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Effect of foreign direct investment on the economy of developing countries: Case of Latvia

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ABSTRACT

The aim of this paper is to determine and evaluate the effect of FDI stock on the Gross Domestic Product per capita and on labor productivity per person, which would give an understanding of the causality of investment in the development of the country. Although foreign investment plays a positive role in the development of several countries, promoting competition, development of employment, and acquiring new knowledge, experience, and technologies, in other countries FDI does not bring significant changes. Summarizing the literature, the authors conclude that there are no unambiguous econometric results on the causal relationship between FDI and economic development in developing, developed, or transition economies, so the authors' research will provide additional insight into the interaction of transition economies with FDI. Within the framework of the conducted research, an adapted Granger causality testing methodology is applied, to find out whether there exists and in which direction a causal relationship can be observed between the income level of Latvian residents, labor productivity, and foreign direct investment. The results of the analysis, which are based on a special VAR compilation mechanism and a modified Wald test, show that foreign investment in Latvia has no causal relationship either with the level of welfare or with labor productivity. The authors conclude that in Latvia there is a correlation between the attraction of foreign investment to the service sectors and the lack of transfer of national knowledge, which is reflected in the lack of a causal relationship between FDI and the level of national income. The authors conclude that in order to improve the welfare level of Latvian residents, the able-bodied population should improve their productivity, aside from attracting additional foreign investment.

1. Introduction

One of the major implications of neoclassical growth theory is that all countries will eventually converge to the same level of productivity. According to this theory, in the long run, foreign investment promotes economic growth through capital accumulation, which promotes new technology and new approaches in industry, and knowledge transfer through the mechanism of labor training and skill acquisition. The possibility of FDI to stimulate economic development is one of the main reasons why even developed countries adopt foreign direct investment-friendly policies and increase their savings (Irandoust, 2001). However, this neoclassical theory has weaknesses -if the country does not have economic stability, has an undeveloped economy of free trade in goods and services, has little, undeveloped human capital available, or the country's economy depends only on FDI capital to develop, then foreign investment will limit economic development (Almfraji and Almsafir, 2014). Notwithstanding the growth of foreign investment capital accumulation and its role in the labor market, as well as the close relationship of several economic sectors with FDI (for example, in the financial sector), the pace of economic development of Latvia has not increased significantly or exceeded the EU

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average levels in all development periods. A similar and even worse situation can be observed in several developing countries, where foreign investment plays an important or even a key role in economic development.

The research object of the paper is the economy of the Republic of Latvia and its interaction with foreign direct investment. In this research, the economy of the Republic of Latvia is characterized by two indicators (Gross Domestic Product per capita and Labour productivity per person), FDI is characterized by the Foreign Direct Investment Capital Accumulation indicator.

The aim of this paper is to determine and evaluate the effect of FDI stock on the Gross Domestic Product per capita and on labor productivity per person, which would give an understanding of the causality of investment in the development of the country.

In order to achieve the set aim, the following objectives have been defined:

- Based on the best practices of scientific literature, determine the most appropriate economic modeling approaches, with the help of which it is possible to determine the causal relationships of economic development;
- Perform econometric modeling and analysis using an optimal modeling methodology;
- Evaluate the obtained modeling results and compare them with the observations of other researchers;
- Draw conclusions based on the results of the analysis carried out in the empirical part and put forward proposals for both economic policy-making and future research.

In the empirical part of the research, the Central Statistical Bureau Republic of Latvia, the European Central Bank, and the International Monetary Fund quarterly data on the selected factors in Latvia in the period from 2007 to 2020 were used (Cernis, 2021).

Qualitative and quantitative analysis methods were applied in the research, including time series analysis using Toda and Yamamoto's (1995) Vector Autoregression modeling and Granger's (1969) causality testing methodology with the modified Wald parameter test[6]. Econometric evaluations are performed in the R environment ('vars' and several testing packages). Thus, the interaction between FDI, the level of income, and the productivity of employees in Latvia is clarified, determining the direction of the causal relationship, the importance, and the strength of the effect between the researched factors.

2. Literature review

Research on FDI suggests that developed economies may experience different effects from a foreign capital investment compared to developing countries. An example is the study conducted by Feridun and Sissoko (2011), which examines the relationship between economic development and foreign investment in Singapore. The researchers use Granger's (1969) causality testing methodology and the Vector Auto regression (VAR) model using Singapore's GDP per capita and FDI data for the period 1976-2002. Their analysis substantiates a unidirectional Granger's (1969) causality from FDI to economic growth. On the other hand, Irandoust (2001), while studying the effect of FDI on the economies of Scandinavian countries in the period 1970-1997, used the methodology proposed by Toda and Yamamoto (1995) to find out the Granger's (1969) causal relationship between FDI, GDP per capita, as well as Total Factor Productivity (TFP) in Denmark, Finland, Sweden, and Norway. They found that there was no Granger's (1969) causality in either direction between FDI and GDP per capita growth in Denmark and Finland, while a unidirectional Granger's (1969) causality from FDI to GDP per capita was observed in Norway, and a reciprocal causality in Sweden. Irandoust (2001) interpreted the causality results to mean that multinational corporations operating in Sweden and Norway operate in the manufacturing sector, while international companies in Denmark and Finland mostly operate in the service sectors.

From the results of the mentioned studies, it can be concluded that the interaction between FDI and the economic growth of the country depends on several conditions, as well as on the geopolitical situation of the country, the goals of foreign companies, the level of economic growth, education, technology and development and other non-economic conditions. FDI flows are influenced by economic, social, and political factors.

In modern scientific and professional literature, the policy principles of attracting foreign investment and creating a favorable investment climate are actively discussed. However, due to the complexity and ambiguity of FDI's contribution to economic growth, it is necessary to develop recommendations for the analysis and management of foreign investment flows in order to maximize their positive effects on the economy and prevent negative effects.

In his paper, Titarenko (2005) evaluated the effects of foreign direct investment on local investment processes in Latvia by analyzing the effect of FDI on the process of capital formation in the Latvian economy. Analyzing the economy in the period from 1995 to 2005, the author concluded that FDI contributed to the decline of domestic investment. This means that the positive effect of FDI on domestic investment processes in Latvia is not ensured. While researching FDI, Saksonova (2014), and Saksonova and Koļeda (2017) concluded that the state investment policy should focus on improving the climate of all types of domestic as well as foreign capital investment, and the main goal is to find new incentives for the FDI inflow in the less developed sectors of the Latvian economy where foreign investors can contribute to new technologies, introduce new products and stimulate the activities of local companies, ensuring the investment effect of inward investment. The inflow of foreign direct investment in any country, including Latvia, requires structural adjustment, especially in the financial (banking and insurance) sector (Prokopieva, 2019), as well as the country's economic openness (Mikhaylova et al., 2019; Savchina et al., 2016). In Latvia, as well as in other countries, these processes are constantly developing and significant progress has been achieved (Konovalova and Caplinska, 2020b; Konovalova and Caplinska, 2020a), so it can be concluded that this aspect is streamlined.

