



THE EFFECT OF FOREIGN DIRECT INVESTMENT ON ECONOMIC GROWTH IN SIERRA LEONE

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Abstract:

The paper investigates the effect of foreign direct investment on economic growth in Sierra Leone. A model of real GDP growth was estimated with annual data from 1980 to 2022. Tests for stationarity were done in order to avoid spurious regression by using the Dickey-Fuller GLS test and a battery of structural break tests. An auto-regressive distributed lag model (ARDL) was estimated using the Ordinary Least Squares, following the transformation of non-stationary variables to obtain stationarity, which was the case for terms of trade only. A parsimonious model was then obtained from an over-parameterized model. The model results show that foreign direct investment (FDI) has a significant positive effect on economic growth, with a one percentage point of GDP increase in foreign direct investment increasing real GDP growth by 0.49 percentage point in the same year. Hence, policies that encourage more foreign direct investment in Sierra Leone are to be strengthened. Also, for enhanced poverty reduction, tilting foreign direct investment towards the agricultural sector to enhance agricultural transformation is imperative for a more productive agricultural sector, as a large chunk of Sierra Leone's labor force, population, and the poor are in the rural areas, where agriculture is the predominant activity.

JEL: F21, F43

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Keywords: foreign direct investment, economic growth, investment and stationarity test

1. Introduction

The combination of factors of production provides the output of an economy. This makes capital a critical element of economic growth, as it adds to the existing stock of capital. However, capital can come from the domestic economy and from abroad in the form of foreign direct capital, portfolio capital or other investment. Thus, foreign capital can be in the form of loans, grants and direct investment. Direct investment is investment by foreign firms in the domestic economy where at least 10% of ownership and management is by foreigners.

There is a large body of literature on the effect of foreign direct investment (FDI) on economic growth. The theoretical channel includes having access to technology that was not available or was undersupplied before the FDI, thus reducing the investment gap necessary to bring the poverty-reducing growth, especially for developing countries (Kokko, 1994 and Caves, 1994). The literature also notes that the positive effect depends on the absorptive capacity of the domestic economy, as in Ang (2008).

In Sierra Leone, the data from 1980 to 2022 reveal that 1986 had the least FDI (% of GDP), which was -28.62%. Though growth was positive in 1986, it was less than both the median of 3.47% and the mean of 2.57% during the period. This was followed by 1985, with FDI (% of GDP) being -3.61% and growth being negative at -5.31%. The highest FDI (% of GDP) in Sierra Leone was in 2011, followed by 2012 and 2013. The years 2011, 2012 and 2013 were years with strong growth, with the strongest being in 2013, with growth of 21.7%, which was basically iron-ore boom related, emanating from foreign direct investment by African Minerals in the iron-ore mining sector.

However, the simple correlation of growth and FDI (% of GDP) reveals a correlation of 0.24 and is not significant at the conventional levels of 1% and 5%. Thus, an important question remains to be answered from theory and the causal empiricism with Sierra Leone data. That is, are large FDI years essential for higher economic growth in Sierra Leone? Hence, the objective of the paper is to investigate the effect of Foreign Direct Investment (FDI) on Economic Growth.

There have been a number of studies on the effect of FDI on economic growth in a number of developing countries. However, we are not aware of a published work on Sierra Leone. In addition, while there are a number of studies on the determinants of FDI, including Ang (2018), Omran and Bolbol (2003) and Borensztein (1998), distinguishing the independent effect of FDI from domestic investment has not been captured. Such consideration is important because changes in aggregate investment may affect economic growth, and the change could happen together with changes in FDI. Also, a change in FDI hits aggregate investment immediately, thus calling for the independent effect of FDI. We deal with this gap by estimating three models, which are: (i) one without aggregate investment but with FDI, (ii) another one that uses FDI without aggregate investment, and (iii) one that captures both FDI and aggregate investment. Also, our

empirical approach uses a number of structural break unit root tests, in addition to the Dicky-fuller GLS test, to ensure that non-stationary variables due to structural breaks are not wrongly used in the model estimated, even when the non-stationarity is only due to the existence of a structural break but not a reality. While there are studies indicating that the effect of FDI on growth is positive, some others have found a negative effect. Moreover, we are not aware of any study on Sierra Leone on the effect of FDI on economic growth, though country circumstances may bring differences in country results. A study focusing on the role of FDI in economic growth is important because knowledge of such a study can support policy makers in the quest for sustainable economic growth, and appropriate policies can be taken to boost private investment. Moreover, Local content policies are meant for all companies, both domestic investment and foreign direct investment companies. Also, as Sierra Leone has started the implementation of Local Content policies, and FDI companies are expected to be 100 percent compliant, knowledge of FDI impact on economic growth is imperative. This can guide the Government through the Sierra Leone Local Content Agency, in terms of the potential benefits or otherwise of the FDI companies, as Local Content Policies are designed to promote local firms in local procurement by FDI companies and local knowledge gain from knowledge transfer.

The rest of the paper is organised as follows: Section 2 is the literature review, Section 3 is the methodology, Section 4 is the empirical results and analysis and Section 5 is the conclusion.

2. Literature Review

There is a wide range of literature across the globe on the effect of foreign direct investment on economic growth. Recent studies make use of time series techniques that account for the non-stationarity of the variables of a specified growth model. For example, the study by Nguyen (2017) in Vietnam from 1990 to 2014 falls in this category, which reveals that FDI inflow has a positive effect on economic growth.

