An Application of the Gravity Model: Exploring Foreign Direct Investment in the Balkan Region

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Abstract: This paper aims to investigate the factors influencing foreign direct investment (FDI) inflows. The study examines several key variables, including Gross Domestic Product (GDP), distance, FDI inflow, percentage of manufacturing value-added, inflation rate, real interest rate, and the index of Economic Freedom. The gravity model analyzes the potential relationships between these independent variables and FDI inflows. Utilizing a logarithmic function, we explore the extent to which FDI inflows are associated with the other variables. The data utilized in this analysis are obtained from reputable sources such as the World Bank and the International Monetary Fund (IMF). The findings reveal a statistically significant relationship between the dependent variable (FDI inflows) and the independent variables.

Keywords: Balkan region, distance, foreign investment, GDP, gravity model, gross capital formation, inflation rate, labor force.

JEL Classification : E1, E10, E17.

1. INTRODUCTION

The economic development of the Balkan region has followed varied trajectories across its countries over time. Relative to other European regions, the Balkan countries have experienced comparatively slower economic growth. This can be attributed to factors such as political instability, weak institutional frameworks, corruption, and limited access to finance for essential commodities.

In recent years, several Balkan countries have witnessed notable economic growth, ranging from moderate to rapid. For instance, Albania has demonstrated significant progress with an average annual growth rate of approximately 4% over the past decade. This growth can be attributed to the flourishing building, energy, and tourist sectors. Similarly, Montenegro and Serbia have experienced substantial economic expansion, both recording an average annual growth rate of around 3.8% during the same period. The infusion of foreign investment in real estate and tourism has played a pivotal role in driving their respective expansions (OECD, 2021).

In contrast, while Albania, Montenegro, and Serbia have experienced notable economic growth in recent years, other Balkan countries, such as Bosnia and Herzegovina, North Macedonia, have faced slower economic growth rates over the past decade, averaging around 2-3% annually. The economic challenges in these countries can be attributed to factors such as political upheaval, weakened institutions, and limited access to credit and finance. These obstacles have hindered investment opportunities and impeded overall economic progress in these regions (OECD, 2021).

Despite the recent progress observed in certain Balkan countries, there remains significant room for further improvement in the region's economic growth and development. To fully harness the potential of the Balkans, it is essential to focus on enhancing various factors. This includes promoting increased political stability, strengthening institutions, reducing corruption, facilitating investment, and improving access to financial resources. By addressing these aspects, the Balkans can foster sustained economic growth and development that benefits the entire region.

This study explores the relationship between the socioeconomic environment and foreign direct investment (FDI) in Balkans. To investigate FDI flows, poverty, and socioeconomic factors at a macro level, we construct a comprehensive dataset and employ an econometric model.

Using the gravity model methodology, factors that influence bilateral FDI flows in six Balkan countries: Albania, Bosnia and Herzegovina, North Macedonia, Serbia, Montenegro, and Kosovo, are examined. To ensure reliable analysis, the study utilizes data from reputable sources, including World Development Indicators, CEPII, KOF, and the Heritage Foundation. The dataset covers the period from 2010 to 2022, providing a thorough examination of the factors shaping FDI flows.

By applying the gravity model technique, the study aims to provide insights into the determinants of FDI flows in the Balkan region. The integration of data from World Development Indicators, CEPII, KOF, and the Heritage Foundation allows for a rigorous analysis of the selected six Balkan countries during the period from 2010 to 2022.

Geographic proximity plays a crucial role in attracting foreign direct investment (FDI) in the Balkans. When host and source countries are closer, managing the supply chain for

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raw materials becomes more cost-effective. To stimulate FDI flows, it is important for the Balkan economies to foster regional cooperation, improve connectivity, and facilitate trade within the region.

