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ORIGINAL ARTICLE

# The significance of foreign direct investment (FDI) and trade openness: evidence from nine European economies

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## Abstract
This study examines the impact of foreign direct investment (FDI) and trade openness on economic growth in nine European countries using World Bank data (1995–2021). The analysis employs the Pooled Mean Group (PMG) Autoregressive Distributed Lag (ARDL) model to capture both short- and long-run dynamics. The findings indicate that FDI has a positive short-term effect but a negative long-term impact on economic growth. Similarly, trade openness stimulates growth in the short run but exerts a negative influence in the long run. Gross fixed capital formation has no immediate effect on GDP per capita but contributes positively in the long term. Granger causality tests reveal a unidirectional relationship from GDP per capita to both trade openness and gross fixed capital formation, while a bidirectional relationship exists between gross fixed capital formation and trade openness. These findings suggest the need for balanced policy measures to maximize the benefits of FDI and trade openness while mitigating long-term risks. Policymakers should focus on strengthening domestic industries, enhancing economic resilience, and implementing strategies to improve the absorptive capacity of FDI to optimize its long-run contributions to growth.

**Keywords** FDI · GDP per capita · Gross fixed capital formation · Causality test · European union

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## Introduction

Economic growth is often assessed using macroeconomic indicators such as gross domestic product (GDP) per capita. Economies with high GDP per capita are typically classified as developed, yet much research has overlooked the evolving relationship between GDP, trade, and foreign direct investment (FDI) (Bazán et al. 2022; Kevin 2016; Shiri 2023). Both FDI and trade openness are widely recognized as fundamental drivers of economic growth, particularly in globally integrated economies.

FDI involves the establishment of business operations or acquisition of assets in foreign countries, facilitating capital inflows, technology transfer, and managerial expertise while expanding market access. In 2019, global FDI inflows reached $1.5 trillion, highlighting its role in economic activity (UNCTAD 2020). Alfaro et al. (2004) emphasize that FDI fosters economic growth through mechanisms such as technology spillovers, competition, and human capital development. Similarly, trade openness, characterized by lower trade barriers and liberalized policies, enhances economic performance by promoting specialization, efficiency, and innovation diffusion (Grima et al. 2020; Janis and Elisabeth 2015; Rodrik 2018; Smith 1999). Exposure to foreign competition incentivizes domestic industries to improve productivity and adopt advanced technologies, boosting efficiency (Grima et al. 2020; Bijsterbosch and Kolain 2009; Argiro and Dimitrios 2011). The interaction between FDI and trade openness creates a reinforcing cycle, where market integration attracts investment, stimulates technological progress, and enhances economic competitiveness (UNCTAD 2020; Montanari 2005).

In the European Union (EU), FDI and trade openness play a central role in economic growth, regional integration, and global competitiveness. As one of the world's largest economic blocs, the EU has shaped intra-regional and international trade and investment flows (Branislav and Mladen 2016). EU nations have both attracted and contributed to FDI, fostering innovation, employment, and structural transformation (Dornean and Oanea 2015). The region's commitment to free trade and economic liberalization, embodied in the European Single Market, has facilitated seamless trade across member states, enhancing market efficiency and resource allocation (European Commission 2021). Additionally, the EU's extensive network of trade agreements has promoted export-led growth, further solidifying its position as a key player in the global economy (European Commission 2021). However, despite these benefits, challenges such as economic disparities, regulatory divergence, and geopolitical uncertainties can affect the distribution and impact of FDI and trade flows within the region (Crescenzi and Giua 2016; Fratesi and Wishlade 2017; Percoco 2017; Ugo and Giovanni 2019). Moreover, rising protectionism and trade tensions in the global economy pose risks to the EU's open trade regime and attractiveness to foreign investors (Handley and Nuno 2015; Keszey 2018; Kyle 2014). While several cross-country studies have examined the links between FDI, trade openness, and economic growth, research focusing specifically on EU member states remains limited (Bijsterbosch and Kolain 2009; Argiro and Dimitrios 2011; Montanari 2005). The economic diversity among EU nations, particularly the distinct experiences of Central and Eastern European transition economies, necessitates a more targeted econometric analysis. A comprehensive understanding of how FDI and trade openness impact economic growth can clarify the effectiveness of existing trade policies and investment flows, which is particularly relevant for Western Balkan economies benefiting from asymmetrical trade concessions within the EU market.

This study investigates the impact of FDI and trade openness on economic growth in nine selected European countries. Specifically, it examines both short- and long-term relationships between FDI, trade openness, and GDP per capita, while also considering the role of gross fixed capital formation in shaping economic performance. The study tests the hypothesis that FDI and trade openness significantly contribute to economic growth and seeks to provide empirical evidence that informs economic policy within the EU. The remainder of this paper is structured as follows: Sect. 2 reviews the relevant literature. Section 3 outlines the research methodology, including data sources and analytical techniques. Section 4 presents the empirical findings and discusses their implications. Finally, Sect. 5 concludes with a summary of key findings.

## Literature review

### Theoretical review

Foreign direct investment and trade openness are fundamental components of international economic relations, both significantly driving economic growth. A strong theoretical foundation is essential for contextualizing these relationships, guiding analysis, and advancing economic thought regarding the link between FDI and economic growth. Neoclassical economists argue that increases in capital, including FDI, contribute directly to economic growth by expanding an economy's productive capacity (Solow 1956). In this framework, FDI supplements domestic investment and fosters technological progress, capital accumulation, and efficiency improvements (Barro and Sala-i-Martin 1992). Endogenous growth theorists extend this argument by emphasizing the role of technology transfer, knowledge spillovers, and skill development as key mechanisms through which FDI enhances productivity growth (Grossman and Helpman 1991; Romer 1986). According to Romer's model, FDI serves as a vehicle for introducing new technologies and managerial expertise, enabling host economies to integrate more effectively into global value chains. Furthermore, FDI can stimulate domestic investment and employment creation while promoting skills development and knowledge transfer (Blomström and Kokko, 2003).