Younsi *et al.* (2021) used panel data techniques for African countries from 1990 to 2016, and the results reveal that foreign direct investment has a positive effect on economic growth. The result of Younsi *et al.* (2021) is similar to that of Chaitanya (2009), who used the model specification regression analysis for the period 1980 to 2006, found a positive effect of FDI on economic growth in Latin America, though with a small coefficient. The result of Chaitanya (2009) is similar to that of Pandya *et al.* (2017) in Australia, with data from 1980 to 2019, in the sense that the coefficient of FDI is small in spite of a positive effect.

As in Chaitanya, (2009), Nguyen, (2017) and Younsi, *et al.* (2021), Salim *et al.* (2015) also found a positive effect of FDI on economic growth with data from Malaysia from 2000 to 2010, using the cointegration technique in the context of the ARDL as was the case of Karthikeyan, (2015) who used. Granger causality test, Johansen cointegration test and vector auto-regression (VAR) for India from 2000 to 2014.

The study conducted by Chisagiu (2015) supports the views of other studies from 1992 to 2012. Multi-dimensional impact of foreign direct investments on the host economy, determinants and effects, and their contribution to economic growth in Romania and using the Coefficient of Regression Analysis, it was concluded that FDI is one of the strong determinants of the Economic Growth rate with significant statistical influence in Romania, with a high contribution to GDP.

Atrayee *et al.* (2006) used data from 1993-1998 to investigate the effect of foreign direct investment on economic growth using time series techniques, and the result shows that FDI has a positive effect on economic growth. The result of Atrayee *et al.* (2006) on the USA is similar to that of Sumei *et al.* (2008) for China, which used data from 1988 to 2003 using a multivariate VAR system with an error correction model (ECM), though the latter also revealed that there is only a single-directional causality from FDI to domestic investment and to economic growth in China. The work of Koojaroenprasit (2012), using data from 1980 to 2009 for South Korea, also on a multiple regression basis, found that there is a strong and positive impact of FDI on South Korean economic growth. However, Athukorala (2003) with data from 1959 to 2002 for Sri Lanka using the co-integration and error correction regression mechanism found that the regression does not provide much support for a robust link between FDI and growth in Sri Lanka, indicating that FDI investment climate has not improved due to poor governance, political instability, bureaucratic inertia, and poor law and order in the country.

At the sectoral level, Pinudom (2019), using simple linear regression for Thailand with data from 2006 to 2016 found that FDI in Thailand FDI investment has a significant positive effect on the GDP of four sectors, which are electricity, gas, steam and air-conditioning but with a negative effect on other sectors of the economy, indicating that FDI inflow does not completely affect the overall growth of the Thai economy. Also, Zhang (2006) investigated the possible channels of how FDI operations affect the economy using data from 1992 to 2004 in the panel data regression context and found that FDI promotes economic growth in the coastal regions than in the inland regions. The Coastal region result is similar to the result of Seilan (2010) for India using the Granger causality test and revealing that FDI has a positive effect on economic growth in India, and Ray (2012) also for India.

Tatyana (2021) for the G7 countries investigated the role of FDI from G7 countries to construction and in Denmark, Italy, Germany, Romania, China, India and Russia from 2005 to 2020 using the Autoregressive distributed lag (ARDL), with co-integration and heteroscedasticity, found that investment in construction supports growth in the long term. Another study conducted on the G7 countries by Nawaz *et al.* (2024) from 1990 to 2021 using the annual time series data, the autoregressive distributed lags bound test of co-integration, revealed the existence of long-run relationships among the variables of the model, and FDI significantly drives GDP growth, which is consistent with Tatyana (2021).

Younsi *et al.* (2021) investigate the FDI-growth effect in African countries with nonlinearities and complementarities from 1990 to 2016 using fixed-effects (FE) and

system-GMM estimators, and found that FDI has a positive effect on economic growth, as in Agyei *et al.* (2022) for Sub-Saharan Africa with the non-linear threshold regression analysis. The result is similar to Adams (2009) on Sub-Saharan Africa from 1990 to 2003, and Njoupougni (2010), for 36 Sub-Saharan African countries with Pooled Mean Growth estimation from 1980 to 2009, which showed that a one percent increase in FDI induces a 0.13 percentage point increase in economic growth.

The study by Ayanwale (2007), during the period 1970 to 2002, using the ordinary least square investigated FDI and economic growth relationship for Nigeria and found that the effort of FDI on economic growth may not be significant as the component of FDI do not have a positive impact, but FDI in commercial sector has the highest potential to grow the economy, unlike the study by Zekarias, (2016), which investigated the impact of FDI on economic growth in Eastern Africa from 1980 to 2011, using the dynamic GMM estimators for Eastern Africa which found a positive effect.

In spite of the body of literature in developing countries, including Sub-Saharan Africa, we are not aware of a study in Sierra Leone on the role of FDI in growth, even though there are large FDI firms in almost every sector in Sierra Leone.

3. Methodology

3.1 The Model

3.1.1 Theoretical Framework

The theoretical framework follows the work of Romer (1990), Grossman and Helpman (1991) and Barrow and Sala-i-Martin (1995). The model focuses on how more capital leads to output. It considers only one good is produced in an economy, and the evolution is as in equation (3.1):

$$Y_t = AH_t^\alpha K_t^{1-\alpha} \quad (3.1)$$

Where Y is output, K is physical capital, H is human capital, A is an exogenous factor, and T is the time subscript. The exogenous factors are control and policy variables that affect the level of productivity and, hence, the output of the economy.

