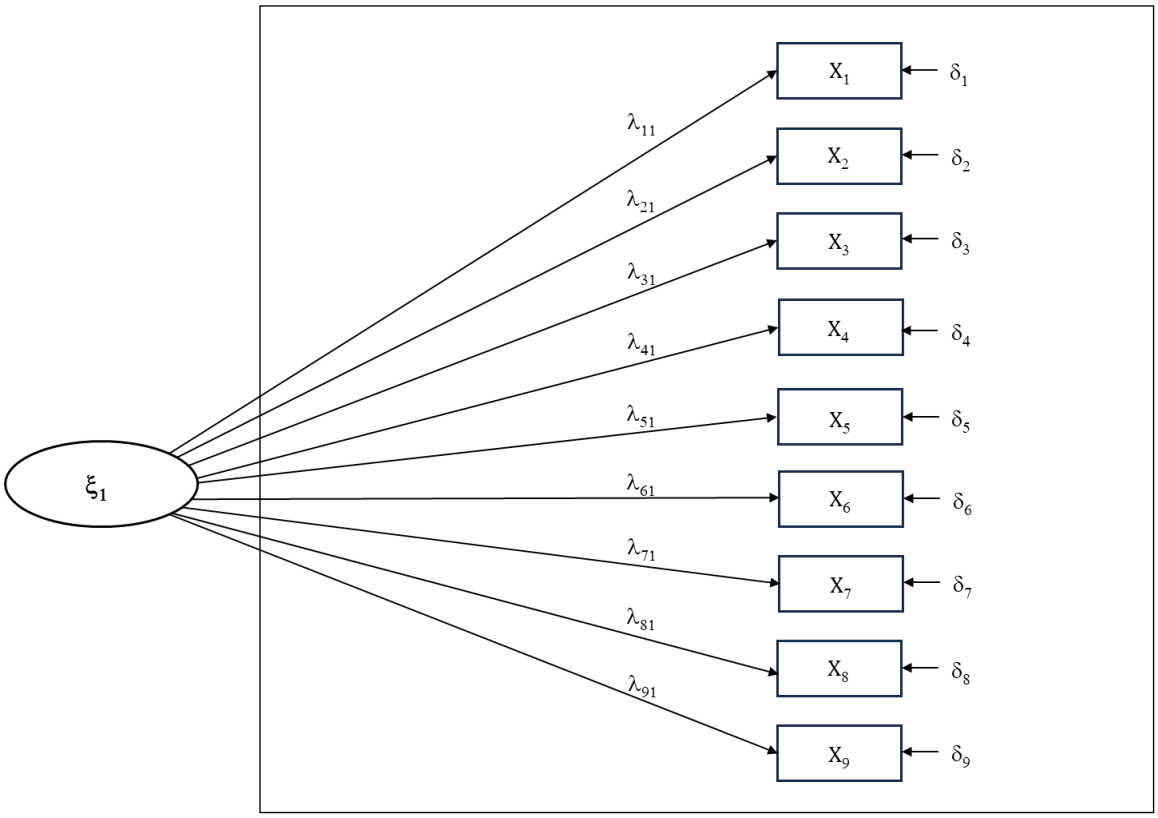
A measurement model is defined by

$$\boldsymbol{X} = \boldsymbol{\Lambda_X \xi} + \boldsymbol{\delta} \quad (5)$$

where $\boldsymbol{X}$, $\boldsymbol{\xi}$ and $\boldsymbol{\delta}$ are, respectively, the vectors of the indicators (observed variables), latent variables and residual terms, $\boldsymbol{\Lambda_X}$ is the matrix of factor loadings, and it is assumed that residual terms are normally distributed with mean zero and variance-covariance diagonal matrix $\boldsymbol{\Theta_\delta}$. Consequently, the generated data have a normal distribution. The parameters of the model are the factor loadings (λ_{ij}; $i = 1, \ldots, 9$; $j = 1$) and the factor covariance (ϕ_{11}), that is assumed to be 1. Two different values for factor loadings, 0.4 and 0.8 (low and high values), are considered. The variances of the residual terms are obtained by $1 - \lambda^2$.

