Strategic Implications of Foreign Direct Investment, Exports, and Financial Development for Sustainable Economic Growth in Serbia: Evidence from ARDL and VECM Models

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Abstract
Background: Small open economies must continuously align external opportunities (foreign capital and export markets) with internal resource capabilities (financial sector maturity) to secure long-term growth. Understanding the interaction among these factors is essential for designing effective development and investment strategies.
Purpose: The paper sets out to uncover the real drivers of economic growth in Serbia and, above all, to offer policymakers and business leaders clear, evidence-based recommendations on the most promising growth strategy and on how to make the country systematically more attractive to investors.
Study design/methodology/approach: The study employs annual time-series data for Serbia. The analysis applies the Autoregressive Distributed Lag (ARDL) bounds testing approach to examine long-run and short-run dynamics, complemented by a Vector Error Correction Model (VECM) to assess Granger causality among the variables.
Findings/conclusions: The findings reveal stable long-run relationships, with exports driving economic growth in the long run and foreign direct investment exerting positive effects only in the short run. Causality analysis identifies short-run causality from foreign direct investment to economic growth and financial development, as well as long-run causal interdependence among economic growth, foreign direct investment, and financial development.

Introduction

In recent years, geopolitical risk has become a significant consideration when making international investment decisions (Adarkwah et al., 2024). Developing countries need the capital for obtaining economic growth (Khan et al., 2025). Due to a lack of domestic savings, those countries rely on international external sources of finance. Foreign direct investment (FDI) is the most desirable source of finance due to its positive influence on economic growth and other macroeconomic indicators such as unemployment and export (Makki & Somwaru, 2004; Mehic et al., 2013). According to both neoclassical and endogenous growth theory, FDI contributes to economic growth. Neo-classical, i.e. exogenous growth is driven by capital accumulation, while endogenous growth is promoted by human capital, technological changes and spillover effects (Mahembe & Odhiambo, 2014). All those determinants - capital, human capital, and advanced technologies - are obtained by FDI. Milovanović and Marković (2022) estimated influence of economic freedoms on foreign direct investment in Bosnia and Herzegovina, while Milovanović et al. (2024) analyzed economic freedom and the influence on financial performance of China's development. Rădulescu et al. (2025) research foreign direct investments in Europe for sustainable economic development. Furthermore, FDI positively influences host countries' export (Mohanty & Sethi, 2019). Due to those reasons, countries have tried to attract FDI in different ways. Financial development (FD) is one of the determinants because it attracts FDI and contributes to economic growth (Rault et al., 2014; Azmeh & Al-Raeei, 2025). Meniago et al. (2025) found a link between financial development and economic growth, as well as evidence about the role of institutions in the Communauté Financière Africaine countries. Rustamovich and Jobirhanovna (2025) considered the importance of foreign direct investments in economic development of the Republic of Uzbekistan. With an emphasis on Uzbekistan, Raximov (2025) investigated how methodological advancements can boost export potential as a catalyst for sustainable economic growth from 2010 to 2024.

Maniraguha and Ndemezo (2025) examined whether financial development can boost the contribution of exports to economic growth in Sub-Saharan Africa.

Based on those facts, various countries, especially transition and developing countries, try establishing economic policy for attracting FDI and boosting export (EX) and economic growth. Fu et al. (2025) explained why China's export boom did not boost its financial development.

The purpose of the paper is to see the role of FDI, EX and FD in economic growth of a developing country – Serbia, but also explore relationships and causality among them. Serbia is a transition and developing country that has been undertaking economic reforms to attain economic growth and development and to fulfil the EU membership requirements. Boosting investment and exports are seen as possibility for attaining economic growth. Furthermore, FD is needed to achieve economic growth (Abbas et al., 2022). The aim of the paper is to explore relationship and causality between FDI, EX, FD and economic growth in Serbia from 1997 to 2020 by using the Autoregressive distributed lag model (ARDL), and the Vector Error Correction Model (VECM). A similar methodology was used by Dritsaki and Stiakakis (2014) for Croatia. The following are the primary research questions:

- RQ1: Do FDI, EX and FD have a role in achieving economic growth in Serbia?
- RQ2: Are there short-run and long-run relations between observed variables (FDI, EX, FD and GDPpc)?
- RQ3: Is there a causal relationship between economic growth (GDPpc) and observed variables?

Using four models with each variable as the dependent variable, we showed a relationship between observed variables. The results of long-run ARDL are as follows. The model where GDPpc is the dependent variable estimates that EX leads to GDPpc increase; the model where FDI is the dependent variable estimates that GDPpc increases FDI, while EX and FD decrease FDI; the model where FD is the dependent variable estimates that GDPpc increases FD, while EX decreases FD. Results validate short-run (ARDL)

links from FDI and EX to GDPpc; from GDPpc, EX and FD to FDI and from GDPpc, FDI, EX to FD. Based on ARDL, a two-way causal relationship exists between FDI and GDPpc, and FDI and FD in short-run. The model where EX was set as a dependent variable did not satisfy statistical properties. Therefore, the EX variable was excluded from the VECM analysis. So, Granger's causality among other variables was examined: GDPpc, FDI and FD by using VECM model. The long-run VECM model reveals causality from the variables GDPpc, FDI and FD towards the variables GDPpc and FD. In the short run VECM model shows unidirectional causality from FDI to GDPpc and FD.

The contributions of this research are an extension of the literature review on the link between FDI, EX, FD and GDPpc in the developing country – Serbia and an investigation of the role of FDI, EX and FD in achieving economic growth in Serbia.

The paper comprises the following sections. After the Introduction, a Literature review of FDI, EX, FD and economic growth is given (Section 1). Section 2 provides Data and Methodology, while Section 3 is dedicated to Results and Discussion. The conclusion remarks are given at the end of the paper.