In contrast, dependency theorists provide a more critical view, arguing that FDI may reinforce economic dependency rather than fostering self-sustaining growth. According to Prebisch (1950) and Cardoso (1977), reliance on foreign capital and technology can create structural imbalances, where host countries remain subordinated to multinational corporations. This perspective suggests that FDI could hinder domestic industrial development by concentrating economic power in foreign entities, leading to profit repatriation and limited local reinvestment. Consequently, while FDI has the potential to enhance economic growth, its impact is contingent on the institutional and policy environment of the host country.

Trade openness, defined as the degree to which an economy is integrated into the global trading system through reduced trade barriers, has long been associated with economic growth. Rooted in classical trade theory, Ricardo's (1817) theory of comparative advantage argues that nations benefit from specializing in industries where they have a relative efficiency advantage, leading to higher productivity and economic expansion (Rodrik 1999). From this perspective, trade openness fosters resource allocation efficiency, market competition, and specialization, all of which contribute to higher economic output. In the modern context, trade liberalization is linked to economies of scale, innovation diffusion, and productivity gains, as firms facing global competition are incentivized to improve efficiency and adopt advanced technologies (Dollar and Kraay 2004). However, some scholars caution that while trade openness can stimulate growth, its benefits are conditional on macroeconomic stability, institutional quality, and industrial capacity (Rodrik 1999).

The interaction between FDI and trade openness generates reinforcing effects that amplify their contributions to economic growth. FDI can drive trade expansion by integrating domestic firms into global value chains, promoting export-oriented production, and providing access to international markets (UNCTAD 2018). At the same time, trade openness enhances a country's attractiveness to foreign investors by offering larger consumer markets, lowering entry barriers, and providing a stable trade policy environment (Feenstra and Wei 2010). Theoretical models suggest that FDI motivations, including market access, resource availability, and cost differentials, are strongly influenced by the openness of a host economy (Helpman and Krugman 1985). Countries with liberalized trade policies and stable investment climates tend to attract higher levels of FDI, reinforcing a cycle of economic expansion through capital inflows, productivity gains, and industrial development. However, the extent to which FDI and trade openness contribute to sustainable economic growth depends on the institutional and policy frameworks that govern them, highlighting the importance of country-specific analysis.

## Empirical review

The relationship between foreign direct investment (FDI), trade openness, and GDP per capita has been extensively explored in the literature, often using panel data methodologies. However, a significant research gap remains regarding the joint interaction between FDI, trade openness, gross fixed capital formation, and GDP per capita within selected European Union (EU) countries. While previous studies have examined these variables individually or within broader regional contexts, a comprehensive analysis incorporating all four factors within the EU framework remains limited.

Several studies have analyzed the effects of FDI and trade openness on economic growth in the EU and beyond. Oana (2018) investigated the role of FDI and local investment in driving export performance in EU member states from 1999 to 2012, finding heterogeneous effects across different sectors and countries. Similarly, Majid and Elahe (2016) examined the causal links between trade, FDI, and economic growth in emerging European and Asian nations, reporting short-term unidirectional causality between GDP and FDI. Nikolaos and Pavlos (2018) focused on 15 EU nations, highlighting the causal relationships between trade, unemployment, and economic growth, emphasizing the role of FDI in labor market dynamics.

Other studies have explored the role of FDI in capital formation and economic development. Panagiotis (2015) analyzed how FDI drives gross fixed capital formation in Eurozone countries, demonstrating its ultimate effect on GDP per capita. Kemal and Turgay (2019) examined the impact of trade liberalization on economic growth in European transition countries, revealing that greater trade openness fosters capital formation and long-term development. Egger (2001) investigated bilateral economic activities between EU member states, confirming a complementary relationship between exports, FDI, gross fixed capital formation, and GDP per capita.

Beyond the EU, studies have assessed FDI and trade openness in diverse economic settings. Radulescu et al. (2020) found that FDI stocks significantly impact trade balances in Central and Eastern European countries, particularly in manufactured exports and imports. Bashir and Sana (2023) explored the FDI-growth relationship in BRICS nations, reporting that FDI negatively affected growth, whereas trade openness had a positive effect. In a similar study, Francois et al. (2023) analyzed official development assistance, FDI, and economic growth in African economies, concluding that FDI has a long-term positive effect on GDP per capita. Michael et al. (2019) examined the impact of FDI on trade openness, inflation, and labor markets in emerging African economies, while Yuldoshboy et al. (2023) investigated FDI, trade openness, infrastructure, and innovation in Commonwealth Independent States (CIS), highlighting significant long-term growth effects.

Despite these contributions, many studies have not explicitly examined the joint influence of FDI, trade openness, and gross fixed capital formation on GDP per capita within the EU context. While existing research has focused on bilateral trade, investment, or sector-specific FDI effects, a holistic approach incorporating all these variables remains underexplored. This study aims to fill this gap by analyzing their combined impact on economic growth across selected EU countries, offering a more integrated perspective on their long-term economic implications.