Moreover, the positive correlation between GDP growth and FDI inflows highlights the need for policies that promote economic expansion. Balkan nations should prioritize measures to increase their GDP, such as fostering entrepreneurship, enhancing infrastructure, and creating a favorable business environment. Additionally, embracing economic globalization, reducing trade barriers, and ensuring economic freedom are vital in attracting foreign investors. It is also crucial to maintain price stability and implement prudent monetary policies to mitigate the negative impact of inflation and interest rates on FDI.

By focusing on regional cooperation, stimulating GDP growth, embracing economic globalization, and ensuring macroeconomic stability, the Balkan countries can enhance their attractiveness for foreign direct investment, paving the way for sustained economic growth and development in the region.

2. LITERATURE REVIEWS

The relationship between foreign direct investment (FDI) and economic growth has been a subject of significant interest among economists. Various empirical studies have examined this connection and have found that FDI's impact on economic growth varies across different nations. Early research on economic growth focused on neoclassical models, which served as the basis for theoretical and practical studies on capital formation and economic expansion due to their simplicity. These models rely on the production function, which explains the relationship between inputs (such as labor and capital) and the output produced. Neoclassical analyses suggest that FDI primarily influences short-term economic growth rates, while its long-term effects remain limited.

Increases in FDI from external sources can have an impact on capital accumulation, which in turn affects output per capita. However, this impact is temporary due to the law of diminishing marginal returns. To sustain long-term economic growth, foreign direct investment needs to be accompanied by technological advancements and the development of the labor force, which are considered external factors influencing the growth rate.

Analogous to Newton's law of gravity in physics, the gravity model provides insights into the determinants of FDI flows. It posits that the force between two economic entities is proportional to their combined economic weight and inversely proportional to the square of the distance between them (Merko et al., 2022). This model offers a framework for understanding the factors that attract or repel FDI and provides valuable insights for policymakers and researchers studying FDI patterns.

By examining the relationship between FDI and economic growth through neoclassical models and the gravity model, economists gain a better understanding of the short-term and long-term effects of FDI on economic development and can devise appropriate strategies to foster sustainable growth in host nations.

$$F = G\frac{M_1 M_2}{D^2}$$

Foreign direct investment (FDI) can be understood through an analogy that relates it to the combined economic measures of two countries, typically represented by their GDP. The flow of FDI between these countries is proportional to their economic measures raised to a certain power, while inversely proportional to the distance between their economic centers of gravity, often symbolized by their capital cities.

According to Carlos Encinas-Ferrer (2015), FDI plays a crucial role in driving economic growth (EG). Investment serves as a dynamic component of gross domestic product (GDP), with FDI acting as an independent variable influencing GDP growth as the dependent variable.

Studies conducted in Argentina by Oglietti (2007) and Abello (2010) have shown that GDP growth serves as the primary driver for both FDI and portfolio investment flows. Surprisingly, the research findings indicated that FDI did not generate a reciprocal impact on economic growth, challenging the expected positive relationship between FDI inflows and GDP growth. Instead, a country's attractiveness to foreign investment tends to increase with its GDP growth.

Factors such as market size, proximity, shared language, and geographical contiguity influence foreign investment. Macroeconomic variables, including inflation and interest rates, also play a crucial role in attracting higher levels of FDI. Additionally, institutional and infrastructure-related factors, such as telecommunication infrastructure, openness level, globalization index, and economic freedom index, contribute to attracting foreign investment from developed nations into prominent Asian countries, as supported by Mishra and Jena's (2019) research.

Kosztowniak's research covering the period between 2004 and 2020 reveals that FDI from innovative industries accounted for approximately 7% of Poland's economy in terms of value added. The value added of foreign businesses in Poland's innovative industries grew at a faster rate (by 5 percentage points) between 2009 and 2018 compared to other industries. The results indicate that innovative industries have a higher explanatory power of FDI in relation to GDP compared to other sectors.

3. METHODOLOGY

We conducted an analysis of bilateral direct investment flows between six Member States, focusing on foreign direct investment (FDI) inflows from the home economy (j) to the host economy (i). Our data covers the period from 2010 to 2021, and we employed natural logarithms (ln) as the scale of measurement to estimate the gravity model.