1. Theoretical Background

Different studies apply different models to investigate FDI's impact on other countries' economic growth. For example, a group of examining authors presents the causal nexus between FDI, EX, and economic growth for a group of countries: Miankhel et al. (2009), Acaravci and Ozturk (2012), Keho (2015), Irandoust (2016), Mahmoodi and Mahmoodi (2016), Goh et al. (2017). Bilas (2020) analyzed FDI and economic growth in EU13 countries using cointegration and causality tests. Abdullahi et al. (2025) investigated the dynamic relationship between financial development, economic growth, urbanization, trade openness, and ecological footprint in ten ECOWAS countries. The exact relationship was studied for individual countries by the following authors: Shaikh (2010) for Pakistan, Shawa and Shen (2013), and Utouh and Kitole (2024) for Tanzania, Dritsaki and Stiakakis (2014) for Croatia, Tapşın (2016) for Turkey, Sunde (2017) for South Africa, Sarker and Khan (2020) for Bangladesh, and Okere et al. (2022) for Nigeria. Below is an overview of the research for individual countries and groups of countries worldwide.

Dritsaki and Stiakakis (2014) studied sustainable economic growth in Croatia using ARDL and the dynamic VECM model. The authors examined the causal connection between FDI, EX, and economic growth from 1994 to 2012. Their results showed a bidirectional causal relationship between EX and growth in both the short and long run. Additionally, FDI does not lead to growth in Croatia, according to Dritsaki and Stiakakis (2014), either in the short or long run.

Sarker and Khan (2020) examined the causal relation between Bangladesh FDI inflows and GDP from 1972 to 2017. They applied ARDL model and the Granger causality test to the annual data. Using the abovementioned techniques, their findings validated the existence of a long-run association between FDI and GDP, with a one-way causal link from GDP to FDI identified in Bangladesh.

Shaikh (2010) used the VECM causality test to study the causality relationship between FDI, international trade and economic growth in Pakistan from 1998 to 2009. Shaikh's (2010) studies indicated bidirectional causality between FDI, EX, and economic growth. The author discovered that FDI favorably impacted Pakistan's trade growth.

The relationship between FDI, EX, and GDP growth in Tanzania between 1980 and 2012 was studied by Shawa and Shen (2013). They applied cointegration and Granger causality tests for their study. The authors found no causal association between FDI and Tanzania's GDP growth, although they did find a unidirectional causal relationship between FDI and EX.

Agbailu (2025) used ARDL and VECM models to analyze the economic relationship between FDI inflows, real GDP, inflation rate, and unemployment rate in Nigeria in the period 2015-2022.

Sunde (2017) used the ARDL and the VECM Granger causality approach in order to explore the link between economic growth, FDI, and EX in South Africa during period 1990–2014. The author found two unidirectional causality relationships, running from FDI to economic growth and from FDI to EX. The existence of a bidirectional causal relation between economic growth and EX was confirmed.

Tapşın (2016) examined the causal relationship among FDI, EX, and economic growth in Turkey from 1974 to 2011. The author used Toda and Yamamoto's (1995) causality test, and he discovered a strong relationship between GDP and FDI, FDI and EX, GDP and EX, and EX to GDP.

Utouh and Kitole (2024) analyzed the impact of FDI on the industrialization process in Tanzania utilizing the Vector Autoregressive (VAR) model and the Error Correction Model (ECM).

Acaravci and Ozturk (2012) analyzed the causal connection among economic growth, EX, and FDI in the ten East-European countries, namely Slovenia, Slovak Republic, Bulgaria, Romania, Hungary, Czech Republic, Estonia, Lithuania, Latvia, and Poland. The authors applied ARDL bounds testing approach and Granger causality test on quarterly data from 1994 to 2008. In four of the ten nations studied, they discovered a causal association between FDI, EX, and economic growth.

Goh et al. (2017) used the bootstrap ARDL model to investigate a long-run relation between FDI, EX, and GDP in 11 Asian economies over the period 1970-2012. When GDP was regarded as the dependent variable, these authors did not discover any evidence of cointegration. According to the authors, while most Asian economies experienced short-term effects on their GDP from FDI inflows and/or exports, there was no lasting reliance on FDI and exports for GDP growth in the long term. In the Asian economies under study, economic growth has also come from factors other than FDI and EX.

Naeem Azmi and Akhtar (2025) tested causal links between exports, financial development and growth hold for services export in OECD countries in the period 2000-2022 using panel ARDL model.

Irandoust (2016) studied the causal relationship between FDI, GDP growth, and terms of trade volatility in the 3 Baltic countries (Latvia, Lithuania and Estonia) using a VAR model for the period 1993–2014. The author demonstrated bidirectional causality between FDI and growth in Estonia, whereas in Latvia and Lithuania, the causality was unidirectional, specifically running from FDI to GDP. Bidirectional causality was not found in Latvia and Lithuania. Irandoust's (2016) findings confirm causality between terms of trade volatility and FDI in each Baltic country.

Keho (2015) investigated the links among FDI, EX, and economic growth in 12 chosen Sub-Saharan African countries using the multivariate cointegration approach of Johansen and Granger causality tests. The author analyzed the period 1970-2013. Keho's (2015) results of applied techniques are mixed across chosen countries.

Mahmoodi and Mahmoodi (2016) tested the causal nexus between FDI, EX, and economic growth in developing countries in Europe and Asia.

By using panel-VECM causality model, the authors investigated the link between FDI, EX, and GDP across developing countries in Europe from 1992 to 2013, and for developing countries in Asia from 1986 to 2013. Mahmoodi and Mahmoodi (2016) found that in the long run, there was causality from EX and FDI to GDP and from GDP and EX to FDI for observed panels. Their findings in the short run indicated bidirectional causality between GDP and FDI, along with a unidirectional causality from GDP and FDI to EX within the panel of countries in Europe. Additionally, bidirectional causality was observed between EX and GDP in the panel of countries in Asia.

In the period 1970-2005, Miankhel et al. (2009) examined the dynamic link between EX, FDI, and GDP in India, Malaysia, Pakistan, Thailand, Chile and Mexico, using VECM model. These researchers discovered evidence of an export-led growth hypothesis in South Asia. They showed that, in the long run, GDP growth acts as the main catalyst for the expansion of other factors, such as EX in Pakistan and FDI in India. Additionally, their findings revealed that while Mexico and Chile had a different relationship in the short term, EX had an impact on FDI and growth in the long run. In the case of East Asian countries, in Thailand, Miankhel et al. (2009) found a bidirectional causality between GDP and FDI, but not in Malaysia.