## The research methodology

### Data source

The study utilizes data from 1995 to 2021 sourced from the World Bank Development Indicators. This timeframe is selected to ensure data availability across all selected countries while capturing significant global economic trends, including the post-2008 financial recovery. The dependent variable, gross domestic product (GDP) per capita, serves as a measure of economic performance, reflecting the average income level within each country. It is calculated by dividing nominal GDP by the total population and is expressed in United States dollars (USD).

The independent variables include foreign direct investment, gross fixed capital formation, and trade openness. FDI is measured as total net inflows into each country, expressed in USD, representing cross-border investment activity. Gross fixed capital formation, a proxy for domestic investment, reflects the total value of fixed asset acquisitions and is also measured in USD. Trade openness is defined as the sum of exports and imports as a percentage of GDP, indicating the degree of economic integration with global markets.

### Model framework

This study examines the relationship between economic growth, foreign direct investment, and trade openness within the European Union, drawing on economic growth theory to establish the model's foundation. Using a panel data framework, the analysis focuses on nine EU economies to assess the long-run and short-run effects of these variables. Gross domestic product (GDP) per capita serves as the dependent variable, representing overall productivity per person. The independent variables include FDI, trade openness, and gross fixed capital formation, all of which are commonly identified as key drivers of economic growth in the literature. The theoretical basis for incorporating these variables stems from neoclassical and endogenous growth models, which highlight the role of capital accumulation, market integration, and investment flows in shaping economic outcomes. The empirical model derived from this framework is mathematically expressed in Eq. (1), capturing the dynamic interactions between these economic variables.

$$GDPpc_t = \mathfrak{f}(FDI_t, Top_t, Gfcf_t) \tag{1}$$

In Eq. 1, GDPpc represents gross domestic product per capita, FDI denotes net foreign direct investment inflow, Gfcf indicates gross fixed capital formation, Top signifies trade openness, and t represents time, respectively. However, all the variables were transformed using their natural logarithm, leading to Eq. 2.

$$lnGDPpc_{it} = \beta_0 + \beta_1 lnFDI_{it} + \beta_2 lntop_{it} + \beta_3 lnGfcf_{it} + \mu_{it} \tag{2}$$

With $\beta_0$ representing the constant, the coefficient of the independent variables is denoting by $\beta_1$, $\beta_2$, and $\beta_3$ whereas $\mu_{it}$ indicates the error term.

### Estimation approach

This study employs the Pooled Mean Group (PMG) Autoregressive Distributed Lag (ARDL) model, a dynamic panel estimation technique developed by Pesaran et al. (1999). This approach is widely used in econometrics to analyze both short- and long-term relationships in panel data, making it particularly suitable for examining the effects of FDI and trade openness on economic growth. The PMG estimator combines the flexibility of the traditional ARDL model with the advantages of the Mean Group (MG) estimator, allowing for heterogeneous long-run coefficients across countries while maintaining common short-run dynamics. This feature is relevant for this study, as the economic structures and growth determinants vary across European Union member states.

The PMG-ARDL model is advantageous because it accommodates both stationary and non-stationary variables, making it appropriate for mixed-order integration processes where variables maybe I (0) or I (1) (Pesaran and Shin 1998). Unlike the MG estimator, which allows all parameters to differ across countries, the PMG approach constrains long-run coefficients to be homogeneous while permitting short-run dynamics and adjustment speeds to vary. This makes it more efficient for analyzing economic relationships in panels where countries share common long-term growth drivers but may exhibit different short-term fluctuations. Moreover, compared to the Dynamic Fixed Effects (DFE) model, which assumes homogeneity in both the short- and long-run, the PMG estimator allows for cross-country heterogeneity in long-run elasticities, making it more suitable for studying macroeconomic relationships in diverse economies.

Another advantage of the PMG approach is its ability to handle lagged dependent and explanatory variables, which ensures that both short-run fluctuations and long-run equilibrium relationships are properly accounted for (Pesaran et al. 1999). By incorporating these dynamic adjustments, the model provides a more comprehensive understanding of the effects of FDI and trade openness on economic growth over time. Additionally, the estimator corrects for potential serial correlation and heteroscedasticity, which enhances the robustness and reliability of the results (Arellano and Bond 1991).

This study follows the methodological framework outlined by Shin et al. (2011), which has been widely applied in empirical research, including the work of David (2021). The estimation equation for the ARDL model is presented in Eq. (3), where GDP per capita is modeled as a function of FDI, trade openness, and gross fixed capital formation, incorporating both short-run dynamics and long-run equilibrium effects.

$$\begin{aligned} \Delta lnGDPpc_{it} = \alpha & + \gamma_1 lnGDPpc_{it-1} + \gamma_2 lnFDI_{it-1} \\ & + \gamma_3 lnTop_{it-1} + \gamma_4 lnGfcf_{it-1} \\ & + \sum{}_{i=1}^{\rho} \varnothing_i \Delta lnGDPpc_{it-i} + \sum{}_{i=1}^{\delta} \phi_i \Delta lnFDI_{it-i} \\ & + \sum{}_{i=1}^{\sigma} \beta_i \Delta lnTop_{it-i} + \sum{}_{i=1}^{\varrho} \psi_i \Delta lnGfcf_{it-i} + \epsilon_{it} \end{aligned} \tag{3}$$

GDPpc is gross domestic product per capita, FDI is the net foreign direct investment inflows, Top is trade openness, and Gfcf is gross fixed capital formation for the selected countries. The short-run coefficients are $\varnothing_i, \phi_i, \beta_i$, and $\psi_i$ whereas $\gamma_1$, $\gamma_2, \gamma_3$, and $\gamma_4$ are the long-run coefficients. However, when cointegration is found in Eq. 3, the panel error correction model can be stated in Eq. 4.