The gravity model equation we utilized in this academic journal is as follows:

$$\ln\left(IHDflow_{ij}\right) = a_0 + a_1 \ln(Y_{it}) + a_2 \ln(Y_{jt}) + a_3 \ln(D_{ij})$$

In this equation, i, j, and t represent indices for the host economy, home economy, and year, respectively. FDI flow refers to the inflow of foreign direct investment into the host economy from the home economy in a given year (t). Yi(t) and Yj(t) represent the Gross Domestic Product of the host and home economies in year t, respectively. Additionally, Dij represents the geographic distance between the economic centers of the host and home economies, which remains constant for EU Member States from 1990 to 2009.

Upon evaluation, the fundamental model yielded reasonably satisfactory outcomes. However, it is important to acknowledge that other factors beyond those included in the model may also influence FDI levels.

The Econometric Model

In the econometric model, we incorporate a random error term " u" to account for the discrepancy between the observed variables Yit, Yjt, Dij, and the expected value of GDP. This random error captures the influence of various other factors on GDP, apart from capital, human capital, and FDI. By including this error term, we enhance the comprehensiveness of the model.

$$\ln(IHDflow_{ij}) = \propto_0 + \propto_1 \ln(Y_{it}) + \propto_2 \ln(Y_{jt}) + \propto_3 \ln(D_i) + u$$

This econometric model presents a more realistic portrayal of the interconnectedness among the variables under investigation.

To construct a comprehensive econometric model that captures the dynamics of foreign direct investment flows, this study builds upon the gravity model initially proposed by Frankel, Stein, and Wei (1997).

The selected model will be expressed in log-log form to facilitate the estimation of elasticity coefficients. However, employing a logarithmic transformation presents two significant challenges. Firstly, the equation cannot be utilized for variables containing zero values as the logarithm of zero is undefined. Secondly, estimating the log-log equation using the Ordinary Least Squares (OLS) method may introduce notable biases.

In the subsequent sections of this paper, we will address these challenges by replacing zero values with $1 in order to exclude them from the dataset employed in our model estimation.

Evaluation Methods

The theoretical foundation and specification of the gravity model have been the subject of extensive discussions during the 1980s and 1990s. However, in recent years, the estimation techniques employed for gravity models have generated significant controversy. In this section, we will provide an overview and elucidate the principal estimation methods applicable to panel data, as outlined by Prendi in 2015.

The Fixed Effects (FE)

This model is based on the assumption that individual variations can be captured by different intercepts, suggesting that (∝_1, ∝_2, ∝_3) may vary across countries. However, it is important to note that this model is not applicable to all types of panel data. Particularly, when dealing with panel data that is characterized as short and wide, this model is not suitable (Hill et al., 2011).

The regression equation for the fixed effects model in panel data can be represented as follows:

$$Y_{it} = \propto_{0t} + \propto_{1t} X_{1it} + \propto_{2t} X_{2it} + \propto_{3t} X_{3it} + u$$

for i = 1,2, ..., N and t = 1,2, ..., T. Where N = the number of countries and T = the number of periods.

However, it is important to note that the fixed effects (FE) estimator has limitations when dealing with variables that remain constant over time or across a set of individuals. To address this issue, we equalize the mean in each observation, hold the opposing variable constant at zero, and subsequently exclude these variables from the further transformation of "ai." For example, variables such as distance, which does not vary over time, and Austrian GDP, which remains constant across individuals, cannot be included in the data structure.

Furthermore, a significant drawback of the FE method arises when the number of subjects (N) becomes extremely large, resulting in a substantial loss of degrees of freedom.

In addition, the inferential validity of the F estimator is potentially more sensitive to deviations from normality, heteroscedasticity, and serial correlation in idiosyncratic errors (Wooldridge, 2003).