Figure 2

Measurement model with 1 latent variable (ξ_1) and 9 indicators (X_1 to X_9). The λ_{ij} are the factor loadings and δ_i are the residual terms



Source: Author's work

Estimating a SEM involves determining the parameter values that result in a variance–covariance matrix, **∑**, that best approximates the empirical variance–covariance matrix, **S**, obtained from the data (Bollen,

1989). This process is guided by a discrepancy function (F), a mathematical procedure used to minimize the difference between the observed matrix (**S**) and the model implied matrix **∑**. The most used discrepancy function in SEM is based on the Maximum Likelihood (ML), which finds the parameter estimates that maximize the likelihood of observing the sample data, assuming the model is correct. For handling with omissions, the FIML method is applied. The key difference between FIML and traditional ML is that FIML computes the likelihood for each case based only on the variables that are observed for that case. This approach ensures that no information is lost, as it uses all available data points, even when some variables are missing, to estimate the model parameters. FIML relies on the MAR assumption (Enders, 2010).

Datasets with complete observations and missing observations were generated according to two different planned missing designs. The percentage of missing data remained the same in all generated datasets, regardless of the number of indicators in the model, and that used by Schoemann, Miller, Pornprasertmanit & Wu (2014).

A total of one thousand samples were generated at random, considering all possible combinations of the manipulated variables, which included both complete and incomplete datasets. The number of replications utilized corresponds with the guidelines established by McNeisch, An & Hancock (2018) and Schoemann, Miller, Pornprasertmanit & Wu (2014). The simulation study used the simsem package in R to manipulate parameter values, introduce missing data, and facilitate a summary of simulation results (Pornprasertmanit, Miller, Schoemann, & Jorgensen, 2021).

Results and Discussion

The results of the proposed simulation study are presented in Table 3. The displayed values correspond to the mean value of the indices of interest derived from the 1000 datasets. Larger sample sizes produce improved outcomes, with lower values for RMSEA and SRMR, and higher values for CFI and TLI. Similarly, the obtained values improve with higher factor loadings, except for the RMSEA index. For this index the values are similar, and all of them are acceptable (under 0.05, the cutoff).

The RMSEA index did not seem to be affected by missing data, which has likewise been noted by Davey, (2005), Hoyle, (2012), and Zhang & Savalei (2023). They investigated the possibility of a bias in RMSEA values and determined that elements such as the missing data mechanism have an important role in deciding whether biases occur.

For the SRMR index, the obtained values are larger with larger models, and worse with a three-form design than with a two-method design, for all sample sizes. For a small sample size and low factor loadings, the values are above the acceptable (0.05), with 9 indicators and data from a three-form design, with 18 indicators and with omissions by design, and with 36 indicators even for complete data. According to Jia, Moore, Kinai, Crowe, Schoemann & Little (2014), when the data have omissions by design, other factors beyond sample size play an important role. Kenny, Kanishan & McCoach, (2015) have shown that sample size and large models' impact in the adjustment of the model.

The CFI and TLI indices show values lower than the acceptable (0.95) in small sample sizes for large models (36 indicators) with low factor loadings, even with complete data. A deviation in CFI values was indicated by Zhang & Savalei (2023) due to using FIML for handling omissions. McNeish & Wolf (2021) and Hancock & Mueller (2011) have indeed pointed out that, in small sample sizes, the impact of the factor loading values measurements in the evaluation of model adjustment should be considered.

Vicente (2023) found similar behaviour for all the fit measures, RMSEA, SRMR, CFI, and TLI, in a simulation study with data from a three-form design with distinct models with and without considering model misspecification. Shi, Lee & Maydeu-Olivares (2019), Moshagen (2012) and Fan, Thompson & Wang (1999) found that in the presence of small sample sizes and large models have worse values for the considered fit indices. Finally, in their work, Cangur & Ercan (2015) showed that the fit index with the worst performance was SRMR.