$$\begin{aligned} \Delta lnGDPpc_{it} = \alpha_0 & + \sum{}_{i=1}^{\rho} \varnothing_i \Delta lnGDPpc_{it-i} + \sum{}_{i=1}^{\delta} \phi_i \Delta lnFDI_{it-i} \\ & + \sum{}_{i=1}^{\sigma} \beta_i \Delta lnTop_{it-i} + \sum{}_{i=1}^{\varrho} \psi_i \Delta lnGfcf_{it-i} \\ & + \vartheta\, ECT_{it-1} + \mu_{it} \end{aligned} \tag{4}$$

The $ECT_{it-1}$ represent the error correction term and ϑ is the speed of adjustment from the short-term changes to the long-term equilibrium. However, the condition of the error correction term coefficient, ϑ, states that it should be negative and statistically significant for a long run equilibrium to be established between the GDPpc and the independent variables. The panel error correction model revealed a long-run causality between GDP per capita and the explanatory variables, allowing the study to discern the direction of causality between the two variables.

### Panel cointegration test

Testing for cointegration among variables is essential to avoid spurious regression and to facilitate the estimation of panel error correction models (PECM). When variables are non-stationary in levels but exhibit a stable long-run relationship, cointegration analysis ensures that regression results are meaningful and not driven by stochastic trends. This study applies the Pedroni (2004) and Johansen (1995) cointegration tests to examine whether a long-run equilibrium exists between foreign direct investment (FDI), trade openness, gross fixed capital formation, and GDP per capita in the selected countries. These tests are widely used in panel data analysis, with Johansen's approach relying on maximum likelihood estimation and Pedroni's method incorporating multiple test statistics to assess the presence of cointegration across heterogeneous panels.

Establishing cointegration among these variables is particularly important given their role in economic growth. If a long-run relationship exists, it suggests that fluctuations in FDI, trade openness, and capital formation are systematically linked to GDP per capita over time. The Pedroni (2004) test estimates Eq. (5) separately for each country in the panel and evaluates whether the variables maintain a stable long-run association across the selected economies.

$$y_{it} = a_i + \beta_i' x_{it-1} + u_{it} \tag{5}$$

Where:

$y_{it}$ represents the dependent variable for entity $i$ at time $t$.

$x_{it}$ represents the independent variables for entity $i$ at time $t$.

$a_i$ represents the entity-specific intercept.

$\beta_i'$ represents the entity-specific coefficients.

$u_{it}$ represents the error term.

In the Pedroni (2004) panel cointegration test, the null hypothesis states that no cointegration exists among the variables. This implies that if the null is not rejected, the lagged levels of the variables do not significantly contribute to a long-run equilibrium relationship. However, rejecting the null suggests that the variables share a common stochastic trend, confirming the presence of cointegration. The Johansen (1995) cointegration test takes a different approach by estimating a Vector Error Correction Model (VECM) and applying likelihood-based trace and maximum eigenvalue tests to assess the number of cointegrating relationships. This method derives eigenvalues from the estimated coefficient matrix and evaluates whether a statistically significant number of cointegrating equations exist within the panel dataset. The mathematical framework for the Johansen cointegration test is formalized in Eq. (6), which presents the estimation approach used in this study.

$$\Delta y_{it} = \prod y_{it-1} + \sum_{j=1}^{\rho-1} \Gamma_j \Delta y_{it-j} + \epsilon_{it} \ (6) \tag{6}$$

Where:

$y_{it}$ is a $K \times 1$ vector of non-stationary variables for entity $i$ at time t.

$\Delta y_{it}$ represents the differenced vector of $y_{it}$, that is, the first difference of $y_{it}$, making the variables stationary.

$\prod$ is a K×K matrix of coefficients on the lagged levels of the variables. It captures the long-run relationships among the variables.

$\Gamma_j$ K×K matrices of coefficients on the differenced variables at lags 1, 2,…, $p-1$, respectively. These matrices capture the short-run dynamics of the variables.

$\epsilon_{it}$ is a $K \times 1$vector of error terms.

## Panel causality test

Granger causality analysis is widely used to investigate whether one economic variable can predict another over time. Granger (1969) introduced the concept, which tests whether past values of one variable contain predictive information about another. If the inclusion of lagged values of an explanatory variable significantly improves the prediction of a dependent variable, the first variable is said to Granger-cause the second. The panel error correction framework is often used in causality testing when variables are co-integrated, as suggested by Engle and Granger (1987). In such cases, short-run deviations from equilibrium can be corrected over time, making panel causality tests particularly useful for understanding both short-term fluctuations and long-term relationships. Given the dynamic nature of economic interactions, this study employs Granger causality tests within a panel data setting to examine the direction of influence between FDI, trade openness, gross fixed capital formation, and GDP per capita. By incorporating lagged values of the explanatory variables in a regression framework, this approach allows for a robust investigation of whether FDI and trade openness Granger-cause economic growth or vice versa. The formal representation of these relationships is provided in Eq. (7), which specifies the structure of the causality tests conducted in this study.

$$\begin{aligned} lnGDPpc_{it} = \alpha_{1t} &+ \sum{}_{i=1}^{k} \omega_i lnGDPpc_{it-i} \\ &+ \sum{}_{i=1}^{k} \pi_i lnFDI_{it-i} + \sum{}_{i=1}^{k} \lambda_i lnTop_{it-i} \\ &+ \sum{}_{i=1}^{k} \delta_i lnGfcf_{it-i} + \mu_{1t} \end{aligned} \tag{7}$$

$$\begin{aligned} lnFDI_{it} = \alpha_{2t} &+ \sum{}_{i=1}^{k} ?_i lnGDPpc_{it-i} + \sum{}_{i=1}^{k} \tau_i lnFDI_{it-i} \\ &+ \sum{}_{i=1}^{k} \upsilon_i lnTop_{it-i} + \sum{}_{i=1}^{k} \varsigma_i lnGfcf_{it-i} + \mu_{2t} \end{aligned} \tag{8}$$