Also, human capital is considered to be a given endowment in the model, while physical capital is the output of combinations of varieties of capital goods to ensure the accumulation of capital is through an increase in the varieties of capital as in equation (3.2), which is derived in Ethier (1982).

$$K = \left(\int_0^Q x(j)^{1-\alpha} dj \right)^{\frac{1}{1-\alpha}} \quad (3.2)$$

Where $X(j)$ is a variety of capital goods, and N is the number of capital goods. In this economy, there are Q varieties of capital goods and they are produced by a domestic firm with direct domestic investment in the economy, producing q^d varieties of capital and a foreign firm with a direct domestic investment producing q^f variety.

Hence, we have:

$$Q = q^d + q^f \quad (3.3)$$

It is assumed that q capital producing firm produces all the varieties of capital and rents it at a cost of $M(j)$ and the demand for capital, which is $X(j)$ is obtained by equating the rental price of a unit of capital to its marginal productivity of capital, so producers can produce the final good. This condition is shown in equation (3.4).

$$m(j) = A(1 - \alpha)H^\alpha x(j)^\alpha \quad (3.4)$$

It is assumed that the process of adopting technology is costly, as it requires a set-up cost prior to production of any new capital. This setup cost varies inversely with q^d/q^f , implying that foreign firms export to the local economy a technology that is useful but is available elsewhere. This makes FDI the hard-core channel of technological progress. It is also assumed that it is easier and cheaper to use products already in use than to create new ones with new technology. Thus, the set-up cost is considered to depend positively on the size of the varieties of capital goods in the domestic economy relative to those in the more advanced economies, referred to as Q^x . Hence, as Q/Q^x If it reduces, there will be more imitations in the economy, and the cost of using new technology reduces. Thus, the set-up cost is as in equation (3.5).

$$S = f\left(\frac{n^*}{Q}, \frac{Q}{Q^*}\right) \quad (3.5)$$

Where the following holds: $f_{n^*/Q} < 0$ and $f_{Q/Q^*} > 0$

It is also considered that there is a maintenance cost in every period following the introduction of a capital good. Given that this marginal cost is $X(j)$, considering it to be unity, assuming capital good depreciates fully, and the interest rate is constant at the steady state, then the profit from the production of a new variety of capital is given as:

$$\pi(j)_{t=-F(n_t^*, q_t/q_t^x)} + \int_t^\alpha (m(j))x(j) - x(j))e^{-r(s-1)} ds \quad (3.6)$$

Hence, the problem of the producer is maximization of (3.6) subject of (3.4), which is the demand for each variety of capital good, $x(j)$. The optimal or equilibrium solution gives the level of production of each capital and $X(j)$ as in equation (3.7).

$$x(j) = H A^{\frac{1}{\alpha}} (1 - d)^{\frac{2}{\alpha}} \quad (3.7)$$

To obtain the price of capital (rental price of capital), equation (3.7) is substituted in the demand function (equation 3.4), and this gives equation (3.8).

$$m(j) = \frac{1}{1-\alpha} \quad (3.8)$$

Assuming that there is free entry into the capital production market, the rental price of capital will take the value consistent with zero profit and solving for this gives equation (3.8).

$$\gamma = \theta F[n^x, n/n^x]^{-1} H \quad (3.9)$$

Where $\theta = A^{1/\alpha} \alpha(1-\alpha)[2-\alpha]/\alpha$.

In order to close the model, the process of capital accumulation deserves description. Essentially, it depends on savings. This is obtained by considering that the consumers choose consumption from an intertemporal behaviour by maximizing the utility function in equation (3.10).

$$U_t = \int_t^\delta \frac{c_s^{1-\gamma}}{1-\gamma} e^{-\rho(s-t)} ds \quad (3.10)$$

Where U is utility and C is consumption. Based on the Euler equation, and noting that the rental price of capital is Y, the optimal consumption path is given as in equation (3.11).

$$\frac{\Delta C_t}{C_t} = \frac{1}{\sigma} (r - \rho) \quad (3.11)$$

At steady state, the growth of consumption is equal to the growth of output. Hence, $\frac{\Delta C_t}{C_t} = g$, Where g is the growth of output and $\frac{\Delta C_t}{C_t}$ is the growth of consumption. Thus,

$$g = \frac{1}{\sigma} (r - \rho) \quad (3.12)$$

Substituting (3.9) in (3.12) gives:

$$g = \frac{1}{\alpha} \left(\theta F \left(n^x, Q/Q^x \right)^{-1} H - \rho \right) \quad (3.13)$$

Hence, equation (3.13) reveals that Foreign Direct Investment (FDI) reduces the cost of introducing new varieties of capital goods. As a result of this, the rate at which new varieties of capital goods are introduced is increased. The model considers that this cost is even smaller for less developed countries, as they produce fewer varieties of capital goods (those with a lower Q/Q^x value). Therefore, more FDI brings more varieties

of capital goods, which is bound to increase growth. Another aspect of the model, however, is that higher human capital makes FDI more productive in raising growth.