Table 3

Obtained fit indices for a model with 9, 18 and 36 indicators

	Number of indicators		*9*			*18*			*36*		
	Factor loading	*Sample size*	*a*	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*C*
RMSEA	*0.4*	*200*	0.016	0.017	0.016	0.013	0.016	0.015	0.018	0.025	0.018
		500	0.009	0.010	0.010	0.007	0.007	0.007	0.007	0.004	0.007
		1000	0.006	0.007	0.007	0.005	0.005	0.005	0.004	0.004	0.004
	0.8	*200*	0.016	0.017	0.016	0.014	0.016	0.014	0.018	0.025	0.018
		500	0.009	0.009	0.010	0.007	0.008	0.007	0.007	0.009	0.007
		1000	0.006	0.006	0.007	0.005	0.005	0.005	0.004	0.004	0.004
SRMR	*0.4*	*200*	0.042	**0.052**	0.047	0.05	**0.062**	**0.053**	**0.055**	**0.070**	**0.057**
		500	0.026	0.032	0.030	0.032	0.038	0.034	0.035	0.029	0.036
		1000	0.019	0.023	0.021	0.022	0.027	0.024	0.024	0.029	0.025
	0.8	*200*	0.018	0.023	0.020	0.022	0.028	0.025	0.024	0.033	0.025
		500	0.011	0.014	0.012	0.014	0.017	0.016	0.015	0.019	0.016
		1000	0.008	0.010	0.009	0.010	0.012	0.011	0.010	0.013	0.011
CFI	*0.4*	*200*	0.971	0.963	0.967	0.974	0.960	0.967	**0.946**	**0.902**	**0.944**
		500	0.99	0.987	0.987	0.99	0.988	0.990	0.989	0.994	0.998
		1000	0.995	0.994	0.993	0.996	0.994	0.995	0.996	0.994	0.995
	0.8	*200*	0.997	0.997	0.997	0.997	0.995	0.996	0.993	0.985	0.992
		500	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.998	0.998
		1000	1	0.999	0.999	1	0.999	0.999	0.999	0.999	0.999
TLI	*0.4*	*200*	0.999	0.994	1	0.987	0.969	0.981	**0.945**	**0.896**	**0.942**
		500	1	0.999	1	0.997	0.996	0.998	0.992	0.996	0.991
		1000	1	1	1	0.999	0.998	0.999	0.998	0.996	0.998
	0.8	*200*	0.999	0.999	0.999	0.998	0.996	0.997	0.992	0.985	0.992
		500	1	1	1	1	0.999	1	0.999	0.998	0.999
		1000	1	1	1	1	1	1	1	1	1

Notes: Column a - results for a complete case; Column b – results from a three-form design; Column c – results from a two-method design

Source: Author's work

Conclusion

This study explores the effect of omissions by design in the fit indices RMSEA, SRMR, CFI and TLI, the most popular fit measures used to evaluate the adjustment of a SEM. The use of the missing data analysis procedure FIML technic makes omissions by design possible (Rioux, Lewin, Odejimi & Little, 2020; Enders, 2010) since it includes intentionally missing data designs. The designs under considerations are a three-form design and a two-method design (Graham, Taylor, Olchowski & Cumsville, 2006). The aim of implementing these approaches is to improve data quality, reduce respondent fatigue, and minimize overall cost. Such designs are underutilized by researchers and can be very useful in areas like market research (Enders, 2010).

Our simulation study revealed that the CFI, TLI, and SRMR indices exhibit sensitivity to non-responses, particularly in scenarios involving small sample sizes, low factor loadings, and a high number of indicators. However, they perform worse when the data are from a three-form design than from a two-method design. The RMSEA index yields the best results in the presence of nonresponses caused by a planned missing data design. Overall, this study contributes to our understanding of the importance of considering omissions by design in market research.

This work has, however, some limitations, namely that the data generated are cross-sectional. In future work, it will be interesting to consider longitudinal data and other models, such as the latent growth curve model.