## Result and discussions

Table 1 presents the descriptive statistics for GDP per capita, foreign direct investment, gross fixed capital formation, and trade openness, offering insights into the distribution and variability of the data. The mean GDP per capita of 9.07 represents the average economic output per person, reflecting the overall prosperity of the observed countries. With a median of 9.25, the distribution of GDP per capita appears relatively symmetric, suggesting that values are fairly balanced around the mean. The range between the maximum (10.24) and minimum (7.22) GDP per capita values highlights differences in economic development, indicating that some countries exhibit significantly higher levels of prosperity than others. A standard deviation of 0.74 suggests moderate variability in GDP per capita across the sample, implying some variation in economic performance.

The negative skewness (-0.67) indicates that more countries have GDP per capita below the mean than above it, though the distribution is not highly asymmetric. Additionally, the positive kurtosis (2.48) suggests a moderately peaked distribution, meaning that GDP per capita values are concentrated around the mean. The Jarque-Bera statistic (20.48) and its associated probability (0.000) confirm that GDP per capita deviates significantly from a normal distribution. For foreign direct investment (FDI), the mean value of 6.76 represents the average level of foreign investment in the sample. The substantially higher standard deviation (15.79) compared to GDP per capita indicates greater variability in FDI among the observed economies, which may be attributed to differences in investment attractiveness, economic policies, or institutional frameworks.

Trade openness has a mean of 4.69, indicating the average level of integration with international trade. A higher value signifies a more open economy. Gross fixed capital formation, which represents the total value of investments in fixed assets, has a mean

**Table 1** Descriptive statistics and correlation matrix

| | lnGDPpc | lnFDI | lnTop | lnGfcf |
|---|---|---|---|---|
| Mean | 9.07 | 6.76 | 4.69 | 23.94 |
| Median | 9.25 | 2.28 | 4.77 | 15.00 |
| Maximum | 10.24 | 171.37 | 5.25 | 109 |
| Minimum | 7.22 | 0.07 | 3.78 | 1.00 |
| Std.Dev. | 0.74 | 15.79 | 0.33 | 23.391 |
| Skewness | -0.67 | 6.63 | -0.53 | 1.56 |
| Kurtosis | 2.48 | 58.26 | 2.55 | 5.22 |
| Jarque-Bera | 20.48 | 32,700 | 13.33 | 148.42 |
| Prob. | 0.000 | 0.009 | 0.000 | 0.000 |
| Sum | 2202 | 1642 | 1139 | 5816 |
| Sum Sq.Dev. | 132 | 60,299 | 26.59 | 132,404 |
| Observation | 243 | 243 | 243 | 243 |
| **Correlation matrix** | | | | |
| lnGDPpc | 1.000 | | | |
| lnFDI | 0.193 | 1.000 | | |
| lnTop | 0.681 | 0.166 | 1.000 | |
| lnGfcf | 0.252 | 0.312 | -0.2007 | 1.000 |

Source: Authors own calculations

of 23.94, reflecting the average level of capital investments. The high standard deviation (23.39) suggests significant variability in investment levels, potentially due to differences in economic growth prospects, infrastructure development, or investment climates.

The correlation analysis provides further insights into the relationships among key economic variables. GDP per capita exhibits a weak positive correlation with FDI, suggesting that higher-income countries attract more foreign investment. A strong positive correlation exists between GDP per capita and trade openness, indicating that more developed economies tend to be more integrated into global trade networks. Additionally, GDP per capita shows a weak positive correlation with gross fixed capital formation, implying that higher-income countries tend to invest more in fixed capital assets, such as infrastructure and machinery.

FDI demonstrates a moderate positive correlation with gross fixed capital formation, suggesting that countries attracting more foreign investment also tend to invest more in fixed assets. However, the correlation between trade openness and gross fixed capital formation is weakly negative, implying that more open economies may invest relatively less in fixed capital assets.

### Panel unit root test

Unit root tests are essential for determining the stationarity properties of the selected variables, as the presence of a unit root suggests that a variable follows a stochastic trend and is non-stationary. In contrast, stationarity implies that a variable reverts to its mean over time. Several widely used methodologies assess stationarity, including the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1981), the Phillips-Perron (PP) test (Perron 1988), the Levin, Lin, and Chu (LLC) test (Levin et al. 2002), and the Im, Pesaran, and Shin (IPS) test (Im et al. 2003). These tests differ in their assumptions regarding cross-sectional dependence and structural breaks, providing complementary insights into the nature of the time series.

The decision criterion for stationarity is based on p-values: if the p-value exceeds the 5% significance level, the null hypothesis of a unit root cannot be rejected, indicating that the variable is non-stationary. Conversely, if the p-value is below the 5% threshold, the null hypothesis is rejected, confirming that the variable is stationary. The panel unit root test results for FDI, GDP per capita, gross fixed capital formation, and trade openness, presented in Table 2, reveal mixed stationarity properties across the different tests. FDI was found to be stationary at level (0) under the LLC and PP tests at the 5% significance level, while the ADF and IPS tests confirmed stationarity at the 1% level. For GDP per capita, only the LLC test indicated stationarity at level (0) at the 5% level, whereas all four tests confirmed stationarity at first difference (level 1) at the 1% significance level.