Okere et al. (2022) looked into the relationship between Nigeria's economic growth, FDI influx, and trade openness between 1982 and 2018. They employed cointegration and the augmented ARDL approach. Their research findings indicated that the global economic crisis has a considerable dampening effect on economic growth. Moreover, they found that the adverse interaction among total trade, FDI, and the global crisis significantly undermines the relationships led by trade growth and FDI growth. Additionally, they noted that the long-run negative effects of FDI inflows interacting with the global economic crisis are more noticeable and significant than the short-run effects.

Asongu et al. (2018) employed panel analysis to look into the variables influencing FDI flows to the BRICS and MINT countries between 2002 and 2011. The research showed that market size, infrastructure accessibility, and trade openness stand out as the primary factors influencing FDI attraction to BRICS and MINT, while natural resource availability and institutional quality have relatively minor significance in this regard.

In a panel of 20 countries in Africa, Olayungbo and Quadri (2019) investigated the link among economic growth, remittances and FD. From 2000 to 2015, these researchers utilized panel unit root and cointegration tests with both Pooled Mean Group and Mean Group/ARDL estimations. Their findings show that unidirectional causal linkages exist between GDP and remittances, and between FD and GDP. However, Olayungbo and Quadri (2019) found no link between remittances and FD in these nations.

Qamruzzaman and Jianguo (2018) used quarterly data to investigate the relationship between financial innovation (FI) and economic growth in India, Bangladesh, Pakistan, and Sri Lanka from 1975 to 2016. These authors used ARDL, the NARDL models, and the Granger causality test under an ECM for their analysis. These authors showed long-run cointegration between economic growth and FI in the analyzed countries. They discovered that advancements in FI are associated with long-term economic growth, and vice versa. Furthermore, Qamruzzaman and Jianguo (2018) found mixed behaviors in the short run when it came to positive and negative changes in FI.

In order to analyze the link between finance and growth in North Cyprus from 1978 to 2015, Türsoy and Faisal (2018) employed the ARDL model and the VECM Granger causality test. They demonstrated that financial debt and growth have a long-term relationship. Their findings indicate that debt benefited economic growth in the short run, whereas inflation had a negative effect. Furthermore, Türsoy & Faisal (2018) discovered that total deposits and inflation were unidirectionally related to North Cyprus economic growth.

We provide a short literature review based on research that uses ARDL and VECM models. However, due to our knowledge, no many papers investigate relationship and causality between FDI, EX, ED, and economic growth in the Western Balkan, especially in Serbia. So, in order to fill in the gap, we explore this relationship and causality in Serbia as one of the Western Balkan countries.

2. Data and Methodology

2.1. Data

In this paper, we utilize annual data spanning from 1997 to 2020 for Serbia. We used the following variables in our study: gross domestic product per capita (GDPpc), foreign direct investment (FDI), exports (EX), and financial development (FD). The data is obtained from the World Bank - World Development Indicators. We converted the value of the variable to its natural logarithm form.

The stationarity of selected variables was assessed using two distinct types of unit root tests: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP). A time series dataset is deemed stationary if it tends to regress to its long-term average without being solely influenced by temporal shifts. Conversely, non-stationary time series do not exhibit this tendency, causing their mean, variance, and covariance to fluctuate over time (Shrestha & Bhatta, 2018). The key distinction between the PP and ADF tests is that the latter only considers autocorrelation while the former considers both autocorrelation and heteroscedasticity (Elyas & Masih, 2019).

Table 1 presents the outcomes of ADF and PP tests regarding the integration properties of GDPpc (lnGDPpc), FDI (lnFDI), EX (lnEX), and FD (lnFD) for Serbia. The findings indicate that all variables are non-stationary at their base level and integrated to the first order or I(1). However, the stationary property is discovered after taking the first difference of the variables. To validate the applicability of the ARDL bounds test approach to cointegration, the ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) tests are undertaken to make sure that no series is integrated to the second order, i.e. I(2) (Nepal & Paija, 2019). According to Bhasin and Gupta (2017), the maximum order of integration among the variables in our study is I(1); hence, we may now securely use the ARDL bound testing approach.

Table 1 Unit root tests

Unit root test	Level						Order of Integrat.
	without intercept and trend		with intercept		with intercept and trend		
Variables	ADF	PP	ADF	PP	ADF	PP	
lnGDPpc	3.752	3.632	-0.849	-0.849	-1.269	-1.367	I(1)
lnFDI	-0.650	-0.650	-1.727	-1.705	-2.312	-2.497	I(1)
lnEX	0.885	2.381	-1.464	-1.242	-3.385*	-3.297*	I(1)
lnFD	0.580	0.886	-1.019	-1.799	-4.383**	-2.422	I(1)
	First Difference						
Δ(lnGDPpc)	-2.923***	-2.890***	-4.105***	-4.105***	-4.044**	-4.044**	I(0)
Δ(lnFDI)	-6.258***	-6.331***	-6.314***	-6.314***	-6.275***	-6.776***	I(0)

Δ(lnEX)	-4.849***	-5.796***	-5.860***	-7.668***	-5.706***	-6.910***	I(0)
Δ(lnFD)	-3.854***	-4.070***	-3.826***	-4.573***	-3.725**	-4.347**	I(0)

Note: Δ is the chosen variables' initial difference operator. Statistical significance of t-statistics is indicated by ***, **, and * at 1%, 5%, and 10%, respectively.

Source: the authors

2.2. ARDL modelling

Pesaran et al. (2001) introduced the ARDL model. It is not necessary to integrate all variables in the same order (Zambrano-Monserrate et al., 2018). Compared to other classic cointegration methodologies, the ARDL bounds testing approach is more suited. It appears to be versatile in terms of the variables' stationarity features, for example (Shahbaz et al., 2016). ARDL can be applied to both stationary and non-stationary time series, including those with mixed orders of integration (I(0) and I(1)). It's still important to make sure none of the variables are integrated to order I(2) or higher (Wang et al., 2011). The co-integration relationship in the ARDL model is estimated using OLS estimation, which is performed after selecting the right lag order for the model (Nepal & Paija, 2019). The ARDL bounds testing approach, according to Narayan and Smyth (2005), offers robust and reliable empirical evidence suitable for small sample datasets. As a result, the ARDL bounds testing approach is appropriate for Serbia.