3.1.2 Specification of the Empirical Model

Our empirical model follows Romer (1990), Grossman and Helpman (1991) and Barro and Sala-i-Martin (1994) under the endogenous growth theory, as in Borensztein (1995), placing importance on the role of FDI in growth. As in Borensztein (1995), we introduce control variables that are included in the growth regression. Essentially, we accounted for the role of trade openness, terms of trade, real exchange rate and macroeconomic instability in the growth process. Also, the role of overall investment is considered, but in separate regressions. In order to determine the independent effect of FDI on growth, both FDI and aggregate investment are included in the same model. Hence, equations 3.14 to 3.16 give the empirical models estimated.

$$GROWTH = \left(\frac{FDI}{GDP}, OPN, TOT, REER, INF \right) \quad (3.14)$$

$$GROWTH = f \left(\frac{INV}{GDP}, OPN, TOT, REER, INF \right) \quad (3.15)$$

$$GROWTH = f \left(\frac{FDI}{GDP}, \frac{INV}{GDP}, OPN, TOT, REER, INF \right) \quad (3.16)$$

Where:

GDP Growth is real GDP growth, $\frac{FDI}{GDP}$ is the ratio of FDI to GDP, $\frac{INV}{GDP}$ is the ratio of investment (INV) to Gross Domestic Product (GDP), OPN is openness of the economy to trade, TOT is Terms of Trade, $REER$ is real effective exchange rate and the INF is the inflation rate, measuring macroeconomic instability.

In linear dynamic form, the theoretical model is given in equation (3.17).

$$GROWTH_t = \varphi + \sum_0^{p_1} \beta_i \left(\frac{FDI}{GDP} \right)_{t-i} + \sum_0^{p_2} \delta_i \left(\frac{INV}{GDP} \right)_{t-i} + \sum_0^{p_3} \sigma_i (OPN)_{t-i} + \sum_0^{p_4} \sigma_i (TOT)_{t-i} + \sum_0^{p_5} \sigma_i (REER)_{t-i} + \sum_0^{p_6} \sigma_i (INF)_{t-i} + \sum_0^q \gamma_i (GROWTH)_{t-i} + U_t \quad (3.17)$$

3.1.3 Expected Signs of Model Variables

3.1.3.1 Foreign Direct Investment

As indicated by Mencinger (2003), Lee and Tcha (2004), and Carkovic and Levine (2002), Foreign Direct Investment is expected to have a positive effect on economic growth because capital inflow brings in foreign capital that can be used for investment in infrastructure and other forms of investment in various sectors. Also, technology transfer, which is often associated with FDI, brings in advanced technology and practices, which can boost productivity and increase economic activities (Borensztein *et al.*, 1998) and Lim (2001). According to Loungani and Razin (2001) when the FDI is in the export sector, it

contributes to export growth and increased economic activities, and hence economic growth, Loungani and Razin (2001).

3.1.3.2 Aggregate Investment

Cornwall (1972, 1977), Palley (1996, 2003), Martin and Rogers (1997) and Blackburn (1999) pointed out that investment positively affects economic growth by increasing a country's productive capacity and efficiency. Investment contributes to capital formation, with an increase in machinery, tools and infrastructure contributing to an increase in capital stock, which boosts production. This can also contribute to building more human capital, which is conducive to higher growth of the economy. It can also contribute to productive gains where technology and innovation raise output per worker and improve overall efficiency. This is because investment in human capital development (in education and health) improves workforce quality, leading to long-term economic growth. This can also lead to stimulation of demand and promoting short-term economic growth (Bhaduu, 2003).

3.1.3.3 Trade Openness

As observed by Krueger and Berg (2003), Lopez (2005) and Dollar (1992), trade openness has a positive effect on economic growth. Trade openness allows a country to have free trade with others, which can strongly influence economic growth through improved access to inputs for domestic production. More openness to trade leads to access to larger markets, which enables firms to sell beyond national borders, boosting exports and income (Yanikkaya, 2002). This can also lead to increased efficiency where exposure to global competition pushes domestic firms to become more productive (Chang and Mendy, 2012).

3.1.3.4 Terms of Trade

Mendoza (1997), Bleaney and Greenaway (2001), Blattman *et al.* (2003) and Urban (2007) have opined that terms of trade have a positive effect on economic growth in that when a country's export prices rise relative to its import prices, output is stimulated in several ways. Exporters have higher income for the same quality of goods sold. Also, when import prices fall, leading to higher terms of trade, importers can afford more imports without spending more, which improves access to capital goods, technology, and raw materials. Thus, terms of trade improvement can lead to the opportunity to produce more with more imported raw materials available (Harrison, 1996).

3.1.3.5 Real Effective Exchange Rate

According to McKinnon (1964), Fletcher (1994), Crompton, Lee, & Shuster (2001), and Surugiu (2009), the real effective exchange rate affects economic growth through its impact on trade competitiveness. A depreciation makes the domestic country more competitive, thus contributing to boosting exports, encouraging exports, stimulating domestic production by boosting domestic industries.

3.1.3.6 Inflation Rate

As observed by Friedman (1956), Stockman (1981), Fischer (1983), Barro (1995) and Valdovinos (2003), inflation is expected to have a negative effect on economic growth because increased inflation creates macroeconomic uncertainty, which discourages investment and also increases opportunistic behaviour such as speculative attack on currencies, which further increases inflation through depreciation of the local currency, culminating into higher uncertainty and reduced aggregate demand from investment and consumption expenditure, Zilibotti (2001). It is more acute when firms are not diversified enough to take advantage of a real depreciation but rely more on the export of primary products, Vinayagathan (2013).