Samborskyia et al. (2020) studied the effect of FDI stock and repatriation on FDI flow and economic growth in developed countries and developing countries, compiling several studies and articles for the period from 1995 to 2020. As a result, it was found that FDI has a great impact on the national economy, and the national economy has an impact on FDI, or a feedback loop occurs, where the two factors under study interact.

Simionescu (2016) analyzed the flow of FDI from the European Union (EU) in the context of the global economic crisis. According to this author's analysis, it was concluded that economic growth depends on a sustained increase in productive capacity, which consists of investment and savings. Low levels of investment and savings mean low economic growth.

Gulbis (2017) looked at the efficiency of the Latvian Special Economic Zone (SEZ) as a tool for attracting foreign direct investment (FDI). When policy planners think about Foreign Direct Investment, they hope to accelerate economic development by attracting much-needed foreign capital for the development of new technologies (Salkovska et al., 2019) and increasing employment and the competitiveness of the local economy (Braslina et al., 2020). However, it is not that simple. Often, FDI is not enough to create wealth from nothing. The flow of capital to the most productive companies only enhances the already existing capabilities in the form of infrastructure, knowledge, and labor. This means that FDI is not a panacea that can help troubled regions recover economically without the host country doing anything. To see truly effective results in the local economy, the host country must be ready to make some major investment of its own. Gulbis (2017) pointed out that there is another problem with FDI. Invested capital seeks to earn a profit and then return to the country that invested it, rather than remaining in the host country. Therefore, there is a rather weak relationship between FDI and economic growth.

Akkermans (2017) showed that there is a very big difference in benefiting from FDI between main or investor countries and host or peripheral countries. Studies by several authors have shown that the main countries, and especially the capital owners, received the most from FDI. The benefit for developing countries was less, which suggests that FDI can by no means be called the panacea.

Desbordes and Wei (2017) have conducted a study where it is concluded that the host country must have a certain level of financial development to fully benefit from FDI, which coincides with the results of Almfraji and Almsafir 's (2014) research results.

Stack et al. (2017) also concluded that Eastern European countries do not achieve the maximum efficiency of FDI use. It is possible that the above reasons have largely contributed to the relatively low efficiency of FDI performance among various Eastern and Western European countries.

Revina and Brekis (2009) analyzed FDI economic models and time series data to find out the effect of FDI on the Latvian economy. Analyzing the situation with the volume of foreign investment, GDP and investment, exports and investment, imports and investment in Latvia, it appeared that although FDI has increased 7 times from 2002 to 2007 (foreign direct investment also increased in company capital), however, such an effect could not be seen in gross value added by type of activity. This shows that FDI in Latvia is not so effective.

After having examined the scientific literature, the authors conclude that foreign direct investment has different effects on developing and developed countries. The effects on developing countries and developed economies are well known and the factors influencing them have been studied in detail in the literature. However, not enough studies have been conducted to be able to make similar judgments about the impact of FDI on the economies of transition countries. The authors' research complements the literature with an econometric analysis of the causal relationship of FDI with income and productivity levels in transition economies. In addition, the literature has documented analyses indicating that even countries with similar incomes have different interactions between income levels and FDI. Although foreign investment plays a positive role in the development of several countries, promoting competition, development of employment, and acquiring new knowledge, experience, and technologies, in other countries FDI does not bring significant changes. Summarizing the literature, the authors conclude that there are no unambiguous econometric results on the causal relationship between FDI and economic development in developing, developed, or transition economies, so the authors' research will provide additional insight into the interaction of transition economies with FDI.

3. Research methodology

Based on the review of previously collected literature on the interaction between FDI and national economic indicators, 4 hypotheses have been formulated for the empirical analysis of the authors' research to determine Granger's (1969) causality:

H_1: FDI is Granger's (1969) causal to the level of GDP per capita,

H_2: The level of GDP per capita is Granger's (1969) causal to FDI,

H_3: FDI is Granger's (1969) causal to the level of labor productivity per person,
H_4: The level of labor productivity per person is Granger's (1969) causal to FDI.

A typical methodology in causality research is Granger's (1969) causality research since this method can be performed relatively simply under certain assumptions in the context of VAR models (Lütkepohl, 2005). Granger's (1969) causality is based on the logical judgment that an effect should follow a cause, not the other way around (Granger, 1969). Formally defined, let us assume that Ω_t denotes the information set containing all necessary past information up to (and including) t period. Let us assume that $\Sigma_z(h|\Omega_t)$ is the optimal (minimum root mean square error) h-step forecast for z_t process at the original time t, based on information Ω_t. The associated mean square error of the forecast is denoted by $\Sigma_z(h|\Omega_t)$. The process X_t will be causal in the Granger (1969) sense to the process Z_t if the following inequality is true for at least one h=1, 2, ...

$$\Sigma_z(h|\Omega_t) < \Sigma_z(h|\Omega_t \backslash \{x_s \leq t\}) \tag{1}$$

Practical Granger's (1969) causality research uses optimal linear forecasts and their mean squared errors. In order to avoid model testing errors and to observe the significance of testing also for non-stationary and cointegrated data, Toda and Yamamoto (1995) developed and proposed a special testing procedure. According to Toda and Yamamoto's (1995) methodology, test statistics used for the purpose of Granger's (1969) causality have the properties of a standard asymptotic distribution. Since non-transformed data of economic indicators tend to be integrated or cointegrated (Johansen, 1988), the authors use Toda and Yamamoto's (1995) and Granger's (1969) causality testing procedure. The Toda and Yamamoto's (1995) procedure includes a modified Wald test (MWald) as a restriction test statistic for the parameters defined by VAR (k) (in a vector autoregressive model with k lags), where k is the length of the lags in the VAR system. The MWald test has an asymptotic chi-square distribution when the VAR (k+d_{max}) model is applied, where d_{max} is the maximum degree of integration in the system. The degree of integration indicates the number of integrations required for the system to achieve stationarity, i.e., constant mean, variance, and covariance. Such a procedure is clearly superior to other procedures when the purpose of the research is to determine Granger's (1969) causality of the variables because it avoids potential testing errors when the alternative procedure consists of multiple steps.