We tested the following models (similar as in Bhasin & Gupta, 2017):

- lnGDPpc=f(lnFDI, lnEX, lnFD)
- lnFDI=f(lnGDPpc, lnEX, lnFD)
- lnEX=f(lnGDPpc, lnFDI, lnFD)
- lnFD=f(lnGDPpc, lnFDI, lnEX)

2.2.1. Long-run model

In our study, we estimate the conditional ARDL (a, b, c, d) long-run model, where a, b, c, and d represent the lag length. Taking each variable individually as the dependent variable, the augmented ARDL (a, b, c, d) model is given by the following equation:

$$\ln Y_t = C + \sum_{i=1}^{a} \alpha_1 \ln Y_{t-i} + \sum_{i=0}^{b} \alpha_2 \ln X(1)_{t-i} + \sum_{i=0}^{c} \alpha_3 \ln X(2)_{t-i} + \sum_{i=0}^{d} \alpha_4 \ln X(3)_{t-i} + \varepsilon_t \quad (1)$$

where Y represents a dependent variable and X(1), X(2), and X(3) indicate independent variables, C stands for the constant term, and εt is the error term (white noise process), t is the time trend.

2.2.2. Short-run model

The next step is to estimate the error correction model and short-run dynamics. This is specified as follows:

$$\Delta \ln Y_t = C + \sum_{i=1}^{a} l_1 \Delta \ln Y_{t-i} + \sum_{i=0}^{b} l_2 \Delta \ln X(1)_{t-i} + \sum_{i=0}^{c} l_3 \Delta \ln X(2)_{t-i} + \sum_{i=0}^{d} l_4 \Delta \ln X(3)_{t-i} + gECM_{t-1} + d_t \quad (2)$$

where λ1, λ2, λ3, and λ4 represent the short-run dynamic coefficients indicating the model's adjustment back to the specified equilibrium, Δ presents the first difference of the selected variables. ECM_{t-1} represents the error-correction term lagged by one period, calculated using the residuals from equation (1). In the presence of a long-run relationship, then ECM_{t-1} indicates the speed at which the variables return to their equilibrium levels from the short-run. ECM_{t-1} reflects the rate of adjustment towards the equilibrium level following a shock, with γ expected to be negative and statistically significant in this scenario. The ECM model is an alternative term for the short-run specification (Zambrano-Monserrate et al., 2018).

2.3. VECM modelling

We tested Granger causality between our variables using VECM Model. As in Bhasin and Gupta (2017), the multivariate nth order VECM is given using the subsequent formula:

$$\Delta Y_t = \Omega + \sum_{i=1}^{n} y_i Y_{t-i} + \tau ECM_{t-1} + \theta_t \quad (3)$$

Where Y_t is the n×1 vector with the variables contained in the model, Ω represents the n×1 vector of constant terms. The interaction coefficients of the variables involved are depicted by ψ_i, which are n×n matrices. τ is the n×1 vector comprising coefficients for each error correction term, and the disturbance terms vector is denoted by θ_t.

3. Estimation Results and Discussion

Before ARDL bound testing, we have to find optimal lag length using different norm (see Table A1 in the Appendix). The findings presented in Table A1 suggest that lag 3 is the most appropriate lag value for the cointegration models.

3.1. Cointegration analysis and diagnostic checking

In our study, for choosing ARDL model, we used Schwarz information criterion (SIC) (Schwarz, 1978). We selected some ARDL models because SIC has the lowest value for that model. With the GDPpc as a dependent variable, a suitable model is ARDL(1,3,3,0). For the FDI as a dependent variable, ARDL(1,3,3,3) is a suitable model. Taking EX as a dependent variable, suitable model is ARDL(3,3,1,3), and taking FD as a dependent variable, a suitable model is ARDL(3,3,2,3) (see Table 2).

Table 2 provides an overview of the cointegration outcomes for each tested model. Narayan's (2005) critical values are employed for the F-test. For every dependent variable observed, the computed F-statistics exceed the upper bound critical value stipulated by Narayan (2005) at a significance level of 1%. Consequently, the null hypothesis of no cointegration is refuted for each model. This outcome affirms the cointegration of the observed variables in the long run within Serbia.

As a result of the total study, the null hypothesis of no cointegration for the variables GDPpc, FDI, and EX and FD is rejected, showing that the variables have a stable long-run cointegration relationship. Because the variables are cointegrated, a short-term correction process is in place to prevent long-term interaction errors from becoming larger (Bhasin & Gupta 2017).

Table 2   Bound tests for cointegration

Model	ARDL	Dependent variable	Independent variables	F-test	Cointegration
1	ARDL(1,3,3,0)	ln(GDPpc)	ln(FDI), ln(EX), ln(FD)	18.124	Yes
2	ARDL(1,3,3,3)	ln(FDI)	ln(GDPpc), ln(EX), ln(FD)	9.251	Yes
3	ARDL(3,3,1,3)	ln(EX)	ln(GDPpc), ln(FDI), ln(FD)	7.071	Yes
4	ARDL(3,3,2,3)	ln(FD)	ln(GDPpc), ln(FDI), ln(EX)	33.765	Yes

Notes: Narayan (2005) states that for 30 observations with three regressors, the upper limit is 5.966 and the lower bound is 4.614, with a confined intercept and no trend at the 1% significance level.