3.2 Estimation Technique

The application of the Ordinary Least Squares (OLS) to estimate a regression model where the dependent variable is a continuous variable leads to the best linear unbiased estimators (the BLUE property). However, this holds under some assumptions about the residuals of the model, which are that the residual has a zero mean, is normally distributed, has a constant variance and is serially uncorrelated. However, even where these assumptions are met, the relationship can be unrelated when the model variables are not stationary. This is because non-stationarity of variables can lead to false relationships when OLS is applied, because the existence of a common trend (due to non-stationarity) can lead to high R-squared and significant t-statistics. In light of this, the series needs to be transformed appropriately when non-stationarity is observed before the OLS is applied. Alternatively, the series may be tested for cointegration to determine whether a long-run relationship exists among the variables. In light of this, we applied tests for variable stationarity to all model variables.

The Dickey-Fuller GLS (DF-GLS) test was applied to all variables as it outperforms the original Dickey-Fuller test. It involves detrending the series before the application of the Dickey-Fuller test for unit root. However, as a structural break in a series may lead to a stationary series appearing or revealing non-stationary when the DF-GLS test is applied, we augmented the test with tests that take a structural break into consideration. The tests used to augment the DF-GLS tests are the Zivot-Andrews unit root test, the Perron-Vogelsang test and the Clement-Montane-Reyes test. The Zivot-Andrews test shows the date of the break and tests for a break in the mean and/or trend of the variable. The Perron-Vogelsang test tests for a single break as in the Zivot-Andrews test, but it tests whether the break is immediate or gradual. The Clement-Montane-Reyes test is similar to the Perron-Vogelsang test and also tests for the existence of a double break, making it superior to the latter if indeed there are two breaks in the series. Hence, we estimated the specified model taking these issues into consideration.

A parsimonious model of economic growth of Sierra Leone was estimated from the annual data obtained from 1980 to 2022. Initially, an over-parameterised model, which includes two lags of all variables, was used in order to save degrees of freedom. The parsimonious model of economic growth was obtained by deleting insignificant

variables one by one from the initially estimated model. The selection was based on the magnitude of the probability of wrongly rejecting the null hypothesis of an insignificant coefficient (P-value). Thus, a variable with the highest p-value was dropped from the model, and the model was re-estimated. The process was repeated until the parsimonious model was obtained, in the context of Hendry's general-to-specific modelling strategy.

As foreign direct investment is part of aggregate investment, the model was estimated in three variants. First, a baseline model that includes only aggregate investment (% of Gross Domestic Product (GDP), without Foreign Direct Investment (FDI) in the model, was estimated. A second model, which includes only FDI, without aggregate investment, was estimated. This was done to determine the specific effect of FDI on growth and the specific effect of investment (aggregate) on growth. In addition, a third model, which includes both FDI and aggregate investment, was estimated. This was to determine whether, because FDI is a component of aggregate investment, both cannot be significant in explaining economic growth in the same model, which can occur when the impact of a variable is embedded in another variable.

3.3 Data Sources and Description

Table 3.1 shows the description of model variables and sources of the data.

Table 3.1: Data Sources and Description

Variable	Description	Source
Real GDP Growth	Percentage change in real gross domestic product	World Development Indicators
Foreign Direct Investment	Net inflow of foreign investment	World Development Indicators
Inflation Rate	Percentage change in consumer price index	World Development Indicators
Real Effective Exchange Rate	The nominal effective exchange rate of the Leone with currencies of the trading partners (with the rate defined as foreign currency per domestic currency) adjusted for the inflation rate in Sierra Leone	World Development Indicators
Aggregate Investment	Gross Exceed Capital Formation	World Development Indicators
Terms of Trade	Unit export value index divided by import unit value index, multiplied by 100	World Development Indicators
Trade Openness	The sum of exports and imports divided by gross domestic product (multiplied by 100)	World Development Indicators

4. Empirical Results

4.1 Descriptive Statistics of Model Variables

Table 4.1 shows the descriptive statistics of model variables. It shows that the mean growth of the economy from 1980 to 2022 was 2.57% and the mean FDI during the same period was 1.94% of GDP, while the mean aggregate investment was 11.84% of GDP. The median of real GDP growth, FDI (% of GDP) and investment (% of GDP) was 3.47%, 2.01% and 10.91%, respectively. Thus, there were more years with real GDP growth above the mean of 2.57%, suggesting that there were a few observations with low real GDP growth that drive the distribution to a negatively skewed distribution. This was also the case for FDI, with the mean less than the median. However, for aggregate investment, with the mean being above the median, there were more years for which investment (% of GDP) was below the mean of 11.84% and thus there were a few high values that dragged the distribution into a positively skewed one.

In addition, all the other variables had their means more than their medians. Thus, most of the values were above the mean values, suggesting that there were a few very high values of inflation, real effective exchange rate, terms of trade and trade openness that led to the distribution having heavy tails to the right (positively skewed).

