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A Bivariate Causality Analysis on the Impact of Foreign Direct Investment Inflows on the Economic Growth of The Gambia

Lee, Cheng-Wen[1] and Mendy, Patrick A.[1]

Abstract

This study explores the relationship between Foreign Direct Investment (FDI) and Economic Growth (GDP) in The Gambia using OLS, Johansen's Cointegration, VECM approach on time series data from 1963 to 2023 period. Through a bivariate regression analysis, the findings reveal a significant and positive association between FDI inflows and economic growth. The estimated model shows that FDI has a substantial impact on GDP, explaining approximately 30.6 percent of the variation in economic performance. Despite the moderate explanatory power, the statistically significant coefficient underscores FDI's potential as a catalyst for growth. The Granger Causality results analysis indicates a non-directional causal relationship for GDP and FDI. These findings imply that while FDI is important, a broader policy mix is required to sustain and enhance growth in The Gambia.

JEL classification numbers: F21, F43, O11, O55, C32.
Keywords: Foreign Direct Investment, Economic Growth, Bivariate Analysis, Granger causality.

[1] Chung Yuan Christian University.

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1. Introduction

The Gambia is a newly established democratic country that prioritizes progress, equal rights and justice in its economic development endeavor in the recent years. The country's economy is based primarily on agriculture, with the tourism sector playing a supporting role. Its land area is approximately 11,300sq/km with a population of around 2.8 million, as recorded in the April 2023 census. The Government established The Gambia Investment and Export Promotion Agency (GIEPA) in 2002 and is responsible for managing the Free Economic Zones (FEZs) in and around the capital city. Additionally, the GIEPA Act 2010 mandates the agency to support and promote the growth and development of small and micro-enterprises (SMEs) furthering the Government's goal of attracting and promoting FDI.

Economic growth (GDP) is essential for developing nations to improve standards of living and increase employment while on the other hand, Foreign Direct Investment (FDI) is often seen as a catalyst for economic growth bringing capital and technology as well as expertise into the host country economy. FDI represents a significant part of the Gambia economic strategy given its limited domestic capital base. GDP is the total value of every goods and services produced by its citizens and corporations within a country in one year. It represents a comprehensive measurement that can compare economic welfare advancement and Standard of living across time for all countries. This paper explores the causality between FDI inflows and economic growth in the Gambia using a bivariate causal analysis approach.

Despite extensive research on the relationship between FDI inflows and economic growth, there are significant gaps in understanding this dynamic in the context of The Gambia economy with unique structural investment climate and policy characteristics. Most existing studies on FDI and economic growth focus on large economies or regional analyses, often overlooking small economies like The Gambia. Some studies adopt multivariate frameworks but fail to provide a direct causal link between FDI and economic growth using bivariate Granger causality tests [1, 2]. Investigating the direction of causality is essential to determine whether FDI drives economic growth or vice versa. Also, prior research offers mixed conclusions on whether FDI positively influences economic growth depending on factors such as human capital, financial market development and institutional quality thus, a study specific to the Gambia can help clarify these inconsistencies. While short-run impacts of FDI on economic growth have been studied, long-term relationships remain underexplored in The Gambia context. Using Johansen cointegration tests and Vector Error Correction Models (VECM) can address this gap. The study will contribute to the literature by providing a focused empirical analysis of how FDI influences economic growth using bivariate causality techniques to determine the direction of the relationship. The study will also offer valuable policy insights for decision-makers looking to optimize FDI's role in economic development of The Gambia.

2. Literature Review

The relationship between FDI and economic growth has been widely studied in economic literature with various findings depending on the country, methodology and time period considered. This section examines bivariate causality studies on FDI and economic growth focusing on the unique case of The Gambia. There are conflicting pieces of evidence in the previous literature concerning how, why and to what extent FDI affects GDP growth in different nations. FDI may affect economic growth directly especially for developing nations [3], since its contribution to capital accumulation and infrastructure development coupled with the transfer of new technologies to host countries. The study attempts to give a thorough grasp of how FDI inflows and economic growth interact and influence one another for The Gambia economy by looking at time series historical data trends and empirical research evidence. Nonetheless, this study's literature is arranged into three primary sections. This covers the theoretical and empirical framework as well as conceptual framework explanation.

2.1 Conceptual Framework

Economic growth can attract FDI, which can lead to knowledge transfer and export diversification. FDI and economic growth have a complex and interconnected causal relationship as well as boosts GDP thus, exerts diverse impacts on economic growth. FDI is essential for fostering economic advancement by infusing capital, technology and skill into host nations [4]. The Gambia has proactively pursued FDI to expedite its development initiatives. Substantial FDI inflows have been attracted to sectors like tourism, fishing, mining, agriculture and manufacturing which promotes employment growth and enhancing industrialization efforts. It not only facilitates capital production but also promotes the transfer of technological knowledge. Collaborations with overseas investors can enhance the competitiveness and capacity of domestic enterprises. The case of The Gambia illustrates that FDI can serve as a catalyst for essential sector diversification and modernization aligning with its long-term developmental objectives [5].

In 2023, the GDP of The Gambia indicative of economic growth amounted to 2.40 billion US dollars, as per official figures from the trading economics. The GDP of The Gambia constitutes zero percent of the global economy. However, in the fourth quarter of 2023, The Gambia's GDP increased by 5.60 percent compared to the same quarter of the prior year. The GDP annual growth rate in The Gambia averaged 3.78 percent from 1968 to 2023 peaking at 12.39 percent in 1975 and hitting a nadir of -8.10 percent in 2011. Agriculture is the biggest contributing sector to the GDP. In the third quarter of 2024, the GDP from Agriculture rose to 5,298,367 dalasi (GMD) Thousand, up from 3,741,063 GMD Thousand in the second quarter. The average GDP from Agriculture from 2014 to 2024 was 3,302,994.95 GMD Thousand, peaking at 5,298,367.00 GMD Thousand in the third quarter of the same year and hitting a nadir of 1,777,740.00 GMD Thousand in the fourth quarter of 2014. In 2023, the GDP per capita was last documented at 727.84 US dollars. The GDP per

capita constitutes 6 percent of the global average. The average GDP per capita from 1966 to 2023 was 642.15 USD, peaking at 727.84 USD in 2023 and hitting a nadir of 526.39 USD in 1967 respectively.

The GDP has exhibited a continuous rising trajectory from 2013 to 2023, signifying sustained economic growth throughout the years. Despite overall growth, many years demonstrate slower rises, maybe attributable to economic shocks, policy alterations or external influences such as global economic conditions. The projected GDP for 2024 and subsequent years (shown by grey bars) in figure 1: indicates an upward trend with the economy anticipated to exceed USD 2.6 billion. A prospective factor in economic growth in The Gambia, consistent with the discourse on the effects of FDI. The Gambian economy has experienced consistent growth in recent years due to advancements in tourism, remittance inflows and re-export activities. The government is striving to sustain the growth rate by enacting policies focused on upgrading agriculture. Figure 1. below shows a bar chart representing the Gambia's GDP in USD billion from 2013 to 2025. The historical GDP figures are depicted in blue bars, but the predicted GDP figures from 2024 onwards are illustrated in grey.