In a further empirical modeling study, Yamada and Toda (1998) demonstrated that Toda and Yamamoto's (1995) procedure has superior statistical power in small samples compared to alternative procedures (Johansen, 1988; Johansen and Juselius, 1990). For the reasons mentioned, the authors use Toda and Yamamoto's (1995) procedure for testing Granger's (1969) causality with FDI, GDP per capita, and labor productivity per worker as variables in a system of VAR (k) equations.

The beginnings of the vector autoregressive (VAR) model can be traced back to the seminal work of Sims (1980), which Sims (1980) suggested the method and its general applications: Economic time series forecasting, economic model building and evaluation, and policy effects over time on multiple variables. Sims (1980) proved the inadequacy of previously available methods and the elegant solution of the new method, because, for example, before the creation of VAR, econometric models were unable to use the same variable in a structural system in which the variable affects both supply and demand simultaneously, similar to what is observed in the real economic environment. In a VAR model, each of the variables involved is also the dependent variable and is modeled by a function consisting of the lagged values of all the variables (including the respective dependent variable). The standard VAR model has its own assumptions about the properties of the user data, the violation of which may force the researcher to use augmented or modified VAR versions (e.g., SVAR (k) for modeling data in the presence of structural breaks, instability, and non-stationarity, or the VECM(k) method with cointegrated data (Lütkepohl, 2005).

Standard VAR is applicable to the modeling of robust data-generating processes that respect constant mean, variance, and covariance (autocovariance). Modeling stable data-generating processes with VAR (k) will result in residual errors that are independent of each other and follow a normal distribution. Residual analysis of the applied model is a statistically more powerful method than studying and testing the original data, so various methods of testing autocorrelation, normality, stability and heteroscedasticity of residual errors were developed (Engle, 1982). Therefore, in order to apply the VAR model, it is necessary to estimate the number of lags in the system of equations corresponding to the data generation process and the number of such lagged explanatory variables must be included in the equations, each with its own coefficient.

There are several information criteria by which users of VAR models determine the number of lags-FPE (final prediction error), AIC (Akaike's (1998) information criterion), SC (Schwarz's (1978) information criterion), HQ (Hannan and Quinn's (1979) information criterion). Following Toda and Yamamoto's (1995) procedure, the authors create the following VAR(k+d_{max}) model:

$$\begin{bmatrix} Ln(GDPPC)_t \\ Ln(FDI)_t \\ Ln(LPPP)_t \end{bmatrix} = B_0 + T_0 + \sum_{i=1}^{k} B_i \begin{bmatrix} Ln(GDPPC)_{t-i} \\ Ln(FDI)_{t-i} \\ Ln(LPPP)_{t-i} \end{bmatrix} + \sum_{j=1}^{d_{max}} B_j \begin{bmatrix} Ln(GDPPC)_{t-j} \\ Ln(FDI)_{t-j} \\ Ln(LPPP)_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{Ln(GDPPC)} \\ \varepsilon_{Ln(FDI)} \\ \varepsilon_{Ln(LPPP)} \end{bmatrix} \tag{2}$$

where, B_0 is a 3 x 1 intercept vector, T_0 represents a 3 x 1 linear trend vector, B_1 to B_{dmax} are 3 x 3 matrices with lagged variable coefficients and ε is a vector of error residuals or (white noise) in a system of equations with a logarithm GDP per capita (LnGDPPC), FDI stock (LnFDI) and labor productivity per person (LnLPPP).

Following Toda and Yamamoto's (1995) methodology, the first step in Granger's (1969) causality testing is to determine the degree of integration of each variable. This step can be performed with unit root or stationarity testing methods. The unit root test tests the null hypothesis of the presence of a unit root in economic time series against the alternative hypothesis of stationarity or trend stationarity. The most popular test of this type is the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981). However, the ADF test does not follow asymptotics at small sample sizes, which are common in economic time series. An alternative is a stationarity test such as the KPSS test (Kwiatkowski et al., 1992), which tests the null hypothesis of level or trend stationarity, depending on the variants of the test used, and is statistically more powerful than the ADF test. In research, various tests of stationarity and unit root are used complementary, so the authors use both testing methods, preferring the results of the KPSS test when the results of the tests are opposite.

The next step is to construct an appropriate VAR (k) model and test the VAR assumptions. As a primary assumption, the authors should check the autocorrelation of the error residuals of the constructed VAR (k) model. One such test is the Ljung-Box, which tests for general significance in autocorrelations of error residuals. The Ljung-Box test tests the most important assumption of the VAR model, which, if violated, results in the model and the subsequent conclusions losing their validity. After constructing the VAR (k) model and testing autocorrelation, the authors check whether the variance of the error residuals of the constructed VAR (k) model meets the conditions of the autoregressive conditional heteroskedasticity (ARCH) data generation process established by Engle (1982). As the last of the tests, the authors perform data stability or structural breakpoint testing. The basis of the stability test is the method of least squares (OLS) and based on its error residuals, the cumulative sum of the error residuals and the limits of 1 standard deviation from 0 (generally accepted mean values of the error residuals) are graphically displayed.

In Granger's (1969) causality testing from FDI to GDP per capita, as well as from FDI to labor productivity per able-bodied and from labor productivity to GDP, the general null hypothesis is as follows,

$$H: R\beta = r$$

where, R is the (N x (32 x k+3)) N rank matrix, r is the (N x 1) null vector, N is the number of specified coefficient constraints, and β or the specified coefficient values.

For testing the null hypothesis of Granger's (1969) causality (H_0: no Granger's (1969) causality) from FDI to the level of income in Latvia and from FDI to the level of labor productivity in Latvia, the coefficients of the equation can be expressed in the following form:

$$H_0: \beta_1^{12} = \beta_2^{12} = \cdots = \beta_k^{12} \tag{3}$$
$$H_0: \beta_1^{32} = \beta_2^{32} = \cdots = \beta_k^{32} \tag{4}$$

where, β_i^{12} are the successive coefficients from $Ln(GDPPC)_{t-1}$ to $Ln(GDPPC)_{t-k}$ in the first ($Ln(GDPPC)$) equation, while β_i^{32} are the successive coefficients from $Ln(LDPP)_{t-1}$ to $Ln(LDPP)_{t-k}$. in the VAR (k) model represented in the third ($Ln(LPPP)$) equation. This means that it is tested whether the coefficients representing the effect of FDI on the level of income (or the effect on the level of labor productivity) are equal to zero and that FDI does not create a causal relationship. Causality from FDI to GDP (or from FDI to labor productivity) per capita is confirmed by rejecting the null hypothesis of the test.