It is worth noting that the FE estimator's mechanism encounters a problem similar to allowing a distinct intercept for each cross-sectional unit. Despite its widespread usage by researchers due to its simplicity and high explanatory power, it is crucial to recognize that violating any of the aforementioned assumptions undermines the consistency of the Fixed Effects (FE) estimator, thereby challenging its status as the Best Linear Unbiased Estimator (BLUE). Consequently, in our analysis, we will carefully examine potential violations (Prendi, 2015).

Random Effect (RE)

The aim of this model is to estimate panel data that may involve interconnections among the explanatory variables across time and countries. The Random Effects (RE) estimator relies on the fundamental assumption of orthogonality between individual effects and regressors: Corr(a_i, x_ij) = 0 for all t and j. This assumption suggests that the heterogeneous unobserved component 'a_i' follows a random distribution with a specified mean and variance. It implies that factors unique to each individual, whether it is a country or a specific year, independently influence bilateral foreign direct investment (FDI), irrespective of variables like GDP, distance, or other covariates. As Zulfikar (2018, p. 7) explains, the random effect model differs from both fixed effect and common effect models as it employs maximum likelihood or general least squares principles instead of ordinary least squares principles.

Johnston and DiNardo (1997) argue that pooling all RE estimators introduces bias to the Ordinary Least Squares (OLS) estimator. Therefore, to mitigate this bias, we refrain from using the OLS method and instead employ the Random Effects (RE) estimation technique, known for its relatively small standard errors. Extensive academic literature consistently demonstrates that the RE estimator provides higher efficiency compared to OLS. Esteemed researchers such as

Fratianni and Hoonoh (2009) have utilized the RE estimator in their studies, further validating its widespread use. In our empirical analysis, we will also employ this estimation technique.

It is common for authors to apply both Random Effects (RE) and Fixed Effects (FE) techniques and conduct statistical tests to evaluate significant differences in their coefficients on explanatory variables. However, due to the conflicts in their underlying assumptions, it is theoretically impossible to simultaneously use both methods.

Selection Method of Regression Data Panel

In order to determine the most suitable model, we will employ the Hausman test, which aids in discerning the appropriateness of either the Random Effects (RE) or Fixed Effects (FE) model.

The hypotheses raised for this test are:

$H_0: Cov\ (a_i, x_{it}) = 0\ \forall\ t$

$H_1: Cov(a_i,\ ex_{it}) \neq 0\ pwr\ tw\ pattern\ new\ t.$

Regarding the choice between Fixed Effects (FE) and Random Effects (RE) estimators, the FE estimator is generally considered to be more robust than the RE estimator under the alternative hypothesis. However, the preference between the two estimators depends on the outcome of the hypothesis test (H_0). If the null hypothesis is rejected, indicating the presence of individual-specific effects, the FE estimator is preferable, whereas if the null hypothesis is not rejected, the RE estimator is more appropriate.

For instance, studies conducted by Frantianni and Hoonoh (2009) and Cavallari (2008) incorporated both estimators and employed the Hausman test to determine the most suitable estimator. The results of the Hausman test led to the selection of the RE estimator in these cases. However, it is important to note that there may be instances where the p-value of the Hausman test presents ambiguity, making the choice between FE and RE estimators less clear-cut.

Additionally, Gomez and Milgram (2009) argued in favor of the FE estimator, emphasizing that although it may yield consistent but less efficient results, it should still be preferred in certain circumstances.

Description of Variables for the Model

Gross Domestic Product (GDP) represents the total market value of all final goods and services produced within a country during a specific time period.

Distance (Dist) refers to the geographical separation between two locations and is generally associated with transportation costs. As the distance increases, the cost of transportation tends to rise.

FDI Inflow stands for foreign direct investment inflow and represents the equity investment flows made by foreign entities into the reporting economy**.**

% Manufacturing Value Added signifies the contribution of the manufacturing sector to a country's overall GDP. It indicates the proportion of value added by the manufacturing industry in relation to the country's total economic output, while FDI refers to investments made by foreign companies in the host country.

Inflation Rate refers to the pace at which the general level of prices for goods and services in a country increases over time, resulting in a decline in the purchasing power of the currency.