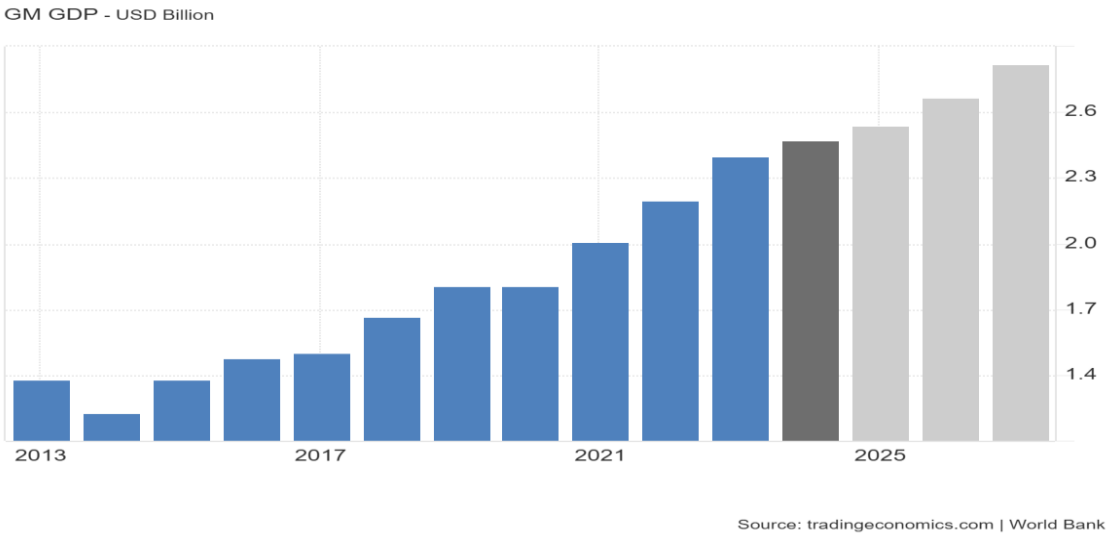

Figure 1: GDP forecast source: https://tradingeconomics.com/gambia/gdp

The GDP has seen variations over the years, however it demonstrates a predominant rising trajectory, particularly post-2000. FDI seems to exhibit greater volatility characterized by frequent and significant fluctuations across time. There are intervals during which GDP and FDI exhibit parallel movements and others where they diverge. Figure 2: illustrates the historical trends of GDP and FDI showing that both have experienced fluctuations but with differing levels of volatility. GDP appears to follow a steadier long-term growth trend, whereas FDI exhibits more dramatic short-term fluctuations.

The two sets of histogram bars figure 3 and figure 4 represents two different datasets: GDP and FDI. The GDP bars are shaded with diagonal lines in black. The FDI bars are shaded with diagonal lines in red. The GDP data appears right-skewed, meaning most of the observations are concentrated on the lower end of the value range, with fewer observations in the higher range. This pattern aligns with the previously observed positive skewness in the descriptive statistics, indicating that a few high GDP values are pulling the mean to the right. FDI values show a clustering around the lower end of the spectrum, with many values near zero. The sharp peaks and rapid decline also confirm the left-skewed nature (as previously suggested by the negative skewness statistic). Most of the FDI inflows are relatively small, with few occurrences of large inflows. On the other hand, Figure 4: shows the statistical comparison bar chart of GDP and FDI key statistical measures in which the x-axis represents different statistical measures (Mean, Standard Deviation, Min, Percentiles, Max, Skewness, Kurtosis). The y-axis represents numerical values for these measures. The legend indicates GDP (orange) and FDI (green). GDP has a higher mean (2.9) than FDI (2.07), indicating that GDP values are generally higher, skewed and are more consistently positive while FDI is negatively skewed, has more outliers and more volatile with extreme negative values and a wider range.