In a similar way, causation can also be tested in the opposite direction:

$$H_0: \beta_1^{21} = \beta_2^{21} = \cdots = \beta_k^{21} \tag{5}$$
$$H_0: \beta_1^{23} = \beta_2^{23} = \cdots = \beta_k^{23}. \tag{6}$$

In this paper, the authors rely on Toda and Yamamoto's (1995) VAR (k+d_{max}) model creation and Granger's (1969) causality methodology and supplement it with autocorrelation and stability testing tests and impulse response functions (IRF). With such a methodology, one can not only determine Granger's (1969) causality between the variables as a result of Toda and Yamamoto's (1995) procedure mentioned above but also investigate in more detail how well the VAR process corresponds to the actual data generation process followed by the variables under study.

4. Data description used in the research

Data are taken for the Republic of Latvia in the period from 2007 to 2020. The Republic of Latvia has a small open economy, where foreign direct investment plays a major role in economic development. The authors chose GDP per capita (GDPPC) and labor productivity per person (LPPP) as the main indicators of the Latvian economy. GDPPC is comparable to the average level of income in the country and with this indicator, it is possible to compare economies with different population sizes, as well as this indicator is often used in FDI and economic development research and will allow comparing the authors' empirical results with other studies (Blomstrom et al., 1992; Irandoust, 2001). LPPP is used as a proxy for the TFP indicator, or the total productivity of the economy. The authors chose this indicator because the LPPP data have the same frequency as the GDPPC indicator (quarterly data), as opposed to the frequency of TFP data (annual data).

For this research, data were collected from official statistical and database websites. The research is based on quarterly data in the period from Q1 2007 to Q4 2020. As a result of the empirical analysis, the selected time period was reduced to the final period from Q2 2009 to Q4 2019. The data used in this research are seasonally adjusted real GDP, population, GDP per capita, FDI stock, and labor productivity per person, which are quarterly data. The data for seasonally adjusted real GDP were obtained from the International Monetary Fund (IMF) database and are expressed in millions of EUR. The number of inhabitants was obtained from the database of the Central Statistical Bureau of Latvia (CSB). GDP per capita data were obtained by dividing seasonally adjusted real GDP data by population, which the authors did before modeling. Labor productivity per person and foreign direct investment stock data were obtained from the European Central Bank (ECB) database and are presented in EUR and millions of EUR, respectively. In the process of analysis, in order to prevent the occurrence of exponential trends, the obtained data were logarithmized using the natural logarithm approach. In the final dataset, the authors include logarithmic 42-quarter data points for GDP per capita, labor productivity per person, and foreign direct investment stock. The following subsection evaluates the results of the empirical analysis using the final data set.

The methodology discussed above for testing Granger's (1969) causality between FDI stock, GDP per capita, and labor productivity per person involves several steps. First of all, after the graphical analysis of Fig. 1, it can be seen that there are two structural breaks in the GDP per capita data, one in Q2 2009 and the other in Q1 2020. Even after logarithmizing the data (a process that reduces anomalies in data variation and linearizing trends) and repeated graphical analysis, these significant breaks persist, increasing the confidence level of subsequent tests. The authors decided to cut the data before and after the relevant structural breaks, reducing the final data set from the original Q1 2007 to Q4 2020 to the final set from Q3 2009 to Q4 2019, reducing the amount of data from the original 56 observations on the final version's 42 observations.

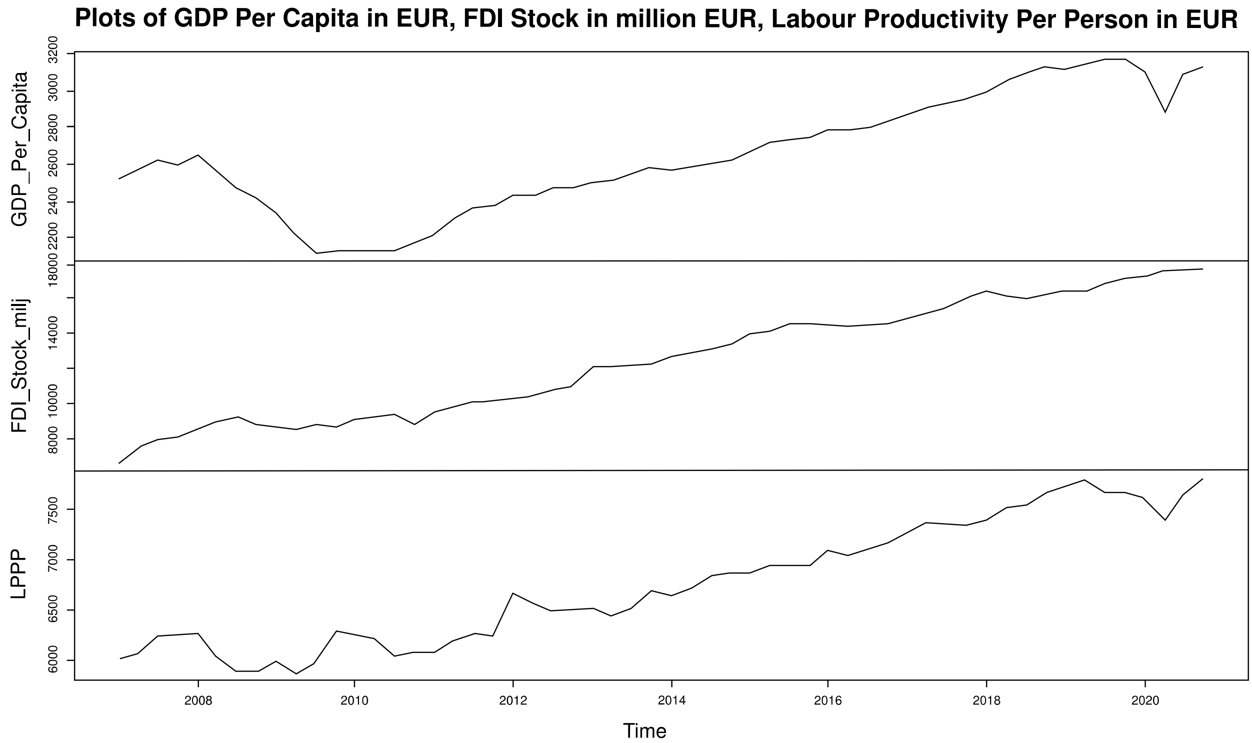

Fig. 1: Selected data time series graphs (Q1 2007–Q4 2020)