Source: the authors

We evaluate each of the ARDL (a, b, c, d) models for reliability and stability before estimating long- and short-run parameters. We apply some diagnostic check tests (Breusch-Godfrey Serial Correlation LM Test, ARCH test, Jarque–Bera test and Ramsey Reset test). From Table 3, we can see that all models have no serial correlation (according to Breusch-Godfrey Serial Correlation LM Test) and no heteroscedasticity (according to ARCH test, except model 3) in residuals of the model. All models have normally distributed residuals (according to Jarque–Bera test). The Ramsey Reset test tells us that no model suffers from misspecification, except model 3. Thus, as model 3 (in which EX is a dependent variable) did not pass the diagnostic test, i.e. does not have satisfactory statistical properties, it will be excluded from further analysis.

Table 3   Diagnostic checking

Model	ARDL	Serial Correlation	Heteroscedasticity test	Normality JB test	Ramsey test
1	ARDL(1,3,3,0)	0.585 (0.644)	0.266 (0.849)	0.019 (0.991)	3.636 (0.089)
2	ARDL(1,3,3,3)	0.548 (0.676)	0.354 (0.063)	0.992 (0.631)	2.866 (0.141)
3	ARDL(3,3,1,3)	1.541 (0.334)	5.504 (0.010)	0.524 (0.770)	18.614 (0.005)
4	ARDL(3,3,2,3)	5.999 (0.088)	1.265 (0.324)	0.285 (0.867)	0.572 (0.483)

Notes: Model 3 does not have satisfactory statistical properties according to the tests for diagnostic verification of the model, and will be excluded from further analysis.

Source: the authors

In Figures 1-3, we present stability tests (Cumulative Sum test (CUSUM) and Cumulative Sum of Squares test (CUSUMSQ) developed by Browns et al. (1975)) for each analyzed model. According to these two tests, each model is stable over the study period. The analysis of plots reveals that CUSUM and CUSUMSQ statistics (for GDPpc, FDI, and FD as a dependent variable) are between the 5% critical bounds lines, showing that the selected ARDL (a, b, c, d) in the presented model have stable short- and long-run coefficients.
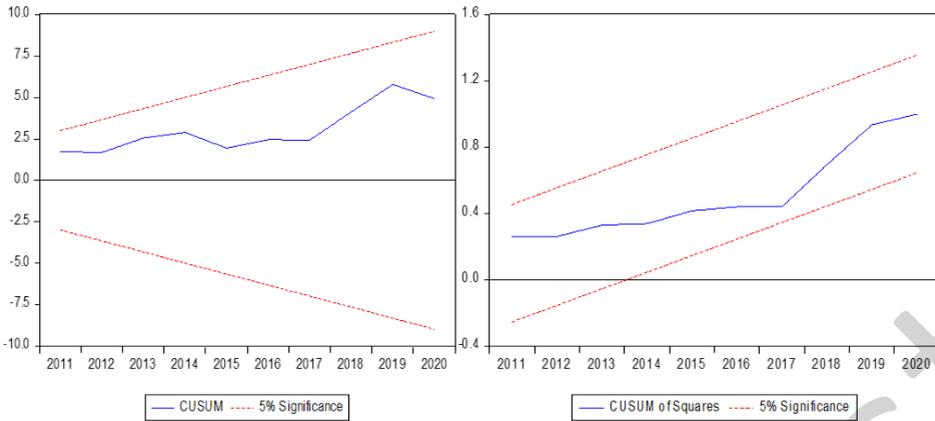
Figure 1   GDPpc as dependent variable (a) CUSUM and (b) CUSUMSQ based on SIC [ARDL (1,3,3,0)].
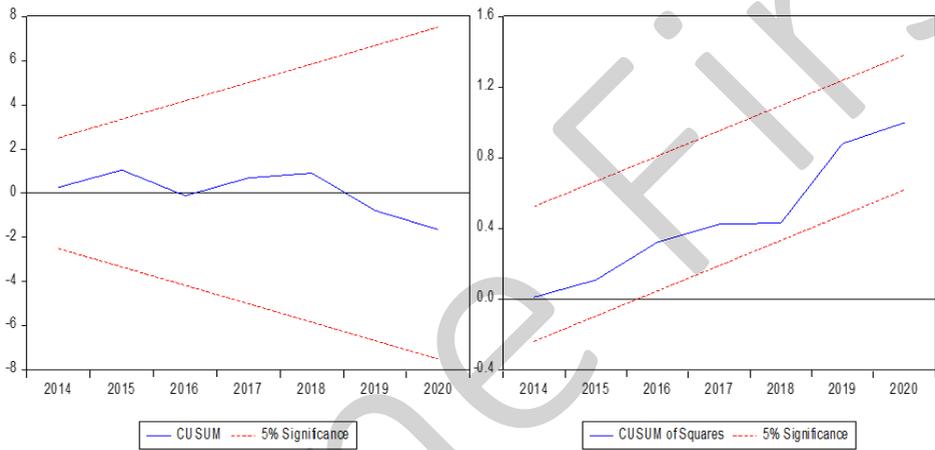**Source**: the aurthors

Figure 2   FDI as a dependent variable (a) CUSUM and (b) CUSUMSQ based on SIC [ARDL (1,3,3,3)].
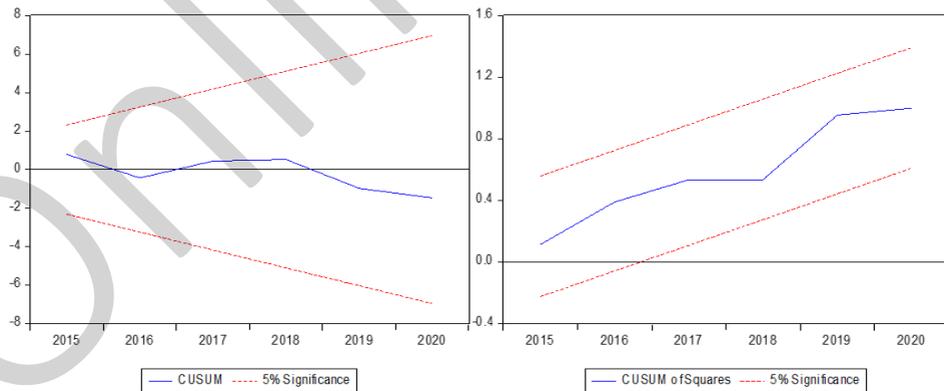**Source:** the authors

Figure 3   FD as a dependent variable (a) CUSUM and (b) CUSUMSQ based on SIC [ARDL (3,3,2,3)].
Source: the authors

3.2. Results of ARDL models

3.2.1. GDPpc as a dependent variable

Table 4 presents long-run estimation with lnGDPpc as a dependent variable. It indicates that EX and constant term are positive and significant at the 1% level to explain GDPpc, while FDI and FD are insignificant. A 1% increase in EX leads to approximately 0.318% increase in the GDPpc. This

finding follows the results of export-led growth in Pakistan (Saleem et al., 2023), while FD is insignificant in obtaining economic growth similar to UEA (Al-Malkawi et al., 2012) as well as FDI, which is following the research conducted for Croatia (Dritsaki & Stiakakis, 2014).