Table 4.1: Descriptive Statistics of Model Variables

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
Real GDP Growth	43	2.57	3.47	8.17	-20.49	26.52
FDI (% of GDP)	43	1.94	2.01	6.25	-28.62	20.72
Investment (% of GDP)	43	11.84	10.91	7.31	-2.42	41.68
Trade Openness (%)	43	39.65	34.41	16.76	12.94	75.47
Terms of Trade	43	53.45	45.79	29.21	7.37	109.09
Real Effective Exchange Rate	43	164.40	122.68	112.52	91.35	561.19
Inflation Rate	43	30.56	16.03	36.13	-0.92	178.70

4.2 Data Analysis from Scatter Plots and Correlations

4.2.1 Scatter Plot Analysis

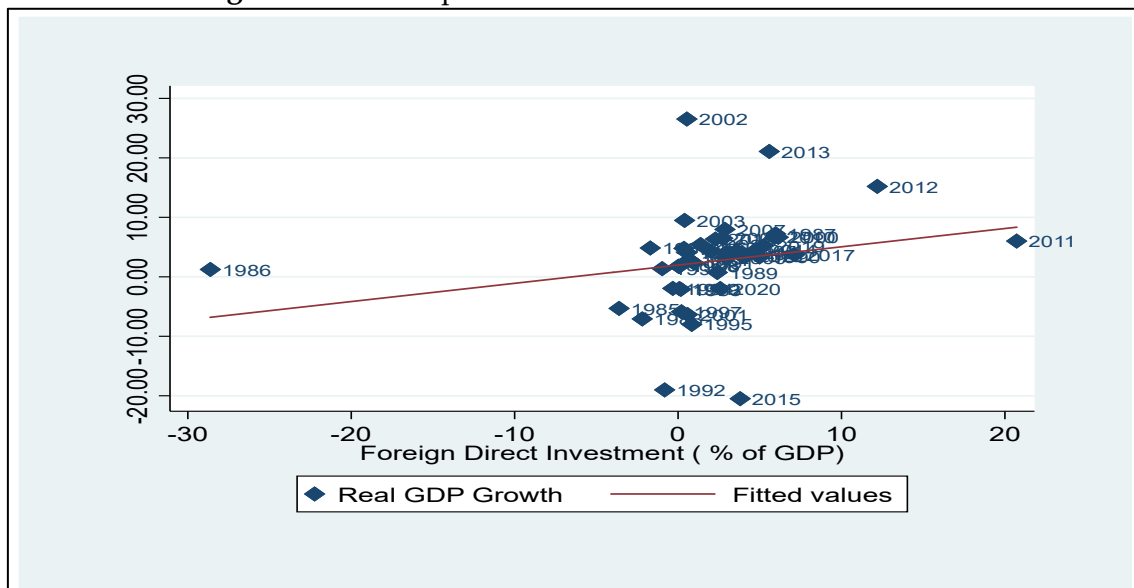
4.2.1.1 Scatter plot of FDI and Economic Growth Relationship

Figure 2.1 shows a scatter plot of Real GDP growth and Foreign Direct Investment (% of GDP). The line of fit shows that there is a positive relationship between FDI and growth. This suggests that more FDI is useful for higher economic growth in Sierra Leone.

Figure 2.1 also reveals that the highest FDI (% of GDP) flow to Sierra Leone was in 2011, followed by 2012 and 2013. These periods were the period of investment by African Mineral in iron ore mining. In addition, the highest GDP growth was in 2002, which was the year of the end of the war in Sierra Leone. This suggests that political stability is critical to the growth of Sierra Leone. Moreover, 2013 was the highest growth year after 2002. The growth was driven by the iron-ore sector growth and came from the huge production of iron ore in 2013, leading to a growth of about 20 %, from about 6 % in the previous year.

The least growth periods were 1992 and 2015. The year 1992 was just a year after the start of the war in Sierra Leone while 2015 was a difficult year in terms of productivity and human resources due to the Ebola health crisis that led to the loss of lives and output in Sierra Leone. This also implies that peace is critical to the growth of Sierra Leone and shocks such as health shocks are not conducive to the growth of Sierra Leone, even when there is good flow of Foreign Direct Investment. The figure also shows that 1986 had the least FDI (% of GDP), a year in which growth was positive but was only 1.24%. This was followed by 1985, which had a negative growth rate, with -5.31%. In addition, in both 1986 and 1985, FDI flows were negative. Specifically, FDI (% of GDP) was -28.62% and -3.61% in 1986 and 1985 respectively, implying net flow was an outflow but not an inflow. Thus, foreign capital for domestic development was destroyed rather than built for development.

Figure 2.1: Scatter plot of FDI and Growth in Sierra Leone



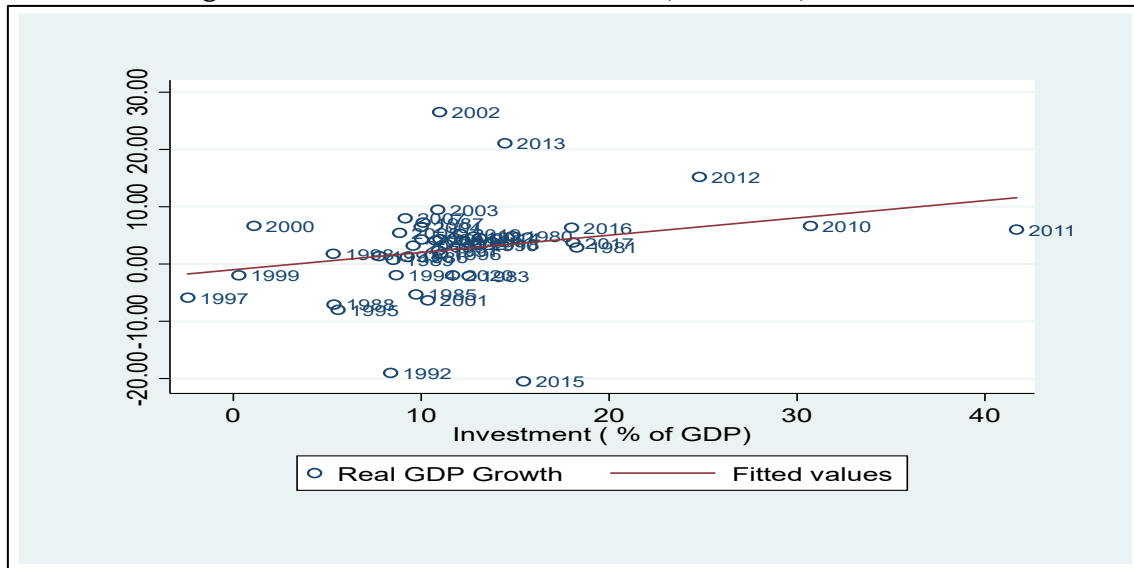
4.2.1.2 Scatter Plot of Investment and Economic Growth Relationship