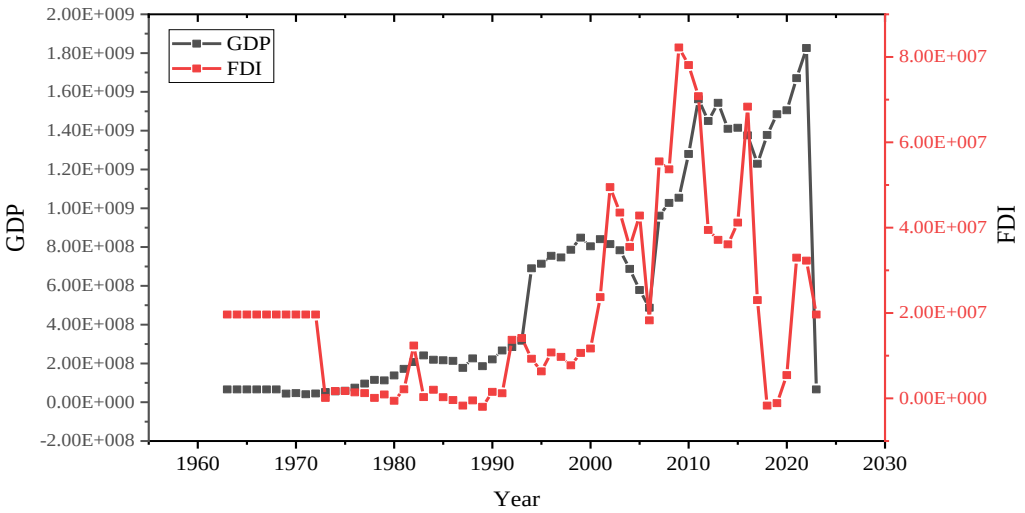

Figure 2: GDP Vs FDI Graph

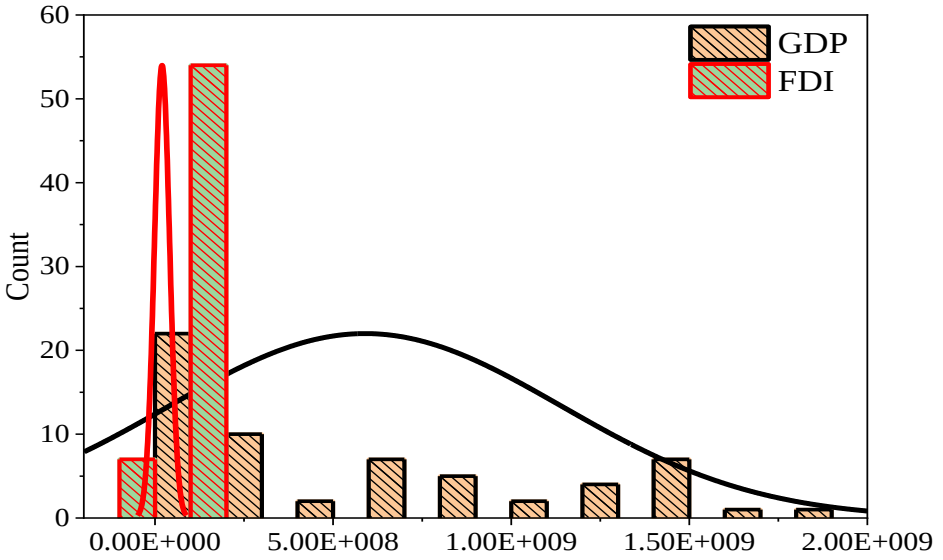

Figure 3: The histogram and distribution plot

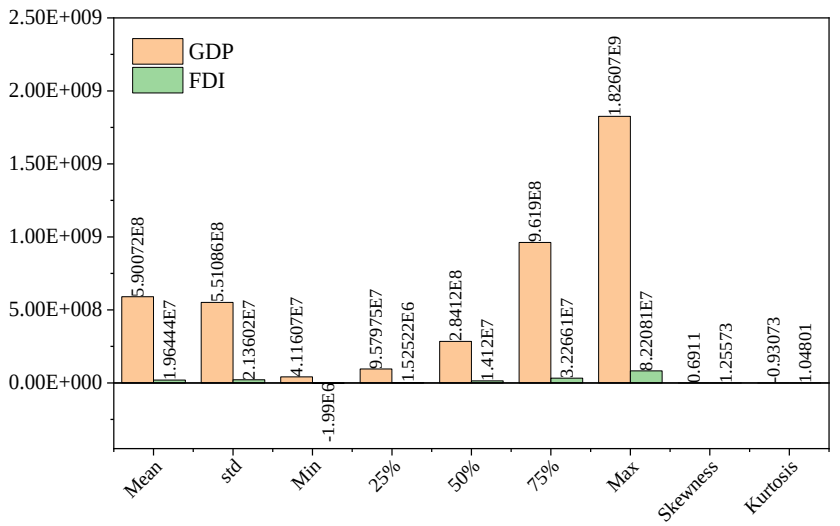

Figure 4: A visual comparison of descriptive statistics for GDP and FDI

2.2 Theoretical Framework

The relationship between FDI and economic growth has been thoroughly examined in economic literature. Various theoretical frameworks aim to clarify this connection concentrating particularly on the direction of causality with each presenting unique viewpoint on how FDI affects or is affected by economic performance. Understanding this relationship is crucial for policymakers in The Gambia where FDI is viewed as one of the key drivers of economic transformation. This literature review section outlines the key theoretical frameworks that underpin the bivariate causality analysis between FDI inflows and economic growth.

The neoclassical growth theory asserts that FDI enhances economic growth through capital accumulation and productivity improvement. Likewise, endogenous growth theory [6] and [7] posits that FDI can result in technology spillovers, enhancement of human capital and improvements in efficiency. The causal relationship between FDI and economic growth is empirically ambiguous requiring the utilization of Granger causality tests and cointegration models. Similarly, Endogenous growth models exemplified by [6] and [7] emphasize the significance of FDI in promoting technological progress, human capital enhancement and innovation. In contrast to the neoclassical paradigm, endogenous growth theory posits that FDI exerts a lasting influence on economic growth by fostering knowledge spillovers, managerial acumen and productivity [8] especially in emerging nations such as The Gambia.

The dependency theory [9] posits that FDI may not inherently result in economic growth for developing countries because of exploitative dynamics between multinational businesses and host economies. This viewpoint contends that FDI might result in capital outflows, reliance on foreign enterprises and structural imbalances, potentially obstructing sustainable economic development while Dunning's OLI Ownership, Location and Internalization Paradigm [10] offers a framework for examining the rationale and mechanisms behind FDI. It indicates that FDI fosters growth when a nation has locational advantages; such as natural resources and stable policies and also when international companies integrate operations that enhance the local economy.

Bivariate causality analysis examines whether FDI leads to economic growth, vice versa, or if both variables have a bidirectional influence. FDI-Led Growth Hypothesis suggests that FDI inflows stimulate economic growth by supplying capital, generating employment and introducing sophisticated technology. Empirical research including that of [11] substantiates that FDI augments productivity particularly in countries with robust human capital foundations. On the other hand, Growth-Led FDI Hypothesis with opposite viewpoint asserts that economic progress draws FDI by fostering a conducive investment environment, enhancing infrastructure and broadening market opportunities. Research conducted by [12] posits that FDI is a consequence of economic growth rather than a catalyst for it. Some scholars find evidence of bidirectional causality where FDI and economic growth reinforce each other [13-15]. This relationship suggests that initial

FDI inflows stimulate economic expansion, which in turn attracts further investment, creating a self-sustaining cycle.

2.3 Empirical Framework

The empirical framework regarding the relationship between FDI and economic growth establish a foundation for analyzing the direction of causality. The Gambia's experience with FDI indicates that a strategic blend of structural reforms, human capital development and effective macroeconomic policies is crucial for optimizing the advantages of FDI inflows. Empirical research examining this correlation has shown inconclusive results differing methodology and temporal context for various countries and regions. The empirical approach for analyzing the FDI and economic growth relationship for the Gambia is crucial to ascertain whether FDI acts as a catalyst for economic expansion or if its influence is constrained. This study assesses current empirical research on bivariate causality analysis, specifically utilizing econometric methods to ascertain the causal relationship between FDI and economic growth in The Gambia.

The relationship between FDI and economic growth has been a subject of extensive empirical research. Two prominent hypotheses have emerged: the FDI led hypothesis and the market size hypothesis. The FDI led hypothesis posits that economic growth attracts FDI as a growing economy signals expanding markets and increasing returns on investment. Conversely, the market size hypothesis suggests that FDI is drawn to countries with larger markets, which can absorb more goods and services. This section reviews empirical studies that examine these hypotheses, focusing on how economic growth attracts FDI. The growth-driven FDI hypothesis argues that economic growth acts as a magnet for FDI inflows. Empirical studies have provided mixed evidence on this hypothesis, with some supporting the idea that growth leads to FDI while others find bidirectional relationships or no significant link. This paper primarily focuses on the FDI led growth hypothesis rather than the market size hypothesis. It finds that positive FDI shocks significantly impact economic growth in Regional Comprehensive Economic Partnership (RCEP) countries, indicating limited support for the market size hypothesis in this context [16].