In the case of gross fixed capital formation, the level (0) series did not show significance, suggesting non-stationarity, but the first-difference series (level 1) exhibited stationarity at the 1% level across all tests. Trade openness showed mixed results at level (0), with the LLC and PP tests indicating stationarity at the 1% and 10% levels, respectively, while the ADF and IPS tests failed to reject the null hypothesis of a unit

**Table 2** Result from the panel unit root test

| Variable | Level | LLC | IPS | ADF | PP |
|---|---|---|---|---|---|
| lnFDI | 0 | -2.016** | -2.665*** | 39.241*** | 34.434** |
| lnGDPpc | 0 | -1.839** | 1.631 | 6.575 | 6.358 |
| lnGDPpc | 1 | -9.048*** | -7.652*** | 87.437*** | 82.951*** |
| lnGfcf | 0 | 0.328 | 1.717 | 8.958 | 8.641 |
| lnGfcf | 1 | -11.231*** | -10.250*** | 122.588*** | 125.317*** |
| lnTop | 0 | -3.337*** | -1.139 | 23.571 | 27.290* |
| lnTop | 1 | -11.584*** | -11.067*** | 131.286*** | 145.873*** |

Significance level ***1%, **5%, *10%; Source: Authors own calculations

**Table 3** Pedroni (Engle-Granger) cointegration

| | t-statistic | Prob. |
|---|---|---|
| **Within dimension** | | |
| Panel v-statistic | 0.204 | 0.429 |
| Panel rho-statistic | -1.355* | 0.088 |
| Panel PP-statistic | -2.641*** | 0.004 |
| Panel ADF-statistic | -3.289*** | 0.000 |
| **Between dimension** | | |
| Group rho-statistic | -0.052 | 0.479 |
| Group PP-statistic | -2.373*** | 0.009 |
| Group ADF-statistic | -3.536*** | 0.000 |

*** shows the parameters which null hypothesis is rejected; Source: Authors own calculations

root. However, at first difference (level 1), all tests confirmed stationarity at the 1% level, implying that trade openness becomes stationary after differencing.

## Panel cointegration tests

The Pedroni (Engle-Granger) cointegration test in Table 3 assesses whether the variables exhibit a stable long-run relationship, thereby determining the presence of cointegration. The results are presented for both within-dimension and between-dimension statistics, providing a comprehensive evaluation of the panel's long-run equilibrium properties. In the within-dimension analysis, the panel v-statistic is 0.204, with a corresponding probability of 0.429, suggesting that the null hypothesis of no cointegration cannot be rejected at conventional significance levels. Similarly, the panel rho-statistic of -1.355 has a probability of 0.088, indicating only marginal evidence against the null hypothesis. However, the panel PP-statistic (-2.641) and the panel ADF-statistic (-3.289) both yield probabilities below the 1% significance level, leading to the rejection of the null hypothesis and suggesting the presence of cointegration.

In the between-dimension analysis, the group rho-statistic registers at -0.052 with a probability of 0.479, indicating no strong evidence against the null hypothesis. However, the group PP-statistic (-2.373) and group ADF-statistic (-3.536) are significant at the 1% level, confirming the rejection of the null hypothesis. Overall, the significance of the panel PP, panel ADF, group PP, and group ADF statistics provides strong evidence that the variables share a long-run equilibrium relationship, confirming that they are cointegrated. This implies that despite potential short-run fluctuations, FDI, trade openness, gross fixed capital formation, and GDP per capita move together over time, reinforcing the validity of long-term economic linkages among these variables.

The Johansen cointegration test assesses whether a long-run equilibrium relationship exists among the variables by evaluating multiple cointegration ranks. This test uses two key statistics: the trace test and the maximum eigenvalue test, which sequentially examine the number of cointegrating relationships in the dataset. Table 4 presents the results of Johansen's cointegration analysis. The null hypothesis of no cointegration (rank = 0) is strongly rejected, as both the trace test (86.18) and maximum eigenvalue test (53.13) yield highly significant results at the 1% level. This suggests the presence of at least one cointegrating relationship among the variables.

When testing for at most one cointegrating relationship, the trace test (46.96) remains significant at the 1% level, while the maximum eigenvalue test (28.26) shows a weaker significance level of approximately 10%. This provides moderate evidence for the presence of a second cointegrating vector. Similarly, for at most two cointegrating relationships, the trace test (33.15) is significant at the 5% level, whereas the maximum eigenvalue test (26.62) retains marginal significance at the 10% level. This suggests the possible existence of a third long-run relationship.

Finally, when testing for at most three cointegrating relationships, both the trace test (36.30) and the maximum eigenvalue test yield highly significant results ($p < 1\%$), confirming the rejection of the null hypothesis. These results provide strong evidence of multiple long-run equilibrium relationships among the analyzed variables.