Real Interest Rate refers to the interest rate adjusted for inflation. It is calculated by subtracting the inflation rate from the nominal interest rate, providing a measure of the actual return on investments after accounting for changes in purchasing power.

Index of Economic Freedom measures the extent to which individuals possess the essential right to control their labor and property. It reflects the degree of economic freedom within a society, allowing individuals to freely engage in work, production, consumption, and investment according to their preferences.

Table of the Variables:

Variables	Symbol
FDI inflow	Y
GDP_distance	X_1
Index of economic freedom	X_2
Inflation rate	X_3
% manufacturing value added	X_4
Real interest rate	X_5
REMOT	X_6
SCALE	X_7

4. ANALYSIS OF RESULTS AND FINDINGS

The gravity model of foreign investment serves as an economic framework that aims to elucidate and predict the patterns of international FDI flows. Inspired by the gravity model of global trade, which asserts that trade volume between two nations is inversely related to their distance and directly proportional to the size of their economies, the gravity model of foreign investment operates on similar principles.

According to this model, various factors influence the movement of foreign direct investment (FDI) between countries. These factors include the economic size of nations, typically indicated by GDP, as well as physical and cultural distances. Additionally, other pertinent considerations such as the degree of economic growth, market size, political stability, legal system, linkages to the local culture, and bilateral economic relations play a role.

The model assumes that economies with larger markets and greater potential profitability attract higher levels of foreign investment. Furthermore, nations that are geographically closer, share borders, or possess cultural affinities tend to experience higher investment flows, facilitated by lower information costs, easier communication, and stronger commercial relations.

To represent the gravity model of foreign investment, the following equation can be employed:

$FDI_{ij} = k * (GDP_i * GDP_j) / D_{ij}$

Where:

- The variable FDI_{ij} denotes the foreign direct investment (FDI) flow between country i and country j.
- GDP_i and GDP_j are the GDPs of country i and country j, respectively.
- D_{ij} denotes the distance or other measures of dissimilarity between country i and country j.
- k represents a scaling constant or coefficient.

The gravity model of foreign investment holds significant prominence in empirical studies as a valuable tool for analyzing and forecasting FDI flows between countries. Its simplicity and intuitive nature make it an attractive framework for understanding the key drivers of foreign investment. Nonetheless, it is crucial to acknowledge that the model's explanatory power may be limited as there can be other factors at play that are not captured within its basic structure.

Researchers recognize the need to extend the basic gravity model by incorporating additional variables to enhance its predictive capability and account for specific country characteristics or policy factors. By expanding the model, they aim to capture a more comprehensive range of determinants that influence foreign investment decisions. These additional variables can encompass a wide array of factors, such as institutional quality, policy frameworks, infrastructure development, technological capabilities, and industry-specific characteristics.

By considering these supplementary variables, researchers strive to refine the gravity model and enhance its applicability in explaining the complexities of foreign investment patterns. This approach enables a more nuanced understanding of the forces shaping FDI flows and offers insights that go beyond the model's initial scope.

Implementation of Gravity Model

The main objective of this section is to assess the Gravity Model and its associated variables that impact foreign direct investment (FDI). To accomplish this, we employ two distinct methods to examine and evaluate the parameters of the Gravity Model:

• Method 1: Panel EGLS (Cross-section random effects)

• Method 2: Panel EGLS (Cross-section fixed effects)

In order to select the appropriate method, we will delve into the details of the Hausman Test. This test serves as a crucial tool in determining whether the random effects or fixed effects approach is more suitable for our analysis.

Hausman Test

The Hausman test is conducted to assess the distinction between the two methods: Panel EGLS (Cross-section random effects) and Panel EGLS (Cross-section fixed effects). The test examines the correlation between the idiosyncratic error term and the explanatory variables, with the null hypothesis suggesting that the random effects model is preferred and the alternative hypothesis indicating that the fixed effects model is more appropriate.

The calculated Chi-Square value is 3.695405, corresponding to a p-value of 0.1576. This result indicates that the cross-section random effects technique is more suitable for our model.