The FDI led growth hypothesis posits that FDI inflows can significantly enhance economic growth by contributing to capital formation, technological advancement and productivity improvements. Empirical research, particularly in developing economies, supports this hypothesis by demonstrating that FDI can lead to economic growth through technology spillovers and employment generation. However, the relationship is complex and influenced by various factors, including the host country's absorptive capacity and sectoral characteristics. Studies supporting the FDI led growth hypothesis argue that FDI inflows enhance capital formation, skills, technological advancement and productivity thereby stimulating economic growth. Many empirical researches indicate that FDI significantly contributes to economic growth in developing economies through technology

spillovers and employment generation. For instance, [17-20] highlight that FDI can promote economic growth by facilitating technology diffusion and improving human capital which are crucial for maximizing the benefits of foreign investments in host countries.

Similarly, [21] also supports the FDI led growth hypothesis, indicating that FDI positively and significantly affects economic growth in developing countries. For them FDI contributes to physical capital accumulation, which is a direct input into the production process, thereby enhancing economic growth. It also acts as a conduit for technology transfer, facilitating technological spillovers that improve total factor productivity (TFP) in the host country. FDI can create jobs, which increases income and consumption, further stimulating economic growth thus, the presence of foreign firms can lead to skill development among the local workforce, enhancing human capital [22]. [21] studies analyze data from 85 developing countries across Asia, Africa and Latin America from 1980 to 2007, confirming that FDI promotes growth by enhancing capital formation and productivity. The study accounts for regional differences and income levels aligning with previous research such as [23] and [24] that highlights FDI's role in technology spillovers and employment generation, ultimately contributing to economic growth.

However, a broad range of empirical studies has explored the impact of FDI on economic growth employing techniques such as Granger causality tests, Vector Autoregressive (VAR) models and Vector Error Correction Models (VECM). [25] uses the ARDL bounds test approach cointegration to test for the long run correlation between economic growth, FDI and exports. He concluded that both FDI and exports spur economic growth. Equally, [26] investigated the relationship between FDI and other economic factors that also have a direct or indirect impact on GDP and found that the two are positively correlated. Existing empirical studies such as [27] on the Gambia's economy suggest positive evidence regarding the FDI and growth nexus. While some studies indicate that FDI inflows contribute to GDP growth through investment in tourism and agriculture [28, 29], others highlight the weak absorptive capacity of the economy due to infrastructural and institutional challenges [30, 31].

[32] indicates a unidirectional significant short-run positive effect of real GDP on net FDI inflows in Turkey, suggesting that economic growth attracts FDI, although no long-run effect was found, contrasting with some empirical studies supporting the growth-driven FDI hypothesis while [33] focuses on the FDI led economic growth hypothesis in Bangladesh, indicating that FDI positively affects economic growth in the long run. However, it does not specifically address the market size hypothesis or how economic growth attracts FDI.

Some studies find no significant relationship between FDI and economic growth, arguing that the benefits of FDI are conditional on factors such as human capital development, financial market sophistication and macroeconomic stability [34]. Similarly, certain research reveals no substantial causal link between FDI and economic growth suggesting that alternative macroeconomic factors like trade openness, institutional quality and financial development may influence the effect

of FDI on economic performance. [35] researched on the Impacts of Domestic and FDI on Economic Growth in Saudi Arabia using the autoregressive distributed lag (ARDL) bounds testing to cointegration approach and the results show that in the long term there are negative bidirectional causality between non-oil GDP growth and FDI.

However, [36, 37] used the Granger causality analysis and the Johansen cointegration test to perform an empirical study on the relationship between FDI and economic growth. The study found no significant relationship between FDI and economic growth in the short or long term. [38] finds no evidence of reverse causality from growth to investment ratio, supporting the growth-driven FDI hypothesis. It emphasizes that FDI complements domestic investment, promoting growth, thus aligning with the market size hypothesis where economic growth attracts FDI. Also, [39] uses panel data to examine the impact of FDI on GDP in 19 Latin American nations. The results provide strong empirical support for the idea that, when taken as a whole, the effect of FDI on GDP is not statistically significant. This suggests that FDI has no effect on GDP growth or decline and vice versa.

The empirical literature regarding the causality between FDI inflows and economic growth in The Gambia indicates a primarily favorable, but occasionally tenuous, relationship. Some studies identify unidirectional causality from FDI to economic growth, while others emphasize a bidirectional link. The efficacy of FDI in promoting economic growth is contingent upon complementary factors, including human capital development and the depth of financial markets. Although the empirical studies reviewed in this section provide evidence on the FDI led hypothesis and the market size hypothesis, there are some studies that support the FDI led hypothesis and others find evidence for the market size hypothesis. The interplay between the two hypotheses suggests that both economic growth and market size play a role in attracting FDI. Policymakers should consider these findings when designing policies to attract FDI and promote economic growth. Future empirical research must address existing deficiencies by employing rigorous econometric methodologies and more extensive data to yield clearer policy implications.

3. Methodology

3.1 Nature and data source

This section describes and outlines the variables used for the research, its source and data collection method. The estimation of an econometric model that establishes the connection between FDI and GDP growth will be part of the techniques used. The data set was drawn from world bank data base for the period 1963 to 2023.

3.2 The ordinary Least Squares methods (OLS)

The OLS frequently reduces the sum of squares of differences between explanatory variables and those projected by the linear function in order to identify factors for the linear function in a given collection of illustrated variables. This technique was

first established by Carl Friedrich Gauss in 1821[40] and has successively advanced as a Classical Linear Regression Model. In case of economic growth (GDP) and FDI, his model's linear regression equation can be expressed as shown below.

$$GDP = f(FDI) \quad (1)$$

$$GDP = \alpha_{\circ} + \beta_1 FDI + \varepsilon \quad (2)$$

While FDI stands for Foreign Direct Investment for the period under consideration, GDP is for Gross Domestic Product. The error term, ε, shows factors other than FDI that have an impact on GDP. The intercepts and the regression coefficient are denoted by $\alpha_{\circ}$ and β_1, respectively. The Gauss-Markov assumptions are applied in this study, which include the following: the estimators ($\alpha_{\circ}$, β_1) are unbiased with an expected value of zero, i.e., E (ε) = 0, which suggests that the errors on average cancel each other out; and the dependent and independent variables (GDP and FDI) are linearly correlated.

E-views 8 is the statistics and econometrics program that will be utilized to estimate the regression model for this investigation. Therefore, defining the explained and explanatory variables will be one of the strategies used, with GDP serving as the explained variable and FDI as the explanatory variable. The output of the algorithms was used to determine the values of the error term ε, the coefficient of regression, β_1 and the constant α (slope). Furthermore, the output displayed the t-statistic and p-values for the coefficients, which at a given level of significance, either reject or fail to reject the hypothesis. The likelihood of obtaining a result that is at least as extreme as the critical value is known as the p-value. If the p-value is less than or equal to the crucial value, the null hypothesis is rejected. The coefficient of determination or R-square which quantifies the percentage of the dependent variable that the regression model explains will be displayed in the output.