In developed countries, FD has a long-term favorable impact on economic growth. The financial industry contributes to economic growth through capital accumulation (savings), increases in savings rates, investment, foreign capital inflows and technical progress. In Serbia, the financial sector was the first privatized in order to improve efficiency and boost economic growth.

However, the level of the FD is insufficient to contribute to economic growth. So, the findings that EX positively impacts economic growth, while low-level FD in Serbia does not affect obtaining economic growth, reflects the macroeconomic situation in Serbia. In practice and economic policy, FDI is considered a factor in economic growth in Serbia. Some studies confirm the positive influence of FDI on GDP in the long run (Jednak et al. 2021; Sarker & Khan 2020; Marjanović & Đukić, 2020; Sultanuzzaman et al. 2018), although other research results demonstrate that FDI and GDP are negatively related (Smolo, 2021).

Table 4 Estimated long-run coefficients: lnGDPpc as a dependent variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnFDI	0.040	0.023	1.728	0.115
lnEX	0.318***	0.051	6.263	0.000
lnFD	0.131	0.092	1.421	0.186
C	7.063***	0.259	27.244	0.000

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. ARDL(1,3,3,0) selected based on SIC.

Source: the authors

Table 5 presents short-run estimation with lnGDPpc as a dependent variable. It indicates that FDI and EX significantly affect GDPpc in the short run. But, FDI impacts GDPpc with a positive and statistically significant sign, while EX impacts GDPpc with a negative and statistically significant sign. At a 1% level, the ECM1 coefficient is significant, and its value is assessed to be -0.411. At a speed of 41.1%, the system is being adjusted towards long-run equilibrium. The adjustment process to restore equilibrium is particularly effective if the error correction term is negative and significant (Wang et al., 2011). In the current year, around 41.1% of disequilibrium resulting from the shock in the previous year returned to the long-term equilibrium.

These findings align with the results indicating that FDI exerts a positive impact on economic growth in the short run (Sahu, 2021; Majumder & Rahman, 2020; Goh et al., 2017; Sultanuzzaman et al., 2018) but contrary to results when export positively influences economic growth (Goh et al., 2017). FDI can increase economic growth in the short term due to additional capital, new technology, knowledge spillover, and increased competitiveness, leading to increased exports. Openness and the rise of exports will influence growth in the short run. Capital inflows into countries that lack capital, and new technologies will drive economic growth. However, FDI's effects on EX and economic growth may vary depending on the host countries (Sahoo & Dash, 2022).

Table 5 Error Correction Regression: Δ(lnGDPpc) is dependent variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δ(lnFDI)	0.020**	0.007	2.835	0.018
Δ(lnFDI(-1))	0.013	0.008	1.714	0.117
Δ(lnFDI(-2))	0.024***	0.006	4.097	0.002
Δ(lnEX)	0.000	0.020	0.002	0.998
Δ(lnEX(-1))	-0.063***	0.018	-3.479	0.006
Δ(lnEX(-2))	-0.060***	0.017	-3.464	0.006
ECM1(-1)	-0.411***	0.036	-11.264	0.000

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. ARDL(1,3,3,0) selected based on SIC.

Source: the authors

We have addressed the first research question (RQ1), which states that EX has a beneficial long-run impact on economic growth. Meanwhile, FDI and FD do not exhibit a significant impact on economic growth. However, in the short run, FDI boosts GDP, while EX negatively influences economic growth in Serbia. Furthermore, we have addressed the second research question (RQ2), confirming the existence of a long-run relationship between EX and GDP, as well as short-term relationships between FDI, EX, and GDP.

3.2.2. FDI as a dependent variable

Table 6 presents long-run estimations with lnFDI as a dependent variable. It indicates that all independent variables are statistically significant. GDPpc is positively and statistically significantly associated at the 5% level, while EX and FD exhibit negative and statistically significant associations at the 5% and 10% levels, respectively. A 1% increase in GDPpc leads to approximately 25.491% increase in the FDI. Then, a 1% increase in EX and FD leads to approximately 5.904%, and 12.978% decrease in the FDI. An

increase in GDP gives confidence to foreign investors to invest in a host country that increases its production, so GDP is an important indicator to attract FDI. Financial development helps the development and efficiency of financial markets and the availability of domestic and international financial resources. At the same time, exports contribute positively to economic growth (Dritsaki & Stiakakis, 2014). With financial development and higher exports, the requirement for FDI lessens. Also, our results are similar to An et al. (2023). They found that high levels of financial development in developing Asia will not encourage foreign investment to support economic growth.

Table 6 Estimated long-run coefficients: lnFDI is dependent variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnGDPpc	25.491**	9.121	2.795	0.027
lnEX	-5.904**	2.319	-2.546	0.038
lnFD	-12.978*	5.581	-2.325	0.053

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. ARDL(1,3,3,3) selected based SIC.