Table 4. 1. Haustmant Test.

Test cross-section random effects		
Test Summary	**Chi-Sq. Statistic**	**Prob.**
Cross-section random	3.695405	0.1576

Panel EGLS (Cross-section random effects)

Table 4.2 presents the estimation of FDI inflow using random effects. The model yields consistent results with the theory, emphasizing the significance of distance between countries, which exhibits a negative sign. Additionally, economic measures demonstrate a positive and significant sign.

Table 4.2. Panel EGLS (Cross-section Random Effects).

Dependent Variable: Y				
Sample: 2011 - 2021				
Periods included: 11				
Cross-sections included: 20				
Total panel (balanced) observations: 220				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X_1	4.425860	1.385734	3.193873	0.0016
X_2	18.62759	11.82574	1.575174	0.1167
X_3	7.077732	11.51531	0.614637	0.5395
X_4	1.791062	0.222526	8.048794	0.0000
X_5	6.148930	2.298807	2.674835	0.0080
X_6	-6.188415	2.598836	-2.381225	0.0181
X_7	16.14893	6.037354	2.674835	0.0080
C	-1632.922	2656.133	-0.614774	0.5394
	Weighted Statistics			
R-squared	0.676352			
Adjusted R-squared	0.665912			
F-statistic	10.14417			
Prob(F-statistic)	0.000000			

Source: Author.

Variables that Affect Inward Direct Investment

The analysis in Table 4.2 reveals several significant findings regarding the factors influencing foreign direct investment (FDI). Firstly, larger countries, as measured by GDP, tend to attract more investment compared to smaller countries, as evidenced by a p-value of 0.0016. Additionally, the real interest rate has a positive effect on FDI, indicating that lower interest rates can encourage higher levels of investment (p-value=0.0016).

Furthermore, the distance between partner countries shows a negative impact on FDI for smaller countries, highlighting the importance of geographic proximity in investment decisions (p-value=0.0000). Population size also plays a role, with larger populations positively impacting FDI (p-value=0.008).

Moreover, the variable MVA (manufacturing value added) demonstrates a positive relationship with FDI. Factors such as capital, technology, market access, and job creation contribute to the growth and development of the manufacturing sector, resulting in a significant increase in economic value added (p-value = 0.000).

These findings provide valuable insights into the factors that drive foreign direct investment and underscore the significance of variables such as GDP, interest rates, distance, population size, and the manufacturing sector in attracting investment flows.

5. CONCLUSIONS

In conclusion, the Gravity model highlights that changes in distance between countries play a significant role in influencing FDI inflows. As the distance increases, FDI inflows tend to decrease. This can be attributed to higher costs and perceived risks associated with investing in geographically distant countries, as well as potential information asymmetry between foreign investors and host countries.

Population size emerges as a positive factor for FDI, as it represents a larger consumer market, enables economies of scale, provides a larger labor pool, and serves as a gateway to regional markets.

The real interest rate also has a positive impact on FDI, as higher rates attract capital inflows from foreign investors seeking higher returns. Foreign investors may demand higher returns to compensate for the cost of capital, which can affect currency values, exchange rates, enhance investor confidence, and ultimately contribute to increased FDI.

GDP exerts a positive influence on FDI due to various factors such as improved market access, expanded growth opportunities, resource availability, cost efficiency, competitiveness, technological advancements, innovation, access to skilled talent, and other relevant determinants.

Furthermore, there exists a reciprocal relationship between manufacturing value added (MVA) and FDI. Changes in MVA can affect FDI, and vice versa. Factors such as market size and potential, competitiveness, comparative advantage, technological advancements, supply chain integration, and infrastructure contribute to this relationship.

These findings underscore the importance of considering distance, population size, interest rates, GDP, and the manufacturing sector when analyzing and understanding the determinants of FDI. By comprehending these factors, policymakers and stakeholders can implement strategies to attract and promote foreign direct investment, ultimately driving economic growth and development.

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