Using the so-called Augmented Dickey Fuller Assessment, a Unit Root test will be performed to analyze the relationship between FDI and GDP in order to confirm whether or not they are stable. The correlation between the variables will next be examined using a cointegration test, which will employ the Johansen Cointegration Test and Engle-Granger Cointegration. Our understanding of whether FDI and GDP are truly integrating at the same level will be facilitated by this. However, Pairwise Granger Causality and the VAR Model will be used to examine the variables' short-term correlation. In order to determine the causality direction of the link between FDI and GDP, this is done. In the event that FDI and GDP have a long-term causal relationship, the VEC Model and Pairwise Granger Causality will be used, respectively.

The Unit Root Test is used here because, even in cases where there is no meaningful relationship between the variables, using the OLS technique to regression a series of data on another series variable often yields a higher R^2 estimate.

If we consider for example:

$$y_t = \delta y_{t-1} + u_t \quad (3)$$

In a random walk scenario where, δ = 1 the u_t is the white noise. We are aware that when an equation is estimated using OLS, the result approximates δ is biased towards zero. However, if 1 is higher or equal to δ, OLS estimate is also biased towards 0. There is Monte Carlo evidence about the distributions' biasness features presented by [41] and [42].
In addition to an initial lagged value, a constant, and a trend, the Augmented Dickey Fuller (ADF) [43] will be used to assist in running regression for the first difference of the time series data set. ADF tests for the null hypothesis that a data set contains a unit root. In actuality, serial correlation is typically shown by the disturbance item in the Dickey-Fuller test. This expression can be depicted as follows:
Without Intercept and Trend

$$\Delta y_t = \delta y_t + u_t \quad (4)$$

With Intercept Trend

$$\Delta y_t = \alpha + \delta y_t + u_t \quad (5)$$

With Intercept and Trend

$$\Delta y_t = \alpha\, \beta T + \delta y_t + u_t \quad (6)$$

The equations above enable us to test whether δ = 1 in which the Null hypothesis and the decision rule

Ho: δ = 1
H1: δ < 1

The Null Hypothesis:

Ho : δ = 0
H1: δ < 0

As a result, since δ = 0, y_t follows a pure random walk. We won't reject the null hypothesis if t* is bigger than the ADF critical value because the unit root is present. However, we reject the null hypothesis if t* is less than the ADF critical value, when the unit root is not present. The null hypothesis of unit root will be accepted for that specific series data set if the ADF statistic or t statistic is less than the absolute value

of Mackinnon t-values. Unit root assessment is frequently tested on the constant of y_{t-1} in an equation. Dickey Fuller has already determined the precise critical values that will be used in the study and they are, in his opinion the best critical values for the three equations shown above [44]. However, we will accept the null hypothesis if the critical figures are greater than the DF assessment in absolute terms and the probability values are greater than 5% as well.

Cointegration techniques, which are essentially the long-term equilibrium or correlation between series, have been a widely used and significant tool in applied economics since their debut almost forty years ago. As a result, it will be the final analytical technique that aids in establishing if a long-term relationship between GDP and FDI exists. When doing a cointegration test, two different test types are frequently available. The Engle Granger, Johansen and Juselius Cointegration were among them. To determine the number of cointegrated vectors, Johansen and Juselius Cointegration used binary test techniques, which include the Maximum Eigenvalue statistic and the Trace statistic, respectively. The Vector Auto Regression based on cointegration test of order p, which may be obtained using the following processes, is typically the first step in the developed Johansen's approach which is described below:

$$y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-1} + \varepsilon_t \tag{7}$$

In contrast, *yt* is the *nx1* vector for non-stationary variables, which are referred to as I(1) for economic growth when they are stated to be integrating by the order of one.

A *nx1* vector of innovation is GDP and ε_t. Simultaneous equations can be utilized when necessary to help identify endogenous, exogenous and predetermined factors because often some explanatory variables of economic model phenomena may not explain the dependent variable [45]. In the event that the variables cannot be determined, they also emphasize the importance of treating each individual variable symmetrically. Thus, this VAR can be rewritten as follows:

$$\Delta y_t - \mu + \prod y_{t-1} + \Sigma_{i=1}^{p-1} \Gamma i \Delta y_{t-1} + \varepsilon_t \tag{8}$$

Where

$$\Pi - \Sigma_{i=1}^{p} Ai - I \; and \; \Gamma_i - \; \Sigma_{j-i=1}^{p} Aj \tag{9}$$

The Π approximates contains information on long term adjustment changes in *yt*. But when the coefficient matrix Π has an abridged rank of r < n which can be concluded that there is a presence of *nxr* matrices of α and β for each and a rank of *r* such that $\Pi = \alpha\beta'$ and $\beta' yt$ are stationary [46]. Each column for β is a cointegrating vector matrix that comprises long term coefficient relationships and the *r* here stands for the number of cointegrating correlations. The components of matrix α include coefficients that describe the rate at which alternating parameters to

disequilibrium in VECM. The cointegrating rank of the system is the number of linearly dependent cointegrating vectors that exist in the system; it can range from 1 to n-1 [47]. We can also be proven for a given r the highest probability parameters for β expresses the amalgamation of y_{t-1} which produces r main canonical associations of Δyt with y_{t-1} after adjusting for the lagged differences and deterministic elements. Johansen has proposed two different probability ratio evaluations of the significance of these known relationships, which lowers the rank of the Π matrix. These consist of the trace and the highest Eigen values shown in equations 10 and 11, respectively.

$$\lambda - trace = -T \sum_{i=r+1}^{n} In(1 - \lambda i) \quad (10)$$

$$\lambda - \max = -T\, In(1 - \lambda_{r+1}) \quad (11)$$

The sample size is denoted by T, the maximum eigenvalue by λ, and the largest canonical correlation by *i* represents *ith*. For *r* cointegrating vectors, the greatest Eigen value tests the null hypothesis against the alternative hypothesis of *r +1*. On the other hand, the trace test compares the alternative hypothesis of *n* cointegrating vectors to the null hypothesis of *r* cointegrating vectors. Specifically, neither of these test statistics has a chi square distribution. The critical asymptotic values can be obtain in [48]. When the Maximum Eigenvalue statistic yields different results, the trace statistic test is considered to be the preferred method. It will be inaccurate if the system's factors are near unit root processes since the key numbers used for Maximum Eigen points and trace statistics are based on the pure unit root postulation. [46]. Additionally, it is somewhat necessary to look at the system's variables to determine their integration rank. When one of the only variables in the model is I(0) instead of I(1), it will reveal itself through the cointegration vector whose planetary crossed by the single stationary variable [49]. For example, equation (14) designates a technique for which $y_t = (y_{1,t} y_{2,t})'$ where $y_{1,t}$ is I(1) and $y_{2,t}$ is I(0), it can be presume that there's one cointegrating vector in the system given by $\beta = (0\ 1)'$ [46]. whereas Π have complete rank, all the n variables will be stationary.