References

Arbuckle, J. L. (1996). Full information estimation in the presence of incomplete data. In Marcoulides, G. A., & Schumacker, R. E. (eds.), *Advanced structural equation modelling*, 243–277. Erlbaum.

Azar, B. (2002). Finding a solution for missing data. *Monitor on Psychology*, *33*,70.

Bandalous, D. L., & Finney, S. J. (2010). Factor analysis: Exploratory and confirmatory. In Hancock, G. R. & Mueller, R. O. (eds.), *The reviewer's guide to quantitative methods in the social sciences*. New York, NY: Routledge. DOI: https://doi.org/10.4324/9780203861554-15

Bentler, P. M. (1990). Comparative Fit Indexes in Structural Equation Models. *Psychological Bulletin*, 107, 238–246. DOI: https://doi.org/10.1037/0033-2909.107.2.238

Bollen, K. (1989). *Structural Equations with Latent Variables*. New York, USA: Wile

Cangur, S., & Ercan, I. (2015). Comparison of model Fit Indices Used in Structural Equation Modeling Under Multivariate Normality, *14* (1), 152–167. DOI: https://doi.org/10.22237/jmasm/1430453580

Davey, A. (2005). Issues in evaluating model fit with missing data. *Struct. Equ. Model. Multidiscip. J., 12*, 578–597. DOI: https://doi.org/10.1207/s15328007sem1204_4

Enders, C. K. (2010). *Applied Missing Data*. New York, USA: The Guilford Press.

Fan, X., Thompson, B., & Wang, L. (1999). Effects of sample size, estimation methods and model specification on structural equation modelling fit indexes. *Struct. Equ. Model. Multidiscip. J.,* 6, 56–83. DOI: https://doi.org/10.1080/10705519909540119

Fürst, G. (2020). Measuring creativity with planned missing data. *The Journal of Creative Behavior*, *54*(1), 150–164. DOI: https://doi.org/10.1002/jocb.352

Garnier-Vilarreal, M., Rhemtulla, M., & Little, T.D. (2014). Two-method planned missing designs for longitudinal research. *International Journal of Behavioral Development*, *38*(5), 411–422. DOI: https://doi.org/10.1177/0165025414542711

Graham, J., Taylor, B., Olchowski, A., & Cumsville, P. (2006). Planned missing data designs in psychological research. *Psychological Methods*, *11*, 323–343. DOI: https://doi.org/10.1037/1082-989x.11.4.323

Graham,J., Hofer,S. & Mackinnon,D. (1996). Maximizing the usefulness of data obtained with planned missing value patterns: An application of maximum likelihood procedures. *Multivariate Behavioral Research*, *31*, 197–218.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed). Columbus, Oh: Pearson.

Hancock, G. R. & Mueller, R. O. (2011). The reliability paradox in assessing structural relations within covariance structure models. *Educ. Psychol. Meas*., *71*, 306–324. DOI: https://doi.org/10.1177/0013164410384856

Hoyle, R. H. (2012). *Handbook of Structural equation Modelling*. New York, USA: Guilford Press.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55. DOI: https://doi.org/10.1080/10705519909540118

Jia, F., Moore, E. W. G., Kinai, R. Crowe, K. S., Schoemann, A. M., & Little, T. D. (2014). Planned missing data designs with small sample sizes: How small is too small? *Int. J. Behav. Dev*., *38*, 435–452. DOI: https://doi.org/10.1177/0165025414531095

Kaplan, D. (2000). *Structural Equation Modeling – Foundations and Extensions*. Sage Publications. DOI: https://doi.org/10.4135/9781452226576

Kenny, D. A., Kanishan, B. & McCoach, D. B. (2015). The performance of RMSEA in models with small degrees of freedom. *Sociological Methods & Research*, *44*, 486–507. DOI: https://doi.org/10.1177/0049124114543236

Kenny, D. A. & McCoach, D. B. (2003). Effect of the number of variables on measures of fit in structural equation modelling. *Structural Equation Modeling*, *10*, 333–351. DOI: https://doi.org/10.1177/0049124114543236

Kline, R. B. (2010). *Principles and Practice of Structural Equation Modeling* (3rd ed.). Guilford Press, New York.