## PMG-ARDL estimated results

The long-run and short-run results of the PMG- ARDL model, presented in Table 5, provide key insights into the relationships between foreign direct investment (FDI), trade openness, gross fixed capital formation, and GDP per capita. The long-run coefficient for FDI is negative and statistically significant at the 1% level, indicating that a one-unit increase in FDI is associated with a 0.014 decrease in GDP per capita. This finding contrasts with the conventional expectation that FDI stimulates economic growth, especially given the EU's role as a major destination for foreign investment. However, the result highlights the complexities of FDI-led growth. While FDI inflows can provide capital, technology, and managerial expertise, their long-term impact on economic growth depends on factors such as the type of FDI (e.g., greenfield investments vs. mergers and acquisitions), the extent of technology transfer, and

**Table 4** Johansen cointegration

| Hypothesized No. of CE(s) | Fisher Stat.* (from trace test) | *p*-value | Fisher Stat.* (from max-eigen test) | *p*-value |
|---|---|---|---|---|
| None | 86.18*** | 0.000 | 53.13*** | 0.000 |
| At most 1 | 46.96*** | 0.000 | 28.26* | 0.058 |
| At most 2 | 33.15** | 0.016 | 26.62* | 0.086 |
| At most 3 | 36.30*** | 0.006 | 36.30*** | 0.006 |

*** shows the parameters which null hypothesis is rejected; Source: Authors' own calculations

**Table 5** Long and short-run results from the PMG-ARDL

| Long run | Coefficient | Std.Error | t-statistic | *p*-value |
|---|---|---|---|---|
| lnFDI | -0.014*** | 0.003 | -4.223 | 0.000 |
| lnTop | -1.160* | 0.666 | -1.742 | 0.085 |
| lnGfcf | 0.105*** | 0.020 | 5.243 | 0.000 |
| **Short run** | | | | |
| ECT (-1) | -0.132*** | 0.045 | -2.862 | 0.005 |
| Δ lnGdppc (-1) | -0.034 | 0.080 | -0.432 | 0.666 |
| Δ lnGdppc (-2) | -0.262 | 0.192 | -1.359 | 0.177 |
| Δ lnGdppc (-3) | 0.274** | 0.135 | 2.021 | 0.046 |
| Δ lnFDI | 0.006 | 0.007 | 0.826 | 0.411 |
| Δ lnFDI (-1) | 0.025* | 0.013 | 1.825 | 0.071 |
| Δ lnFDI (-2) | 0.011 | 0.008 | 1.268 | 0.208 |
| Δ lnFDI (-3) | 0.005 | 0.010 | 0.581 | 0.562 |
| Δ lnTop | 0.699*** | 0.177 | 3.938 | 0.000 |
| Δ lnTop (-1) | 0.240 | 0.158 | 1.511 | 0.134 |
| Δ lnTop (-2) | 0.165 | 0.297 | 0.556 | 0.579 |
| Δ lnTop (-3) | 0.006 | 0.199 | 0.264 | 0.792 |
| Δ lnGfcf | -0.004 | 0.014 | -0.343 | 0.732 |
| Δ lnGfcf (-1) | -0.003 | 0.018 | -0.151 | 0.880 |
| Δ lnGfcf (-2) | -0.002 | 0.002 | -0.092 | 0.926 |
| Δ lnGfcf (-3) | 0.008 | 0.016 | 0.541 | 0.590 |
| Constant | 1.686*** | 0.607 | 2.773 | 0.007 |

*** 1%, ** 5%, and *10% level of significance respectively; Source: Authors own calculations

the degree of integration with domestic industries. In some cases, FDI can crowd out domestic investment or lead to profit repatriation, limiting its contribution to sustained economic growth. These findings are consistent with Abdouli and Hammami (2017), Banday et al. (2021), and Batrancea et al. (2021), who emphasize the role of absorptive capacity and institutional quality in determining FDI's growth effects.

Trade openness also exhibits a long-run negative effect on GDP per capita, suggesting that while greater integration into global markets can foster growth, it may also expose domestic industries to heightened competition, potentially reducing their competitiveness. However, in the short run, trade openness has a positive and significant impact, indicating that access to international markets, specialization, and economies of scale can drive temporary economic gains. This result aligns with theories of trade-led growth, which argue that increased market access and foreign competition can boost short-term productivity. The findings are in line with previous research by Antonis and Christos (2016), Alam and Murad (2020), Huchet-Bourdon et al. (2018), Qunxi et al. (2021), and Wiredu et al. (2018), who emphasize that while trade liberalization can stimulate economic activity, its long-term benefits depend on domestic policies, infrastructure development, and global market conditions.

Gross fixed capital formation shows a positive and statistically significant long-run relationship with GDP per capita at the 1% level, reinforcing its role as a key driver of economic growth. This finding supports the theoretical expectation that investments in infrastructure, machinery, and technology enhance productivity and long-term economic expansion. However, the absence of a significant short-run effect suggests that such investments require time to generate measurable economic

**Table 6** Result from the panel Granger causality

| Null hypothesis | F-Statistic | $p$-value | Decision |
|---|---|---|---|
| FDI Granger cause GDP per capita | 0.318 | 0.727 | Fail to reject |
| GDP per capita Granger cause FDI | 0.415 | 0.660 | Fail to reject |
| Trade openness Granger cause GDP per capita | 1.293 | 0.276 | Fail to reject |
| GDP per capita Granger cause trade openness | 4.676 | 0.010 | Rejected |
| Gross fixed capital formation Granger cause GDP per capita | 0.775 | 0.462 | Fail to reject |
| GDP per capita Granger cause gross fixed capital formation | 3.109 | 0.046 | Rejected |
| Trade openness Granger cause FDI | 0.638 | 0.529 | Fail to reject |
| FDI Granger cause trade openness | 0.041 | 0.959 | Fail to reject |
| Gross fixed capital formation Granger cause FDI | 4.207 | 0.016 | Rejected |
| FDI Granger cause gross fixed capital formation | 1.454 | 0.235 | Fail to reject |
| Gross fixed capital formation Granger cause trade openness | 8.590 | 0.000 | Rejected |
| Trade openness Granger cause gross fixed capital formation | 3.455 | 0.033 | Rejected |

Source: Authors own calculations

returns. These findings align with studies by Apergis and Poufinas (2020), Hajamini and Falahi (2018), and Topcu et al. (2020), which affirm that fixed capital investment is essential for sustained economic growth but does not always yield immediate financial benefits.