In the graphs shown in Fig. 1, it is possible to observe a pronounced trend in the all-time series and it can be seen that a rapid structural change began around 2008, which coincides with the 2008 Global Financial Crisis, the impact of which ended around Q2 and Q3 2009. A similar observation can be seen at the beginning of 2020, the cause of which is the pandemic resulting from the coronavirus. After logarithmizing the data, it can be observed that structural breaks remain in the logarithmic GDP per capita data, which, based on the above, would weaken the strength of the model results and their level of reliability. Therefore, these breakpoints should be replaced by adjusted time series data that could still represent well the trend or interactions with other variables in the data. However, not taking into account that the impact of shocks and changes caused by the crisis on the local economy is not studied within the framework of this paper, but rather the long-term causal relationship between these time series, the authors decided to look for another solution that would allow studying the long-term relationship of the variables and allow applying the methodology described by Toda and Yamamoto (1995). After cropping the period of the time series, the authors obtain the graphs shown in Fig. 1, which have a pronounced linear trend without visually popping out anomaly data points. This linear trend will be taken into account in the construction phase of the VAR (k) model. The authors are now commencing Toda and Yamamoto's (1995) testing procedure.

5. Research results

The first step in Toda and Yamamoto's (1995) methodology is to build a VAR (k+d_{max}) model on the selected data. The authors determine the order of integration of each variable by applying the ADF unit root and KPSS stationarity tests. Since the KPSS test is sensitive to the way the deterministic trend is treated, the authors consider two stationarity hypotheses in each test:

1. The time series has level stationarity; and
2. The time series has trend stationarity.

As can be seen in Table 1, in no case do the variables reject the ADF or confirm the null hypotheses of the KPSS tests. Therefore, the authors perform a first-order differentiation of all variables (*LnGDP, LnFDI, LnLPPP*) and repeat the tests. According to the results, it can be observed that the null hypothesis of stationarity of the KPSS level is confirmed for all variables. However, according to the result of the ADF test, only the differenced *LnGDP* and *LnLPPP* variables reject the unit root hypothesis with greater than 95% confidence level, while *LnFDI* does not reach similar confidence. An explanation of the weak statistical power of the ADF test in small samples, similar to the one used in the authors' work, should be also mentioned here. Taking into account these aspects and test results, the authors conclude that the degree of integration of all studied variables corresponds to 1, i.e., I(1) and dmax,LnGDP = dmax,LnFDI=dmax,LnLPPP=1.

Table 1: Summary of ADF unit root test and KPSS stationarity test results

	ADF		KPSS Level stationarity test		KPSS Trend stationarity test	
	H0 p-value	Ldevel	H0	Level	H0	Trend
LnGDP	0.1504	- 3.0737	0.01*	1.1248*	0.0644	0.13822
LnFDI	0.9627	- 0.69556	0.01*	1.1245*	0.01	0.24981
LnLPPP	0.01*	- 5.167*	0.01*	1.1286*	0.1	0.070918
Diff(LnGDP)	0.1 -	0.092079 -	0.1 -	0.092079 -	After differentiation, the data remain stationary (with constant mean, variance, and covariance values) and no additional trend stationarity tests are required	
Diff(LnFDI)	0.1	0.19505	0.1	0.19505		
Diff(LnLPPP)	0.1 -	0.042099 -	0.1 -	0.042099 -		

*: The coefficient is statistically significant at greater than 99% confidence level; -: The coefficient is statistically significant at a lower than 90% confidence level

The calculation of the optimal number of lags for the VAR model has been carried out, offering an estimate of the lags of all information criteria (*FPE, AIC, HQ*, and *SC*). All criteria suggest k=1 as the optimal estimate for the number of delays in the VAR system compiled by the authors. The authors estimate the coefficients of the VAR (*1*) model. According to the results of the VAR (*1*) model Table 2, all factors (constant, trend, 1-step lagged *LnGDP, LnFDI, and LnLPPP*) are significant in the GDP equation, the R-squared value of the equation is 0.997 and the p-value is significant at all significance levels (p-value<$2.2*10^{16}$). In the VAR (*1*) FDI equation, the R-squared value is similarly high (0.9897) and the p-value is similarly small (<$2.2*10^{-16}$), but only the lagged ATI coefficient is significant. Finally, similar to the FDI equation, the VAR (*1*) labor productivity equation also has a large R-squared value (0.9686), a small p-value (<$2.2*10^{-16}$), and only the *LnLPPP* lag coefficient is significant.

Table 2: VAR (1) model results

	$Ln(GDPPC)_{t-1}$	$Ln(FDI)_{t-1}$	$Ln(LPPP)_{t-1}$	Trend	Constant
$Ln(GDPPC)_t$	0.943***	-0.051	-0.380	0.004***	4.216***
$Ln(FDI)_t$	0.339	0.830***	0.050	-0.001	-1.461
$Ln(LPPP)_t$	0.171	-0.051	0.345*	0.003	4.848

*,***: the coefficient is statistically significant at 90% and 99% confidence levels, respectively

To strengthen confidence in the correctness of this VAR (*1*) model, the authors also conduct verification tests of the VAR (*1*) model. According to the results of Ljung-Box testing, there is no autocorrelation in the error residuals of the compiled VAR (*1*). This can be judged because the p-value of the test (0.3026) is very large and does not reach any level of statistical significance. This means that any observed autocorrelation of the error residuals in this model is only an error in the data selection process and not in the DGP. In addition, the authors evaluate the error of the assembled model in autocorrelation and partial autocorrelation graphs or correlograms. Given the low number of inflated autocorrelations and the previously discussed Ljung-Box test results, the authors conclude that these autocorrelations cannot be identified as significant in the error residuals. Therefore, the authors consider the assumptions of autocorrelation of error residuals of the VAR model fulfilled and do not find significant autocorrelation in the constructed VAR(*1*) model.