Lang, K. M., Moore, E. W. G., & Grandfield, E. M. (2020). A novel item-allocation procedure for the three-form planned missing design. *MethodsX*, *7*, 100941. DOI: https://doi.org/10.1016/j.mex.2020.100941

Lawes, M., Schultze, M., & Eid, M. J. A. (2020). Making the most of your research budget: Efficiency of a three-method measurement design with planned missing data. *Assessment*, *27*(5), 903–920. DOI: https://doi.org/10.1177/1073191118798050

Little, T. D., Jorgensen, T. D., Lang, K. M., & Moore, W. G. (2013). On the Joys of Missing Data. *Journal of Pediatric Psychology*, *39*(2), 151–162. DOI: https://doi.org/10.1093/jpepsy/jst048

McNeish, D., & Wolf, M. G. (2021). Dynamic Fit Index Cutoffs for Confirmatory Factor Analysis Models. *Pshycological Methods*. DOI: https://doi.org/10.1080/00223891.2017.1281286

Moore, E. W. G., Lang, K. M., & Grandfield, E. M. (2020). Maximizing data quality and shortening survey time: Three-form planned missing data survey design. *Psychology of sport & Exercise*, *51*, 1–12. DOI: https://doi.org/10.1016/j.psychsport.2020.101701

Moshagen, M. (2012). The model size effect in SEM: Inflated goodness of fit statistics are due to the size of the covariance matrix. *Struct. Equ. Model. Multidiscip. J.*, *19*, 86–98. DOI: https://doi.org/10.1080/10705511.2012.634724

Nye, C. D. (2022). Reviewer Resources: Confirmatory Factor Analysis. *Organ. Res. Methods*. Online publishing. DOI: https://doi.org/10.1177/10944281221120541

Pornprasertmanit, S., Miller, P., Schoemann, A., & Jorgensen, T. D. (2021). *simsem: SIMulated Structural Equation Modeling (version 0.5-16) [R package]*. Retrieved from http://simsem.org/

Rhemtulla, M., & Hancock, G. R. (2016). Planned Missing Data Designs in Educational Psychology Research. *Educational Psychologist*, 51(3-4), 305–316.

Rioux, C., Lewin, A., Odejimi, O. A., & Little, T. D. (2020). *International Journal of Epidemiology*, 1702–1711. DOI: https://doi.org/10.1093/ije/dyaa042

Rubin, D. (1976). Inference and missing data. *Biometrika*, *63*(3), 581–592. DOI: https://doi.org/10.1093/biomet/63.3.581

Schoemann, A. M., Miller, P., Pornprasertmanit, S, & Wu, W. (2014). Using Monte Carlo simulations to determine power and sample size for planned missing designs. *International Journal of Behavioural Development*, *38*(5), 471–479. DOI: https://doi.org/10.1177/0165025413515169

Shi, D., Lee, T., & Maydeu-Olivares, A. (2019). Understanding the Model Size Effect on SEM Fit Indices. *Educational and Psychological Measurement*, *79*(2), 310–334. DOI: https://doi.org/10.1177/0013164418783530

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research*, *25*, 173–180. DOI: https://doi.org/10.1207/s15327906mbr2502_4

Tucker, L. R., & Lewis, C. (1973). The reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, *38*, 1–10. DOI: https://doi.org/10.1007/bf02291170

Vicente, P. C. R. (2023). Evaluating the Effect of Planned Missing Designs in Structural Equation Model Fit Measures. Psych, *5*, 983–995. DOI: https://doi.org/10.3390/psych5030064

Wu, W., & Jia, F. (2021). Applying planned missingness designs to longitudinal panel studies in developmental science: An overview. *Child & Adolescent Development*, 2021 (175), 35–63. DOI: https://doi.org/10.1002/cad.20391