Given that FDI is part of aggregate investment, we also present the link between investment and real GDP growth. Figure 2.2 shows the scatter plot of economic growth and investment (% of GDP) in Sierra Leone. The line of fit shows that there is a positive relationship between investment and growth.

The highest investment (% of GDP) was in 2011, followed by 2010 and 2012. Out of these, the 2011 and 2012 investments were driven by the FDI induced by African Mineral in the iron ore mining sub-sector. The least investment was in 1997, followed by 1999 and 2000. The year 1997 was an unstable year with the advent of the May 25th political turmoil that led to reduced economic activities, as was the case in 1999 due to the January 6 invasion of Freetown with a crisis that lasted for about two months, but had a long-lasting impact. The year 2000 was also a year of crisis on the political front, from a crisis that led to the arrest of the then-rebel leader. This suggests that political stability is critical to investment and growth in Sierra Leone and that political stability is

useful for investment and growth. Thus, it implies that more investment is useful for higher economic growth in Sierra Leone.

Figure 2.2: Scatter Plot of Investment (% of GDP) and Growth



4.2.1 Correlation Analysis

4.2.1.2 Simple Correlation

Table 2.1 shows the simple correlation matrix of model variables. The table (first column) shows that FDI, investment, trade openness and terms of trade have a positive relationship with the economic growth of Sierra Leone, while real exchange rate and inflation have a negative relationship with real GDP growth. However, it is only the correlation with investment that is significant, at the 10% level, as the P-value is 0.08. Hence, based on linear correlation, while investment is useful for growth, FDI is not significant, though its link with growth is positive. The correlations among pairs of regression are low, though FDI and investment have a correlation coefficient of 0.50. Also, the relationship between terms of trade and inflation is 0.56. Both correlations are also significant at the 1 % level.

Table 4.2: Simple Correlation Matrix of Model Variables

Variables	Real GDP Growth	FDI (% of GDP)	Investment (% GDP)	Trade Openness	Terms of Trade	Real Exchange Rate
FDI (% GDP)	0.2351 (0.129)					
Investment (% GDP)	0.27 (0.080)	0.502 (0.001)				
Trade Openness	0.2499 (0.106)	0.256 (0.097)	0.602 0.000			
Terms of Trade	0.0039 (0.980)	-0.2705 (0.079)	0.051 (0.743)	0.356 (0.019)		
Real Exchange Rate	-0.1248	-0.3928	-0.0262	-0.1327	0.297	

	(0.425)	(0.009)	(0.868)	(0.396)	(0.053)	
Inflation Rate	-0.1713	-0.2474	-0.1532	-0.0718	0.569	0.347
	(0.272)	(0.110)	(0.327)	(0.647)	(0.000)	(0.025)

Note: P-values are given in parentheses.

4.2.1.3 Partial Correlation

Partial correlation deals with the independent effect of a variable on the dependent variable of interest while controlling for all other independent variables. On the other hand, simple correlation deals with the overall effect of a change in a variable, with causality coming from the variable as well as the independent variable, without netting out the efforts of other variables on the variable.

Table 2.2 shows the partial correlation of real GDP growth with respect to FDI, investment, trade openness, terms of trade, real effective exchange rate and inflation. The result of the partial correlation shows that none of the partial correlations is significant. Also, the squared partial and semi-partial correlation squared, which show the proportion of changes in real GDP growth that is explained by each variable, are very low, at 0.92 and 1.0% respectively. This suggests the need for further investigation to actually determine the effect of FDI and the controlled variables on the growth of Sierra Leone. It reveals that FDI has no significant effect on real GDP growth, though its impact is positive. In addition, the real effective exchange rate and inflation have negative effects on the growth of the Sierra Leone economy and investment, trade openness and terms of trade also have positive effects. However, the results of the partial correlation show that none of the partial correlations is significant, judged by the high probabilities of rejecting the null hypothesis wrongly (the p-value).

Table 2.2: Partial Correlation and the Independent Variables

Variable	Partial Correlation	Semi-Partial Correlation	Partial Correlation Squared	Semi-Partial Correlation Squared	P-Value
FDI (% of GDP)	0.098	0.093	0.010	0.009	0.557
Investment (% of GDP)	0.087	0.082	0.008	0.007	0.605
Trade Openness	0.068	0.064	0.005	0.004	0.687
Terms of Trade	0.071	0.066	0.005	0.004	0.674
Real Effective Exchange Rate	-0.031	-0.029	0.001	0.001	0.853
Inflation	-0.128	-0.121	0.016	0.015	0.445

4.3 Tests for Stationarity of Variables

A variable is stationary when its mean and variance are constant and its covariance does not depend on time apart. In such a case, a shock to the variable does not last long (does not have memory). The stationarity of a variable matters for the use of the Ordinary Least Squares (OLS). Thus, we investigated the stationarity of each model variable to determine the strategy for estimation of the specified model of economic growth.