Source: the authors

Table 7 presents short run estimation with lnFDI as the dependent variable. In the short run, GDPpc, EX and FD all significantly impact FDI. In short-run GDPpc mostly negatively influences FDI, which is different than results in long-run. Alshamsi and Azam (2015) showed that foreign investors perceive increasing economic growth as a favorable indicator of a country's economic performance, hence GDP has a positive impact on FDI, and these results confront our results in the short run. Similarly, a developed financial system related to other attributes like access to external finance, quality of finance, human and natural resources and others will increase FDI attraction (Desbordes & Wei, 2017), but our results are mixed and cannot be confirmed. The coefficient of ECM2 is statistically significant at the 1% level, with an estimated value of -0.703. This indicates that the system is adjusting towards long-term equilibrium at a rate of 70.3%. In the current year, around 70.3% of disequilibria resulting from the shock in the previous year return to the long-term equilibrium.

Table 7 Error Correction Regression: Δ(lnFDI) is dependent variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-104.988***	14.426	-7.278	0.000
Δ(lnGDPPC)	2.453	1.814	1.352	0.218
Δ(lnGDPPC(-1))	-21.514***	3.224	-6.673	0.000
Δ(lnGDPPC(-2))	-18.561***	3.019	-6.147	0.001
Δ(lnEX)	-2.696***	0.575	-4.687	0.002
Δ(lnEX(-1))	-0.240	0.527	-0.455	0.663
Δ(lnEX(-2))	2.652***	0.573	4.627	0.002
Δ(lnFD)	-8.704***	1.014	-8.585	0.000
Δ(lnFD(-1))	4.111***	0.636	6.459	0.000
Δ(lnFD(-2))	1.749***	0.374	4.676	0.002
ECM2(-1)	-0.703***	0.097	-7.271	0.000

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. ARDL(1,3,3,3) selected based on SIC.

Source: the authors

We addressed the second research question (RQ2) by demonstrating that there are long-term and short-run relationships between GDPpc, EX, FD, and FDI.

3.2.3. FD as a dependent variable

Table 8 presents long-run estimation with lnFD as a dependent variable. At 1% and 10%, respectively, it shows that GDPpc and EX are statistically significant. GDPpc is positive and statistically significant, while EX is negative and statistically significant in the long run. A one percent rise in GDPpc leads to an approximately 1.427% increase in the FD. A one percent rise in EX results in a 0.291 percent decline in FD. Finance is viewed as an essential component for achieving growth. The majority of the research focuses on this link. However, the study (Mtar & Belazreg, 2021) reveals a unidirectional causality from economic growth to FD, consistent with our finding that GDP positively affects FD.

Table 8 Estimated long-run coefficients: lnFD as a dependent variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnGDPpc	1.427***	0.377	3.784	0.009
lnFDI	-0.003	0.041	-0.063	0.952
lnEX	-0.291*	0.135	-2.164	0.074

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. ARDL(3,3,2,3) was selected based on SIC.

Source: the authors

Table 9 presents short run estimation with lnFD as a dependent variable. It indicates that GDPpc, EX and FDI have significant effects on FD in the short run. At the 1% level, the ECM4 coefficient is significant, and its value is estimated to be -0.973. The system is approaching long-term equilibrium rapidly, with a rate of adjustment of 97.3%. In the current year, roughly 97.3% of the disequilibria resulting from the shock in the previous year return to the long-term equilibrium. Song et al. (2021) stated that economic growth positively influences financial development. We cannot confirm all our findings.

Table 9 Error Correction Regression: Δ(lnFD) as a dependent variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.300***	0.514	-14.208	0.000
Δ(lnFD(-1))	0.330***	0.050	6.627	0.001
Δ(lnFD(-2))	0.195***	0.034	5.783	0.001
Δ(lnGDPPC)	-0.370	0.191	-1.937	0.101
Δ(lnGDPPC(-1))	-2.526***	0.237	-10.660	0.000
Δ(lnGDPPC(-2))	-2.194***	0.243	-9.027	0.000
Δ(lnFDI)	-0.075***	0.011	-6.877	0.001
Δ(lnFDI(-1))	-0.031**	0.011	-2.776	0.032
Δ(lnEX)	-0.299***	0.037	-8.181	0.000
Δ(lnEX(-1))	-0.214***	0.042	-5.119	0.002
Δ(lnEX(-2))	0.147**	0.054	2.710	0.035
ECM4(-1)	-0.973***	0.068	-14.233	0.000

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. ARDL(3,3,2,3) was selected based on SIC.

Source: the authors

We can conclude that there are long- and short-run relationships between GDPpc, EX, FD and FDI answering the second research question (RQ2). Our long-run results align with findings from Hassan et al. (2011) that showed positive relation between FD and economic growth in developing countries, but not with our short-run results. The usual research practice is more committed to influencing FD to FDI, than vice versa. FDI has the potential to introduce new technologies and knowledge, thereby influencing the evolution and enhancement of financial systems, markets, and institutions. Even so, according to Majeed et al. (2021), FDI exhibits a robust positive correlation with FD. We discovered that the relationship is significant, although some are positive and others are negative, so we can confirm significance but not only positive impact, as stated in Majeed et al. (2021). Figure 4 summarizes all long- and short-run relationships between observed variables as disclosed by the ARDL analysis.

Figure 4 Results of ARDL analysis
Source: the authors

The result that FDI leads to economic growth in Serbia, in the short run, does not agree with Dritsaki & Stiakakis (2014) for Croatia, Shawa and Shen (2013) for Tanzania, Miankhel et al. (2009) for Malaysia. On the contrary, this result coincides with Shaikh (2010) for Pakistan, Sarker and Khan (2020) for Bangladesh, Sunde (2017) for South Africa, Tapşın (2016) for Turkey, Mahmoodi and Mahmoodi (2016), Miankhel et al. (2009) for Thailand. We showed that FDI has a role in obtaining economic growth in the short-run, while EX has a role in achieving economic growth in the long run. With these results, we have answered the first research question (RQ1) that EX positively impacts economic growth in the long run. At the same time, FDI and FD do not influence the economic boost. However, in the short run, FDI positively influences GDP, while EX negatively impacts economic growth in Serbia. Moreover, we confirm that long- and short-run relationships exist among observed variables and thereby have answered the second research question (RQ2).

3.3. VECM results

As the model with the EX variable as a dependent variable proved unsuitable according to the diagnostic verification tests, the EX variable was excluded from the VECM analysis. Namely, Granger causality was examined between the following variables: GDPpc, FDI and FD.