Yuan, K.-H. (2005). Fit indices versus test statistics. *Multivariate Behavioural Research*, *40*(1), 115–148. DOI: https://doi.org/10.1207/s15327906mbr4001_5

Zhang, X., & Savalei, V. (2023). New computations for RMSEA and CFI following FIML and TS estimation with missing data. *Psychol. Methods*, *28*, 263–283. DOI: https://doi.org/10.1080/10705511.2019.1642111

Načrtovane opustitve opazovanj v raziskavi: Ali je to dobra izbira pri uporabi modelov strukturnih enačb?

Izvleček

Manjkajoča opazovanja se lahko pojavijo zaradi napora, potrebnega za odgovarjanje na številna vprašanja v dolgih anketah, in stroškov, ki so potrebni za pridobitev nekaterih odgovorov. Izvajanje načrtovane zasnove manjkajočih opazovanj v anketah pomaga zmanjšati količino vprašanj, na katera mora odgovoriti vsak anketiranec, s čimer se zmanjša utrujenost anketirancev in zmanjšajo stroški izvajanja. Načrt s tremi oblikami in načrt z dvema metodama sta dve različni vrsti načrtovanih manjkajočih opazovanj. Pomemben vidik pri načrtovanju raziskave z načrtovanimi opustitvami je vedeti, kako bo to vplivalo na statistične rezultate. V tem članku je izvedena simulacijska študija, da bi analizirali, kako se običajna merila ustreznosti, kvadratni koren povprečne kvadrirane napake ocen (angl. root mean square error of approximation - RMSEA), standardizirani kvadratni koren povprečja kvadriranih ostankov (angl. standardized root mean square residual - SRMR), primerjalna mera prileganja (angl. comparative fit index - CFI) in Tucker-Lewisov indeks (TLI), obnesejo pri prilagoditvi modela strukturnih enačb. Rezultati so pokazali, da indeksi CFI, TLI in SRMR kažejo občutljivost na izpuste pri majhnih vzorcih, nizkih faktorskih obremenitvah in velikih modelih. Na splošno ta študija prispeva k našemu razumevanju pomena upoštevanja opustitev opazovanj pri načrtovanju tržnih raziskav.

Ključne besede: opustitve opazovanj pri načrtovanju, model strukturnih enačb, anketa

NAVODILA ZA AVTORJE

Mednarodna znanstvena revija Naše gospodarstvo / Our Economy objavlja znanstvene članke z vseh področij ekonomije in poslovnih ved. Avtorje vabimo, da v uredništvo revije pošljejo originalne znanstvene članke, ki še niso bili objavljeni oziroma poslani v objavo drugi reviji. Avtorji podeljujejo lastniku revije ekskluzivno pravico za uporabo članka, ki stopi v veljavo na osnovi sprejetja članka v objavo. Objavljeni so samo članki s pozitivno oceno najmanj dveh recenzentov. Avtorji v celoti odgovarjajo za vsebino članka.

Revija avtorjem ne zaračunava stroškov objave.

Članki naj bodo napisani v angleškem jeziku. Na posebni strani naj bodo navedeni ime avtorja/imena avtorjev, korespondenčni avtor, avtorjev polni akademski ali strokovni naziv, e-naslov avtorja/avtorjev ter ustanova, ki ji avtor pripada. Prva stran članka naj vsebuje naslov, izvleček (maksimalno 250 besed), ključne besede in do tri kode JEL klasifikacije. Iz izvlečka naj bodo razvidni namen, metodologija/pristop, ugotovitve, omejitve, implikacije in izvirnost/vrednost.

Dolžina članka naj bo med 30.000 in 32.000 znakov. Številke tabel in slik z naslovi naj bodo navedeni nad tabelami in slikami, opombe in viri pa pod njimi. Celoten članek je treba urediti skladno z APA standardom (http://www.apastyle.org/learn/tutorials/basics-tutorial.aspx).