However, certain differences in the autocorrelation graphs could be a signal of changing data variance, which would cast doubt on the predictions of the VAR (*k*) model and, in that case, would also not correspond to the true data generation process. Due to these suspicions, the authors apply the heteroskedasticity test. The heteroscedasticity test allows you to check whether there is unequal variance in the lagged values of the error residuals in the selected data. The results of this test indicate that the null hypothesis of homoscedasticity of the data cannot be rejected, as the p-value (0.571) is significantly greater than any significance level. According to the results of this test, the authors conclude that there is no heteroscedasticity observed in the studied time series and the variance of the error residuals is within acceptable norms so that these time series can be used with the compiled VAR (*1*) model. As the next testing method, the authors use the normal distribution test of error residuals. This test is not as hugely important as the previous tests in the context of long-term causality, but the skewness and kurtosis of the distribution of error residuals play a role in modeling future forecasts. The results of the Jarque–Bera test show that the distribution of error residuals of the compiled VAR (*1*) model does not correspond to the normal distribution with very high reliability - the null hypothesis of the skewness of the normal distribution is rejected with a p-value of 0.01495, while the null hypothesis of the kurtosis of the normal distribution is rejected with a p-value of 0.0001744. This result may explain the anomalies in the lagged autocorrelations of the error residuals seen in the autocorrelation plots. Finally, to ascertain any structural changes in the data generation process, the authors perform a structural breakpoint test. Structural breakpoint graphs show readings of 1 standard deviation (red lines), the violation of which would indicate a structural breakpoint. The authors selected the data before performing the VAR (*k*) modeling and the result of the structural breakpoint test (Fig. 2) confirms that there are no structural breaks in the data.

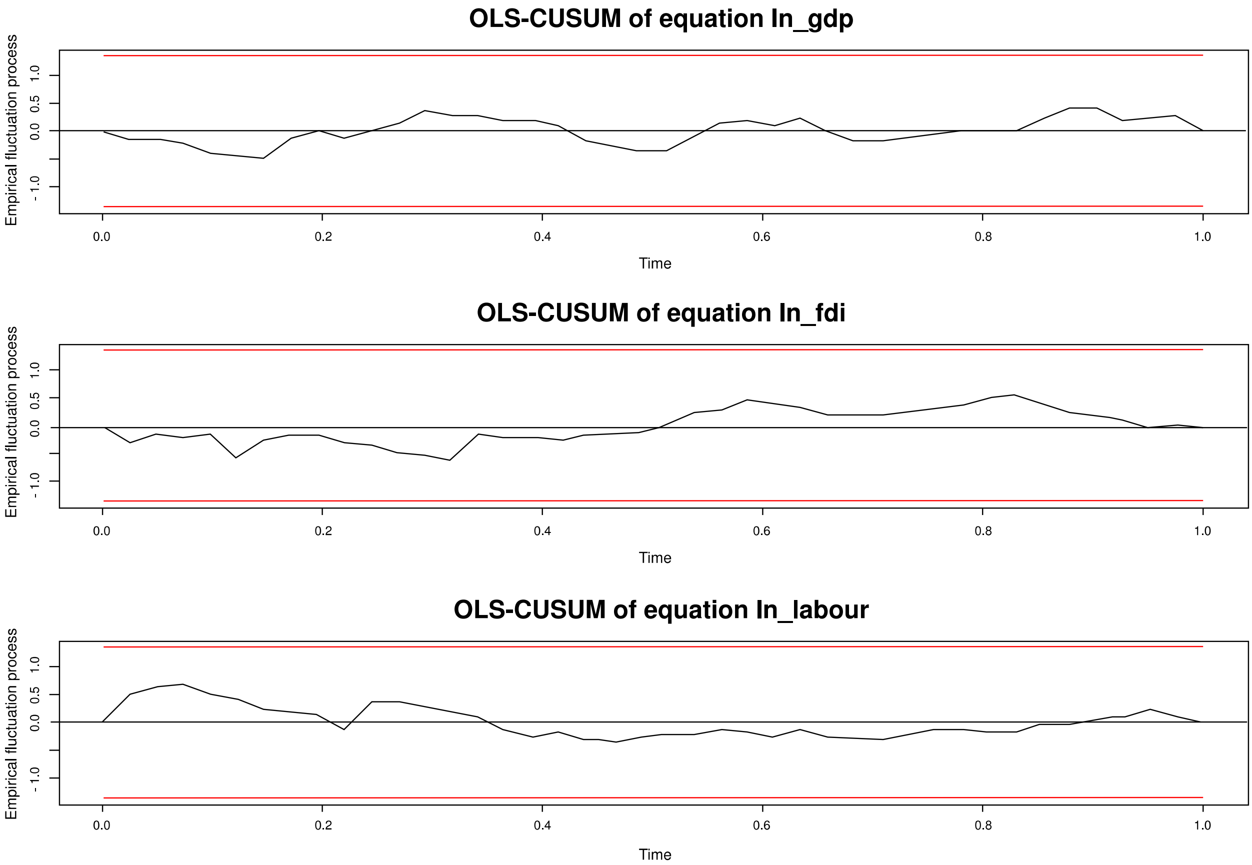

Fig. 2: Structural fracture graphs (Q2 2009–Q4b 2019, Latvia)

According to the results of the Johansen test, it can be concluded that there is no significant cointegration between the data. However, it should be noted that the Johansen test is based on VECM (*k*) (VAR with model error correction) with normally distributed errors. As the normal distribution test shows, there are no signs of normal distribution in the selected data. Previous tests and the relatively small number of observations in the authors' research may cast doubt on the correctness of this test. Data from Granger's (1969) causality test for the VAR (*k+1*) (or VAR (*2*) model in the authors' case) are calculated and used for a modified Wald test. The Wald test results are summarized in Table 3.

Table 3: Summary of Granger's (1969) causality (MWald) test results

Effect	Cause	Wald-stat	p-value	Test results
LnGDP	LnFDI	1.3	0.53	FDI is not Granger's (1969) causal to GDP
LnGDP	LnLPPP	19.6	5.6×10^{-5}***	LPPP is Granger's (1969) causal to GDP
LnFDI	LnGDP	1.5	0.48	GDP is not Granger's (1969) causal to FDI
LnFDI	LnLPPP	0.45	0.8	LPPP is not Granger's (1969) causal to FDI
LnLPPP	LnGDP	3.8	0.15	GDP is not Granger's (1969) causal to LPPP
LnLPPP	LnFDI	2.0	0.36	FDI is not Granger's (1969) causal to LPPP

***: the coefficient statistically significant at 99% confidence levels

According to the combined results of the Wald test, it follows that FDI stock does not affect the development of GDP per capita, and there is only one one-way causal relationship from labor productivity per capita to GDP per capita in Granger's (1969) sense. The authors decided to construct impulse response functions to determine the response of GDP from the impulse to the FDI shock and the labor productivity shock. Based on the results of the previous VAR model, the authors concluded that the only variable whose response to shocks is worth analyzing is GDP. Thus, the authors created two impulse response functions, one testing the GDP response to the FDI impulse shock and the second testing the GDP response to the labor productivity impulse shock Fig. 3.