Since the VECM method's primary distinction is the inclusion of a vector of co-integration residual, it is deemed suitable for examining causality between non-stationary and co-integrated variables [50]. Since econometrics models and methods help provide strategies or procedures on organizing and making decisions as well as examine the shape of the connection among the variables, they help overcome complete uncertainty in forecasting [45]. To prevent misspecification issues or misspecification caused by too many eliminated variables, these models must adhere to certain clear rules.

As a result, the models can be written like this:

$$GDP_t = \alpha_1 + \alpha_2 FDI_t + \varepsilon_t \quad (12)$$

$$FDI_t = \beta_1 + \beta_2 GDP_t + \varepsilon_t \quad (13)$$

Where:
GDP represents Gross Domestic Product.
FDI represents Foreign Direct Investment.
ε represents the disturbance term.
α_1, β_1, to α_2, β_2, are the unknown population parameters respectively.

The Granger causality between two economic variables has been confirmed using a bivariate framework and the Granger, 1969. "If factor x granger causes factor y, then the mean square error of the predicted y centered on previous values of the two factors is lesser than the projected which employs merely the previous values of y," according to this analysis.
The following regression techniques are used to carry out the Granger causality correlation:

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \beta_i \, \Delta y_{t+1} + \sum_{i=1}^{p} \gamma_i \, \Delta x_{t-1} + \varepsilon_t \quad (14)$$

To test the combined hypothesis of H0: $\gamma_1 = \gamma_2 = \ldots \gamma p = 0$ alongside H_1: $\gamma_1 \neq \gamma_2 \neq \ldots \gamma p \neq 0$ the granger causality of the explained element y to the coextensive element x can be recognized for the fact the null hypothesis of asymptotic chi-square (χ^2) assessment not accept. The x element has a projecting figure for estimating actions in y above the evidence encompassed in the recent past, according to the considerable test statistic. Despite this, pairwise Granger causality is thought to be more illuminating than simple correlation constants. Granger causality summarizes the logical topics of causation by only stating that prognostic context and progressive preference are crucial factors for variables to granger cause one another. Only stationary parts that aren't guaranteed to be together in the potential long term through cointegrating correlation can benefit from the correlation result critical points [51].

4. The Regression Results

4.1 The Descriptive Statistic and Analysis

Table 1 below presents the results and values for the descriptive statistics of the variables. It presents the mean values and the standard deviation, which quantifies variability. Similarly, the respective maximum and minimum values of the variables. The standard deviation, by definition, signifies the dispersion of observations relative to the mean value.

Table 1: Descriptive Statistic empirical results

	GDP	FDI
Mean	5.90E+08	19644355
Median	2.84E+08	14120000
Maximum	1.83E+09	82208103
Minimum	41160659	-1990000.
Std. Dev.	5.51E+08	21360219
Skewness	0.673991	1.224633
Kurtosis	2.047058	3.867285
Jarque-Bera	6.926432	17.15902
Probability	0.031329	0.000188
Sum	3.60E+10	1.20E+09
Sum Sq. Dev.	1.82E+19	2.74E+16
Observations	61	61

Source: Authors regression output

Table 1 shows that, acting as a surrogate for economic development, GDP has an average growth rate of 5.90% with a standard deviation of 5.51% from 1963 to 2023 for the same variable. This helps us to determine the degree of variances the variables exhibit. Regarding the FDI standard deviation, mean, and median, they are judged high with respect to the dataset, so certain years have negative values. A higher standard deviation denotes a variation in the FDI annual value.

4.2 OLS Regression Empirical Results Analysis

One significance of OLS is its ability to estimate unknown parameters while minimizing the sum of squared differences between the regressors and the dependent variable in linear regression. Following the empirical procedures used [52] in their study, We will employ multiple regression analysis and correlation for data analysis. The method necessitates the generation of regression coefficients instead of the model, followed by the presentation of results and conclusions regarding the population sample. The research findings indicate that the predictor variable accounts for 30% of the variance in Gambia's GDP economic development, as denoted by the R-square, while the remaining 70% may be attributed to the influence of other significant variables. The statistical significance value is shown to be smaller than 0.05, so the model used is statistically significant to forecast in what way FDI influence GDP. Furthermore, proving that the general model applied is statistically significant, the F statistic produced value exceeds their associated F critical value. The GDP will be 309860293.666 if all the independent components are constant at zero level, according the regression output equation. The sample data set also reveals, for instance; a one unit increase in the FDI results in a 14.26 % GDP gain.

Table 2: Regression output and the estimated equation of the Least Square Method

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.10E+08	80858811	3.832115	0.0003
FDI	14.26422	2.798771	5.096602	0.0000
R-squared	0.305681	Mean dependent var		5.90E+08
Adjusted R-squared	0.293913	S.D. dependent var		5.51E+08
S.E. of regression	4.63E+08	Akaike info criterion		42.77690
Sum squared resid	1.27E+19	Schwarz criterion		42.84611
Log likelihood	-1302.695	Hannan-Quinn criterion		42.80403
F-statistic	25.97535	Durbin-Watson stat		0.354319
Prob(F-statistic)	0.000004			

Source : Author's regression output

The regression result attained from the OLS estimation method:

*GDP = 309860293.666 + 14.264221245*FDI*

The regression outcome is in concurrence with the discoveries of[53, 54],[55-58] and [59, 60] who also establish in their individual various research that the FDI has positive impact on GDP. Table 2 indicates that the p-value of 0.0000 is less than 0.5%, hence suggesting the rejection of the null hypothesis for the two-tailed test at the 5% significance level. The computed t-value of 5.0966 is likewise significant at the 5 percent level of significance. The hypothesis that an increase in FDI is not a significant determinant of GDP in The Gambia is rejected, hence adopting the alternative that an increase in FDI is a primary factor influencing GDP in The Gambia during the analyzed period.

4.3 Unit Root Test

4.3.1 Augmented Dickey Fuller Test Results and Analysis

A time series dataset presents several econometric issues that can complicate parameter estimation when employing the OLS method. [51] indicate that a very high R^2 is frequently achieved when regressing a time series variable against another, particularly when this strategy is employed despite the absence of a significant correlation between the variables. This issue may result in erroneous regression among discrete variables generated by a nonstationary process. Based on the aforementioned, it is advisable to run a unit root test or assess stationarity to analyze the integration direction using the Augmented Dickey-Fuller (ADF) test. The EViews 8 program will be utilized to perform the ADF test accordingly.