Nekaj osnovnih napotkov za navajanje literature in virov:

Navajanje v besedilu:

Primer 1a: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995).

Primer 1b: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995, p. 36).

Primer 2a: Engle and Granger (1987) present critical values also for other cointegration tests.

Primer 2b: Engle and Granger (1987, p. 89) present critical values also for other cointegration tests.

Navajanje v seznamu literature in virov:

Primer 1: Knjiga: Gujarati, D. N. (1995). *Basic Econometrics*. New York: McGraw-Hill.

Primer 2: Članek v reviji: Engle, R. F., & Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica, 55*(2), 251-276.

Primer 3: Poglavje v knjigi, prispevek v zborniku: MacKinnon, J. (1991). Critical Values for Cointegration Tests. In R. F. Engle & C.W. J. Granger, (Eds.), *Long-Run Economic Relationships: Readings in Cointegration* (pp. 191-215). Oxford: University Press.

Primer 4: Elektronski vir: Esteves, J., Pastor, J. A., & Casanovas, J. (2002). *Using the Partial Least Square (PLS): Method to Establish Critical Success Factors Interdependence in ERP Implementation Projects*. Retrieved from http://erp. ittoolbox.com/doc.asp?i=2321

Avtorji poleg referenc v seznamu virov navedite tudi DOI številke, če te obstajajo.

Članek v MS Word datoteki pošljite v uredništvo revije preko online submission sistema ali po e-pošti na nase.gospodarstvo@um.si, our.economy@um.si.

INSTRUCTIONS FOR AUTHORS

The international scientific journal Naše gospodarstvo / Our Economy publishes scientific articles in all areas of economics and business disciplines. Authors are invited to submit original scientific articles that haven't been published or submitted for publication to another journal yet. Authors grant the owner of the journal an exclusive right to use the article, effective immediately upon acceptance of the article for publication. Only articles with a positive evaluation by at least two reviewers are published.

The authors are fully responsible for the content of the article.

The journal does not charge publication costs to authors.

Articles should be written in English. A separate page should indicate the name of the author(s), the corresponding author, the author's full academic or professional title, the author(s)' e-mail address and the institution to which the author belongs. The first page of the article should contain the title, abstract (maximum 250 words), keywords and up to three JEL classification codes. The abstract should make clear the purpose, methodology/approach, findings, limitations, implications and originality/value.

The length of the article should be between 30,000 and 32,000 characters. Table and figure numbers with titles should appear above tables and figures and footnotes and references below them. The full article should be edited according to APA standard (http://www.apastyle.org/learn/tutorials/basics-tutorial.aspx).

Some basic guidelines for literature quotation:

In-text quotation:

Example 1a: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995).

Example 1b: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995, p. 36).

Example 2a: Engle and Granger (1987) present critical values also for other cointegration tests.

Example 2b: Engle and Granger (1987, p. 89) present critical values also for other cointegration tests.

Quotation in the list of references:

Example 1: A book: Gujarati, D. N. (1995). *Basic Econometrics*. New York: McGraw-Hill.

Example 2: A paper in a journal: Engle, R. F., & Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica, 55*(2), 251-276.

Example 3: Chapter in a book, paper in a Proceedings: MacKinnon, J. (1991). Critical Values for Cointegration Tests. In R. F. Engle & C.W. J. Granger, (Eds.), *Long-Run Economic Relationships: Readings in Cointegration* (pp. 191-215). Oxford: University Press.

Example 4: Electronic source: Esteves, J., Pastor, J. A., & Casanovas, J. (2002). *Using the Partial Least Square (PLS): Method to Establish Critical Success Factors Interdependence in ERP Implementation Projects*. Retrieved from http://erp. ittoolbox.com/doc.asp?i=2321

Next to the references in the list, authors should also provide DOI numbers if they exist.

Submit your article in an MS Word file to the journal's editorial office via the online submission system or by e-mail to nase.gospodarstvo@um.si, our.economy@um.si.

NG
OE

LETNIK
VOLUME 70