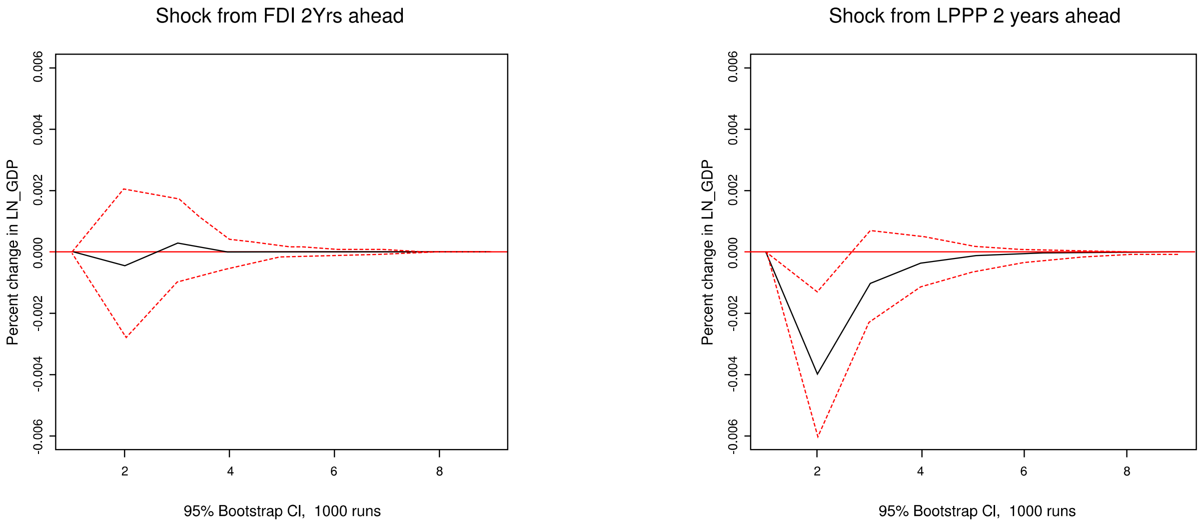

Fig. 3: Impulse response functions Diff (LnFDI) and Diff (LnLPPP) shock to Diff (LnGDP)

In the graph of the impulse response function Fig. 3, it can be seen that the FDI shock is weak and temporary-the effect is present until about Q4 or one year after the effects of the impulse shock are completely eliminated. The changes in GDP are minimal and the predicted mean value of the impulse function stays around the zero point of stationarity. From the result of this function, it can be concluded that rapid changes and shocks of FDI stock do not have a significant effect on GDP per capita, and the resulting effects are not permanent, but rather transitory. This confirms the previous result of Granger's (1969) causality test, according to which FDI inflows do not have a direct causal relationship with GDP per capita. The second graph of the impulse response function plots the impact of the labor productivity impulse shock on GDP per capita. As shown by Granger's (1969) causality test, labor productivity has a significant effect on the GDP response. Labor productivity shocks have a small negative impact and also take longer than FDI shocks (about one and a half years, or 6 quarters) for the effects of the shock to dissipate.

These tests of the Impulse Response Function (IRF) confirm what was calculated in the Wald test of Granger's (1969) causality of the studied objects, only labor productivity per person has a unidirectional causality affecting GDP per capita, and the accumulation of foreign direct investment has no causal relationship with either labor productivity per person or gross domestic product per capita.

6. Conclusions

Summarizing the literature, the authors conclude that there are no unambiguous econometric results on the causal relationship between FDI and economic development in developing, developed, or transition economies, so the authors' research will provide additional insight into the interaction of transition economies with FDI.

The empirical results of this research, based on the adapted Granger's (1969) causality methodology and VAR modeling approach, show that foreign direct investment stock does not have a significant causal effect on the gross domestic product or labor productivity in Latvia. Based on the results of the compiled model, it can be concluded that foreign investment does not have a statistically significant effect on the level of welfare of the population of the Republic of Latvia. Comparing the results of the authors' analysis with the results of Irandoust

(2001), it can be concluded that also in Latvia there is a regularity between the attraction of foreign investment to the service sectors and the lack of national knowledge transfer, which is reflected as a lack of causality between FDI and the level of national income. The authors' model, based on Toda and Yamamoto's (1995) modified Wald testing, was created with the hypothesis that changes in foreign investment stock have an impact on the level of welfare of the country's population and labor productivity per person.

The results of the authors' research indicate that Granger's (1969) causal relationship is observed between labor productivity per person and GDP per capita. So, the authors conclude that labor productivity is an important cause of Latvia's level of welfare. The results show that there is no causal relationship between GDP and labor productivity. Thus, the one-way causal relationship arises between labor productivity and the level of welfare. The authors conclude that in order to improve the welfare level of Latvian residents, the able-bodied population should improve their productivity, aside from attracting additional foreign investment.

The results of the impulse response function indicate that the FDI value shock does not have long-term or permanent consequences for the Latvian economy. The authors' research shows that any changes caused by FDI are transitory after only 4 quarters or one year. Therefore, the authors conclude that FDI is not of great importance in the development of the Latvian economy.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Akaike H (1998). Autoregressive model fitting for control. In: Parzen E, Tanabe K, and Kitagawa G (Eds.), Selected papers of Hirotugu Akaike: 153-170. Springer, New York, USA. https://doi.org/10.1007/978-1-4612-1694-0_12

Akkermans DH (2017). Net profit flow per country from 1980 to 2009: The long-term effects of foreign direct investment. PLOS ONE, 12(6): e0179244. https://doi.org/10.1371/journal.pone.0179244 **PMid:28654644 PMCid:PMC5487018**

Almfraji MA and Almsafir MK (2014). Foreign direct investment and economic growth literature review from 1994 to 2012. Procedia-Social and Behavioral Sciences, 129: 206-213. https://doi.org/10.1016/j.sbspro.2014.03.668

Blomstrom M, Lipsey RE, and Zejan M (1992). What explains developing country growth? (No. w4132). National Bureau of Economic Research, Massachusetts, USA. https://doi.org/10.3386/w4132

Braslina L, Batraga A, Legzdina A, Salkovska J, Kalkis H, Skiltere D, and Bormane S (2020). Barriers to the development of regional competitiveness in the context of regional economies-Eu, Latvia, Region Vidzeme case study. In the International Conference on Applied Human Factors and Ergonomics, Springer, California, USA: 3-10. https://doi.org/10.1007/978-3-030-50791-6_1

Cernis R (2021). Effect of foreign direct investment on Latvian economy. M.Sc. Thesis, Latvijas Universitate, Rīga, Latvia.