Table 10 displays the results of Granger causality using VECM. The direction of causality can be separated into two portions due to the cointegration of the variables: short- and long-run causation. The one-period represents the long-run causality lagged error-correction term ECM, whereas the short-run causality represents the lagged differenced explanatory variables (Bhasin & Gupta, 2017).

According to Table 10, the GDPpc equation exhibits a unidirectional causality, with significance found at the 10% level, indicating that FDI influences GDPpc in the short run. Similarly, examining the equation for FD, there is evidence of unidirectional causality, with FDI significantly impacting FD at the 1% level of significance in the short run.

Table 10 Granger causality test results

VECM	Short run			Long run (ECM)	
	Δ(lnGDPpc)	Δ(lnFDI)	Δ(lnFD)	t-statistics	Coefficient
Δ(lnGDPpc)	-	4.695* (0.096)	2.788 (0.248)	-2.534 (0.015)	-0.584**
Δ(lnFDI)	1.126 (0.570)	-	1.391 (0.499)	-0.383 (0.704)	-2.166
Δ(lnFD)	1.022 (0.600)	12.103*** (0.002)	-	-3.440 (0.001)	-4.476***

Notes: Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. P-values are presented in parenthesis.

Source: the authors

These empirical data show that all ECM coefficients are negatively signed when looking at long-run causality (Table 10). For GDPpc, ECM is statistically significant at a 5% level, for FD it is statistically significant at a 1% level, and for FDI, ECM is insignificant. Figure 5 presents the results of VECM analysis.
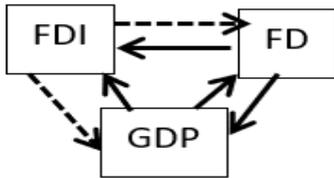
Notes: Short-run- dashed lines; long-run- the solid line.
Figure 5   Results of VECM analysis
Source: the authors

This finding implies that the dependent variables GDPpc and FD, as well as the explanatory variables GDPpc, FDI, and FD, as shown in the model, are causally related in the long run. Therefore, there is a causal relationship among the observed variables GDP, FDI and FD, which answers the third research question (RQ3) about causal relationship between economic growth (GDPpc) and other variables. Previous research confirmed some results, but not all. Irandoust (2016) discovered unidirectional relationship from FDI to GDP in Latvia and Lithuania, which supports our findings in Serbia. Mahmoodi & Mahmoodi (2016) investigated relationships between GDP and FDI in European countries, Miankhel et al. (2009) explored it in Thailand, and their results reinforce our findings about the presence of bidirectional correlation between GDP and FDI. However, Olayungbo & Quadri (2019) revealed that unidirectional causal linkages exist between financial development and GDP, contradicting our results that state a bidirectional link between FD and GDP.

Conclusion

Lacking its own capital, Serbia attracted FDI to achieve economic growth. It is thought that FDI, EX, and FD can substantially impact economic growth. As a result, we attempted to study the impact of FDI, EX, and FD in achieving economic growth in this paper. Furthermore, we explored the long- and short-run relationships between these variables. We utilized two models (ARDL and VECM) to demonstrate the relations among FDI, EX, FD, and GDPpc in Serbia from 1997 until 2020.

We analyzed long- and short-run relationship using the ARDL model. The following are the long-run ARDL outcomes. When GDPpc is the dependent variable, the model predicts that EX will raise GDPpc. When FDI is the dependent variable, the model predicts GDPpc raising FDI, while EX and FD decrease FDI. GDPpc increases FD, while EX decreases FD, according to a model with FD as the dependent variable. Short-run (ARDL) links from FDI and EX to GDPpc; GDPpc, EX, and FD to FDI; and GDPpc, FDI, EX to FD are all confirmed. The model with EX as the dependent variable did not satisfy the statistical characteristics. As a result, the EX variable was left out of the VECM study. The VECM model was used to investigate Granger's causality among additional variables such as GDPpc, FDI and FD. The VECM model reveals causality between the variables GDPpc, FDI and FD and the two variables GDPpc and FD in the long run. The VECM model indicates unidirectional causality from FDI to GDPpc and FD in the short run. To summarize findings, in the short run, FDI plays a role in achieving economic growth, while EX has a part in Serbian economic growth, having a negative impact. However, in long-run, EX has an important part in achieving economic growth, whereas FDI and FD do not.

The main findings, organized in relation to the research questions, are summarized as follows: RQ1 confirms that FDI and EX affect economic growth in Serbia, with FDI being relevant in the short run and EX in the long run. RQ2 confirms the existence of both short-run and long-run relationships among GDPpc, FDI, EX, and FD, as evidenced by the ARDL results. RQ3 provides evidence of both short-run and long-run causal relationships among GDPpc, FDI, and FD, with short-run bidirectional causality involving FDI and long-run causality confirmed by the VECM framework, while the determinants of EX remain an open issue for future research.

As the results show, EX affects GDP in long-run. However, it was not possible to determine which variables influence EX. It is the research's limitation. Moreover, despite Serbia's efforts to attract FDI, they have not had the expected positive impact on economic growth in long-run. However, in the short-run FDI raises GDPpc. Nevertheless, the policy aimed at attracting foreign capital should perhaps be revised. In order to achieve economic growth and enhance FDI and FD, Serbia should embrace an FDI-led and export-led policy. Future studies could examine the variables used in different countries and compare them to Serbia.

Appendix A.

Table A1 Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6.56593	NA	9.21E-06	-0.244374	-0.045418	-0.2012
1	69.73309	96.25471	1.07E-07	-4.736484	-3.741701	-4.52059
2	103.4893	38.57852	2.41E-08	-6.427552	-4.636942	-6.03894
3	146.4677	32.74549*	3.35e-09*	-8.996928*	-6.410491*	-8.435605*

Notes: * indicates lag order selected by the criterion; LR-sequential modified LR test statistic (each test at 5% level); FPE-Final prediction error; AIC-Akaike information criterion; SC-Schwarz information criterion; HQ-Hannan-Quinn information criterion.

Source: the authors

Declarations

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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