Finally, the error correction model (ECM) coefficient of -0.132 reveals that approximately 13.2% of any deviation from the long-run equilibrium in GDP per capita is corrected after one period. This result confirms the presence of a stable long-run relationship between the variables, with short-term imbalances gradually adjusting back to equilibrium. The significance of the ECT coefficient highlights the dynamic adjustment process of the EU economies, where short-term shocks are absorbed over time, ultimately reinforcing the long-term economic equilibrium.

## Panel causality test

The panel Granger causality test results, presented in Table 6, provide insights into the directional relationships among GDP per capita, foreign direct investment, trade openness, and gross fixed capital formation. This test evaluates whether past values of one variable help predict future changes in another, thereby identifying short-run causal dynamics. The findings indicate that FDI does not Granger-cause GDP per capita, suggesting that short-term fluctuations in FDI do not significantly influence economic output per person within the EU. Similarly, GDP per capita does not Granger-cause FDI, implying that economic growth does not immediately influence FDI inflows. These results highlight the complex nature of FDI-GDP interactions, where long-term effects may exist but are not captured by short-term causal dynamics.

For trade openness, the test results indicate that it does not Granger-cause GDP per capita, meaning that short-term changes in trade openness do not immediately impact economic output per person. However, GDP per capita Granger-causes trade openness, suggesting that economic expansion influences subsequent trade openness levels, potentially through increased participation in international markets. Regarding gross fixed capital formation, the test reveals that it does not Granger-cause GDP per capita, implying that short-term changes in investment do not immediately affect economic output. However, GDP per capita Granger-causes gross fixed capital formation, indicating that higher economic output may drive increased investment in fixed capital over time.

Notably, the results identify a bidirectional causal relationship between trade openness and gross fixed capital formation. Specifically, gross fixed capital formation Granger-causes trade openness, suggesting that higher investment in fixed assets may facilitate greater trade activities through improved infrastructure and production capacity. Conversely, trade openness Granger-causes gross fixed capital formation, indicating that greater trade exposure may incentivize investment in capital-intensive industries.

## Conclusion and policy implication

This study investigates the effect of foreign direct investment (FDI) and trade openness in nine European countries, utilizing World Bank data from 1995 to 2021 and applying the panel autoregressive distributed lag (ARDL) method. The findings reveal that FDI has a long-run negative impact on economic growth, despite exhibiting a short-term positive effect. In contrast, gross fixed capital formation does not influence GDP per capita in the short run, but demonstrates a positive long-run relationship. Trade openness contributes positively to economic growth in the short run but exerts a negative effect in the long run. Additionally, Granger causality tests suggest that GDP per capita influences both trade openness and gross fixed capital formation, while bidirectional causality exists between capital formation and trade openness.

These results indicate the need for targeted economic policies to enhance the benefits of FDI and trade openness while mitigating their adverse long-run effects. Given that FDI negatively impacts long-run growth, sector-specific policies should aim to channel foreign investment into industries that drive innovation, productivity, and sustainable economic development. This can be achieved through strategic tax incentives, research and development (R&D) grants, and targeted subsidies, ensuring that FDI contributes to long-term economic resilience rather than creating vulnerabilities associated with foreign capital dependency. A well-structured industrial policy that aligns FDI with national development priorities may help address the observed negative long-run effects on GDP per capita.

Trade openness, while beneficial in the short run, presents long-term economic challenges that necessitate adaptive policy responses. Policymakers should implement comprehensive trade adjustment assistance programs to support industries and labor markets affected by structural shifts in global trade patterns. These programs may include financial support, retraining initiatives, and job transition mechanisms to help workers and firms adjust to competitive pressures. Additionally, the negotiation of trade agreements should strike a balance between economic openness and domestic industrial priorities, ensuring that exposure to global markets does not lead to long-term economic stagnation.

Investment in domestic capital formation is critical for sustaining long-run economic growth. Policies that incentivize infrastructure development, promote advanced manufacturing, and encourage private sector capital investments can enhance the positive long-run relationship between gross fixed capital formation and GDP per capita. Ensuring that capital investments are directed toward high-productivity sectors may further improve long-term economic performance and strengthen domestic competitiveness.

Finally, continuous policy evaluation and adaptive governance are essential to ensure that economic strategies remain effective. Governments should establish robust monitoring systems using clear economic performance indicators, such as FDI inflows, trade balances, productivity metrics, and sectoral growth trends, to assess policy effectiveness. Regular policy reviews and stakeholder consultations will help ensure that economic strategies remain responsive to evolving global and regional economic conditions.

## Limitations of the study

This study relies on World Bank data, which, while widely used, may have measurement limitations affecting the accuracy of the findings. The focus on nine European countries may also limit the generalizability of the results to broader regional or global contexts. While Granger causality tests were conducted, establishing definitive causal relationships remains challenging. Additionally, the use of the panel ARDL model excludes alternative econometric approaches that might offer different insights. Unobserved factors, such as geopolitical events and institutional changes, were not explicitly considered, which could influence the results. The study's static nature may also overlook the evolving dynamics of FDI, trade openness, and economic growth over time. Future research could address these limitations by incorporating a broader dataset, alternative modeling techniques, and dynamic policy considerations to provide a more comprehensive understanding of the topic.

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## Declarations

**Ethical approval** This article does not contain any studies with human participants performed by the authors.

**Conflict of interest** The authors declare no conflict of interest.



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