The test describes the method of including a lagged difference term into the ADF equation. Still, should we wish to estimate an augmented Dickey-Fuller test including a constant in the regression and apply an automatic lag length selection

approach such the Akaike Information Criteria (AIC) with a maximum lag length of one year? Usually assessing the null hypothesis for the presumed nonstationary research variables of interest, the ADF test assesses the This method helps to find the length of time a variable need to be differenced to reach stationarity. The null hypothesis is not disproved at conventional significance levels and likewise if their statistical values surpass the appropriate critical values. The output shows the existence of a unit root, thereby making the series data set nonstationary.

4.4 Johansen's Cointegration Test Results and Analysis

Given the non-stationary at levels of the dataset, a Johansen cointegration analysis was conducted to confirm the cointegration link between the dependent and independent variables. Johansen's co-integration is better than Engle-Granger. Cointegration solves the normalizing problem connected with the cointegration vector of a single variable by identifying the cointegration vectors and considering the variables as possibly endogenous. Since the data set is integrated at the first order, the main goal of this assessment is to establish the long-term correlation between the two variables. Selected with a lag interval of one, the used data was at level, showing a trend and an intercept (without trend) on CE and VAR, decided by the Lag Order Selection Criteria. The results do not confirm if cointegration between FDI and GDP exists for The Gambia by means of the variables integrated at order one I(1). The Trace statistics and Max-eigenvalue test findings at the 0.05 level show non-cointegration at the 5% significant level based on a sample size of 61 years and a chosen lag length of one.

Still, Johansen's cointegration shows with opposite interpretation, the results of the normalized cointegrating coefficients statistical test show one cointegrating equation at the 5% significant level, therefore indicating a positive relationship between GDP and FDI. Present here are two statistical tests: the maximal eigenvalue test and the trace test. The long-term connection between FDI and GDP is indicated by the trace and Eigen statistics exceeding their respective critical values.

Table 3: Series: GDP FDI

Series: GDP FDI				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.141415	11.32904	15.49471	0.1921
At most 1	0.038776	2.333324	3.841466	0.1266
Trace test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.141415	8.995721	14.26460	0.2865
At most 1	0.038776	2.333324	3.841466	0.1266
Max-eigenvalue test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
GDP	FDI			
-1.73E-09	5.84E-08			
1.56E-09	1.34E-08			
Unrestricted Adjustment Coefficients (alpha):				
D(GDP)	37469381	-45562463		
D(FDI)	-3908536.	-1546603.		
1 Cointegrating Equation(s):		Log likelihood	-2269.119	
Normalized cointegrating coefficients (standard error in parentheses)				
GDP	FDI			
1.000000	-33.83327			
	(9.45142)			
Adjustment coefficients (standard error in parentheses)				
D(GDP)	-0.064710			
	(0.05801)			
D(FDI)	0.006750			
	(0.00289)			

Source: Author's regression output

The results of the regression show above imply two evaluations: the Maximal Eigenvalue test and the Trace test. We will look at both. We do not reject the null hypothesis as the Trace statistic shows the lack of cointegrating equations among the variables at the 0.05 level with p-values over 5%; so, the rule states that we reject the null hypothesis, thus indicating no cointegration, if the p-value is less than 5%; conversely, if the p-value is more than 5%, we accept the null hypothesis, so implying the existence of cointegration between the variables. As a result, there is a long-term correlation among the variables since every one of their p-values is below 5%. Cointegration causes the different series data sets to be non-static at their levels, so they cannot diverge endlessly from one another. Though it does not define the direction of the causal connection, co-integration indicates a causal relationship between the two variables of interest. All ultimately converges with time.

The maximal Eigenvalue test, the second analysis, also reveals no cointegrating equations; consequently, we do not reject the null hypothesis since the p-values surpass the 5% criterion. As such, the null hypothesis is confirmed. Cointegration of all the variables indicates their long-term correlation and simultaneous movement. Given the existence of cointegration, we might thus use the VECM. We can find in The Gambia over the investigated time a long-term equilibrium relationship between FDI and GDP.

After the optical lag length and Johansen's cointegration are successfully implemented, a Vector Error Correction Model (VECM) is used to find out whether the variables will co-move long term. According to the previous work, the ADF test showed that at their initial difference GDP and FDI are integrated of order I(1). The Johnsen cointegration strengthens the existence of a long-term link in the data set even further.

The VECM included long-term and short-term behavior of dependent and independent variables. As GDP and FDI are the variables of interest in the research project, the model is used to derive their relationship. If other conditions stay the same, foreign direct investment (FDI) will eventually help to increase GDP. At the 1% level the coefficients have statistical relevance. Reversing the null hypothesis of the absence of cointegration, the alternative that a cointegration relationship exists inside the model is accepted.

The theory underlined above suggested a causal link between GDP and FDI for The Gambia. This will be investigated to find whether changes in FDI cause GDP to expand or versa, whether GDP drives higher FDI inflows, or if there is a causal relationship between the two variables in both the short and long runs. Analyzing VECM with (p-1) is done using the selected optimal lag variable obtained from the VAR Lag Order AIC (Akaike Information Criteria estimate). Second, while EViews may translate the level series data into first differences over the estimate process with the VECM, we will use the level series data instead of their first difference series.

Table 4: Vector Error Correction results

Cointegrating Eq:	**CointEq1**	
GDP(-1)	1.000000	
FDI(-1)	-33.83327	
	(9.45142)	
	[-3.57970]	
C	56789186	
Error Correction:	D(GDP)	D(FDI)
CointEq1	-0.064710	0.006750
	(0.05801)	(0.00289)
	[-1.11545]	[2.33249]
D(GDP(-1))	-0.229995	-0.012399
	(0.33938)	(0.01693)
	[-0.67769]	[-0.73239]
D(FDI(-1))	-1.672733	0.055090
	(2.91514)	(0.14542)
	[-0.57381]	[0.37883]
C	7219774.	358152.4
	(3.5E+07)	(1747388)
	[0.20611]	[0.20496]
R-squared	0.037617	0.099297
Adj. R-squared	-0.014876	0.050168
Sum sq. resids	3.66E+18	9.11E+15
S.E. equation	2.58E+08	12871252
F-statistic	0.716610	2.021146
Log likelihood	-1224.391	-1047.506
Akaike AIC	41.64036	35.64428
Schwarz SC	41.78121	35.78513
Mean dependent	0.000000	-6.31E-11
S.D. dependent	2.56E+08	13206795
Determinant resid covariance (dof adj.)		1.00E+31
Determinant resid covariance		8.72E+30
Log likelihood		-2269.119
Akaike information criterion		77.25826
Schwarz criterion		77.61038

Source: Author's regression output

The preliminary segment of the VECM regression results reveals a positive correlation between GDP and FDI, as the signs are interpreted in reverse. A one-unit increase in FDI leads to a 33.83 percent rise in GDP, providing all other factors remain constant. This section is devoid of p-values, making it insufficient for assessing the link between GDP and FDI in both the short and long term. A

sustained positive correlation between foreign direct investment and gross domestic product is apparent throughout the examined timeframe. The F-statistic of 2.021146 is relatively high and considerably significant. Therefore, we are currently unable to determine the presence of a short-term link between GDP and FDI.