Desbordes R and Wei SJ (2017). The effects of financial development on foreign direct investment. Journal of Development Economics, 127: 153-168. https://doi.org/10.3386/w23309

Dickey DA and Fuller WA (1981). Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica: Journal of the Econometric Society, 49(4): 1057-1072. https://doi.org/10.2307/1912517

Engle RF (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. Econometrica: Journal of the Econometric Society, 50(4): 987-1007. https://doi.org/10.2307/1912773

Feridun M and Sissoko Y (2011). Impact of FDI on economic development: A causality analysis for Singapore; 1976-2002. International Journal of Economic Sciences and Applied Research, 4(1): 7-17.

Granger CW (1969). Investigating causal relations by econometric models and cross-spectral methods. Econometrica: Journal of the Econometric Society, 37(3): 424-438. https://doi.org/10.2307/1912791

Gulbis I (2017). Foreign direct investment and special economic zones in Latvia. In the Scientific Conference on Economics and Entrepreneurship, Riga Technical University, Rīga, Latvia.

Hannan EJ and Quinn BG (1979). The determination of the order of an auto regression. Journal of the Royal Statistical Society: Series B (Methodological), 41(2): 190-195. https://doi.org/10.1111/j.2517-6161.1979.tb01072.x

Irandoust JEM (2001). On the causality between foreign direct investment and output: A comparative study. The International Trade Journal, 15(1): 1-26. https://doi.org/10.1080/088539001300005431

Johansen S (1988). Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12(2-3): 231-254. https://doi.org/10.1016/0165-1889(88)90041-3

Johansen S and Juselius K (1990). Maximum likelihood estimation and inference on cointegration-With appucations to the demand for money. Oxford Bulletin of Economics and Statistics, 52(2): 169-210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Konovalova N and Caplinska A (2020a). Approaches to evaluation of banks' financial sustainability. In the International Conference on Reliability and Statistics in Transportation and Communication, Springer, Riga, Latvia: 758-768. https://doi.org/10.1007/978-3-030-68476-1_70

Konovalova N and Caplinska A (2020b). Impact analysis of factors influencing bank capital management. Entrepreneurship and Sustainability Issues, 8(1): 484-495. https://doi.org/10.9770/jesi.2020.8.1(34) **PMCid:PMC2983660**

Kwiatkowski D, Phillips PC, Schmidt P, and Shin Y (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? Journal of Econometrics, 54(1-3): 159-178. https://doi.org/10.1016/0304-4076(92)90104-Y

Lütkepohl H (2005). New introduction to multiple time series analysis. Springer Science and Business Media, Heidlberg, Germany. https://doi.org/10.1007/978-3-540-27752-1

Mikhaylova AA, Mikhaylov AS, and Savchina OV (2019). Macroeconomic dataset for comparative studies on coastal and inland regions in innovation space of Russia. Data in Brief, 27: 104640. https://doi.org/10.1016/j.dib.2019.104640 **PMid:31687443 PMCid:PMC6820115**

Prokopieva E (2019). Factors for the effective functioning of the regional insurance markets in Russia. Voprosy Economiki: 2019(10): 146-155. https://doi.org/10.32609/0042-8736-2019-10-146-155

Revina I and Brekis E (2009). Foreign direct investment and economic growth in Latvia. In the Economic Science for Rural Development Conference Proceedings, Latvia University of Life Sciences and Technologies, Jelgava, Latvia, 2009(18): 142-149.

Saksonova S (2014). Foreign direct investment attraction in the Baltic States. Verslas: Teorija ir Praktika, 15(2): 114-120. https://doi.org/10.3846/btp.2014.11

Saksonova S and Koļeda O (2017). Evaluating the interrelationship between actions of Latvian commercial banks and Latvian economic growth. Procedia Engineering, 178: 123-130. https://doi.org/10.1016/j.proeng.2017.01.075

Salkovska J, Batraga A, Braslina L, Skiltere D, Braslins G, Kalkis H, and Legzdina A (2019). Four conceptual perspectives of innovation components. In the International Conference on Applied Human Factors and Ergonomics, Springer, California, USA: 72-82. https://doi.org/10.1007/978-3-030-20154-8_7

Samborskyi O, Isai O, Hnatenko I, Parkhomenko O, Rubezhanska V, and Yershova O (2020). Modeling of foreign direct investment impact on economic growth in a free market. Accounting, 6(5): 705-712. https://doi.org/10.5267/j.ac.2020.6.014

Savchina OV, Savchina OV, Bobkov AL, and Sharashidze AZ (2016). On the state of the mortgage market in the Russian federation in the conditions of global economic crisis. Journal of Applied Economic Sciences, 11(6): 1096-1103.

Schwarz G (1978). Estimating the dimension of a model. The Annals of Statistics, 6(2): 461–464. https://doi.org/10.1214/aos/1176344136

Simionescu M (2016). The relation between economic growth and foreign direct investment during the economic crisis in the European Union. Zbornik Radova Ekonomskog Fakulteta u Rijeci: Časopis za Ekonomsku Teoriju i Praksu, 34(1): 187-213. https://doi.org/10.18045/zbefri.2016.1.187

Sims CA (1980). Macroeconomics and reality. Econometrica: Journal of the Econometric Society, 48(1): 1-48. https://doi.org/10.2307/1912017

Stack MM, Ravishankar G, and Pentecost E (2017). Foreign direct investment in the eastern European countries: Determinants and performance. Structural Change and Economic Dynamics, 41: 86-97. https://doi.org/10.1016/j.strueco.2017.04.005

Titarenko D (2005). The influence of foreign direct investment on domestic investment processes in Latvia. Transport and Telecommunication, 7(1): 76-83.

Toda HY and Yamamoto T (1995). Statistical inference in vector auto regressions with possibly integrated processes. Journal of Econometrics, 66(1-2): 225-250. https://doi.org/10.1016/0304-4076(94)01616-8

Yamada H and Toda HY (1998). Inference in possibly integrated vector autoregressive models: Some finite sample evidence. Journal of Econometrics, 86(1): 55-95. https://doi.org/10.1016/S0304-4076(97)00109-7