The error correction equations, which help to estimate probability figures to control the short- and long-term associations between dependent and independent variables respectively, can be developed from the second component of the VECM. The p-values of C(1) have to be statistically significant if one wants to build a long-run causal link. As so, the evaluation of D (FDI) in relation to D (GDP) shows a favorable value C [60] as shown below and a p-value that is greater than 5 percent and consequently its statistically insignificant. This does not support the long-term link among factors established previously. The C(1) p-value of 0.2671 is presented in Table 5 below.

Table 5: Estimation Method: Least Squares

Total system (balanced) observations 118				
	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C(1)	-0.064710	0.058012	-1.115450	0.2671
C(2)	-0.229995	0.339381	-0.677690	0.4994
C(3)	-1.672733	2.915136	-0.573810	0.5673
C(4)	7219774.	35028447	0.206112	0.8371
C(5)	0.006750	0.002894	2.332488	0.0215
C(6)	-0.012399	0.016930	-0.732394	0.4655
C(7)	0.055090	0.145421	0.378832	0.7055
C(8)	358152.4	1747388.	0.204965	0.8380
Determinant residual covariance		8.72E+30		
Equation: D(GDP) = C(1)*(GDP(-1) - 33.8332684359*FDI(-1) +				
56789186.4966) + C(2)*D(GDP(-1)) + C(3)*D(FDI(-1)) + C(4)				
Observations: 59				
R-squared	0.037617	Mean dependent var		0.000000
Adjusted R-squared	-0.014876	S.D. dependent var		2.56E+08
S.E. of regression	2.58E+08	Sum squared resid		3.66E+18
Durbin-Watson stat	1.299812			
Equation: D(FDI) = C(5)*(GDP(-1) - 33.8332684359*FDI(-1) +				
56789186.4966) + C(6)*D(GDP(-1)) + C(7)*D(FDI(-1)) + C(8)				
Observations: 59				
R-squared	0.099297	Mean dependent var		-6.31E-11
Adjusted R-squared	0.050168	S.D. dependent var		13206795
S.E. of regression	12871252	Sum squared resid		9.11E+15
Durbin-Watson stat	1.967195			

Source: Author's regression output

4.5 Tests for Block Exogeneity and VECM Granger Causality

Data must be steady when doing a Granger causality test. Our objective is to establish the causal relationship between GDP and FDI, as these are the variables of interest. The inquiry pertains to whether GDP induces FDI or if the reverse is true. We will also presume that our two residuals are uncorrelated. The regression results indicate that GDP does neither Granger-cause FDI, nor does FDI Granger-cause GDP, in both the short and long term. It is stated that there is no directed causality link. A lag of one variable was employed to determine the causal relationship and the direction of causality among the different variables. With 61 observations for every lag adjustment, the research data runs from 1963 to 2023 and has both order one I~(1) integrated into it. Table 6 shows the causal link running from GDP to FDI. The p-values are regarded as negligible since they exceed five percent. We can say that gross domestic product (GDP) and foreign direct investment (FDI) show a good relationship. The gross domestic product will also rise as foreign direct investment flows to The Gambia rise. Though they do not define the direction of causality, the Block Exogeneity Wald Tests and Granger Causality Tests show the lack of a causal relationship from GDP to FDI. One used a Pairwise Granger causality test to confirm the causative link. Table 6 below lists the VECM Granger causality and Block Exogeneity Wald test results:

Table 6: VEC Granger Causality/Block Exogeneity Wald Test

Dependent variable: D(GDP)			
Excluded	Chi-sq	df	Prob.
D(FDI)	0.329258	1	0.5661
All	0.329258	1	0.5661
Dependent variable: D(FDI)			
Excluded	Chi-sq	df	Prob.
D(GDP)	0.536401	1	0.4639
All	0.536401	1	0.4639

5. Discussion and Conclusion

Since it improves savings, employment, education, training, tax income, foreign capital, infrastructure, free trade, market options and lowers prices in markets, FDI is absolutely vital.

Many studies carried out on a similar line have confirmed that GDP is favorably correlated with FDI. Consolidating opportunities for significant financial inflow, globalization and knowledge transfer, sometimes known as the spillover effect FDI is seen as a driver for development in emerging economies like The Gambia. It also improves exports and employment opportunities, therefore raising the possibility of host nation development.

For the period from 1963 to 2023, the World Bank website provides the annual time series statistics for GDP and FDI from The Gambia. Stationarity was evaluated using descriptive statistics, ordinary least squares (OLS), unit root tests and the augmented dickey-fuller test. Also, Johansen's Cointegration test, Optimal Lag Length Criteria and the VECM then were applied. The findings validated and shown a long-term non-causal connection between GDP and FDI. The affirmative association between GDP and FDI shows that, in The Gambia, FDI acts as a suitable driver for economic development. The model explains only roughly 30.6% of the variance in GDP, showing that while FDI is a significant contribution, other factors such domestic investment, trade, government policy and institutional quality still play crucial roles in driving economic growth even in spite of this positive association.

Given the above specified outcomes, the following suggestions are meant to help stakeholders in their decision-making procedures. The government of The Gambia should foster an environment fit for corporate activities within its borders. This will attract foreign companies and potential private investors to create businesses, therefore improving the flow of FDI. Policies developed by the government should help domestic investors to compete with foreign colleagues.

FDI is a valuable component of The Gambia’s economic growth engine. While it is not a silver bullet, a well-structured policy that facilitate and complement foreign investments can significantly enhance the country’s development trajectory. Policymakers must now focus on strengthening the domestic environment to make FDI a catalyst for inclusive and sustained economic progress. The government ought to enhance infrastructure standards by incorporating appropriate recreational centers with social parks and amenities to attract increased FDI. This will promote overall economic development in the state as the industry expands. They should also present a blueprint for an architectural landscape that can handle new and future technological advancements, hence fostering economic progress. The central state government must maintain a consistent regulatory framework that fosters investor trust to enhance the investment sector. The state administration should target prospective foreign investors inclined to engage in sectors such as agriculture, tourism, fishing and mining.

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