Table 4.5 shows a summary of the unit root test results. Based on the summary results of the unit root tests, all the model variables are stationary, with the exception of

Terms of Trade, which is stationary after first differencing. Hence, terms of trade is integrated of order, that is, it is $I(1)$. Economic Growth, Foreign Direct Investment (% of GDP), Investment GDP ratio, Trade Openness, Real Effective Exchange Rate and Inflation rate are stationary in level. That is, they are integrated of order zero ($I(0)$).

Tables 4.6 to 4.9 show the individual unit root test results, which are the Dicky-Fuller- GLS test results, the Zivot-Andrews unit root test results, the Perron-Vogelsang test results and the Clement- Montane- Reyes test results.

The Zivot-Andrews unit root test, the Perron-Vogelsang test and the Clement-Montane- Reyes test are all structural break unit root tests. However, the Zivot Andrews test and Perron-Vogelsang test consider only one break, though the latter test for both immediate and gradual breaks. Also, the Clement – Montane – Reyes tests for two breaks. Thus, in having a compromise on the final decision on the order of integration, the result of a test using a structural break is more robust, except if it has a higher order of integration than a test without a structural break. Also, a test with two structural breaks is more robust than one with only one break, except if the one break test has a lower order of integration.

Table 4.5: Summary of the Unit Root Test Results

Variable	Dicky-Fuller GLS	Zivot-Andrews	Perron-Vogelsang	Clement Montane-Reyes	Decision
Real GDP Growth	$I(0)$	$I(0)$	$I(0)$	$I(0)$	$I(0)$
FDI (% of GDP)	$I(1)$	$I(0)$	$I(0)$	$I(0)$	$I(0)$
Trade Openness	$I(2)$	$I(1)$	$I(0)$	$I(2)$	$I(0)$
Trade Openness	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Real Effective Exchange Rate	$I(1)$	$I(0)$	$I(0)$	$I(0)$	$I(0)$
Inflation Rate	$I(0)$	$I(0)$	$I(0)$	$I(2)$	$I(0)$
Investment (% of GDP)	$I(0)$	$I(0)$	$I(0)$	$I(0)$	$I(0)$

Table 4.6: Dickey Fuller GLS Unit Root Test Results

Variable	Transformation	Drift Term	Lag	Test Statistics	Conclusion
Growth	Level	Constant	1	-3.631	$I(0)$
FDI (% of GDP)	Level	Constant	1	-2.212	$I(1)$
	1st Difference	Constant	1	-4.691	
Trade Openness	Level	Constant	1	-1.182	$I(2)$
	1st Difference	Constant	1	-2.171	
	2nd Difference	Constant	1	-3.868	
Terms of Trade	Level	Constant	1	-2.379	$I(1)$
	1st Difference	Constant	1	-4.500	
Real Effective Exchange Rate	Level	Constant	3	-0.368	$I(1)$
	1st Difference	Constant	1	-2.753	
Inflation Rate	Level	Constant	2	-3.746	$I(0)$
Investment (% of GDP)	Level	Constant	2	-2.872	$I(0)$
Critical Value: 1%: -2.631 5%: -2.362					

Table 4.7: Zivot-Andrews Unit Root Test Result

Variable	Transformation	Lag	Break Date	Test Statistics	Conclusion
Growth	Level	0	2002	-7.744	I(0)
FDI (% of GDP)	Level	0	1987	-7.011**	I(0)
Trade Openness	Level	0	2010	-3.889	I(1)
	1st Difference	0	2014	-6.686**	
Terms of Trade	Level	0	1995	-3.998	I(1)
	1st Difference	0	2015	-6.936**	
Real Effective Exchange Rate	Level	1	1989	-7.371**	I(0)
Inflation Rate	Level	0	1993	-6.338**	I(0)
Investment (% of GDP)	Level	0	2010	-5.659*	I(0)
Critical Value: -1%: -5.57 5%: -5.08					

Table 4.8: Perron-Vogelsang Unit Root Test Result

Variable	Transformation	Gradual Break (Innovative Outlier (IO))		Immediate Break (Additive Outlier (AO))		Conclusion
		Break Date (t-Prob)	Test Statistics	Break Date (t-Prob)	Test Statistics	
Growth	Level	2000 (0.004)	-4.494*	1999 (0.045)	-2.399	I(0)
FDI (% of GDP)	Level	1995 (0.089)	-8.827*	1984 (0.470)	-2.538	I(0)
Trade Openness	Level	2008 (0.000)	-4.054	2007 (0.000)	-3.681*	I(0)
Terms of Trade	Level	1993 (0.024)	-3.420	1992 (0.000)	-3.133	I(1)
	1st Difference	1994 (0.824)	-6.660*	1993 (0.682)	-5.945*	
Real Effective Exchange Rate	Level	1983 (0.000)	-8.637*	1988 (0.000)	-2.193	I(0)
Inflation Rate	Level	1990 (0.049)	-7.848*	1993 (0.000)	-3.318	I(0)
Investment (% of GDP)	Level	2008 (0.002)	-3.917	2009 (0.000)	-4.922*	I(0)
Critical Value						
Gradual Break			Immediate Break			
5%: -4.270			5%: -3.660			

Table 4.9: Clemente-Montane-Reyes Unit Root Test Results

Variable	Transformation	Innovative Outlier (IO)			Additive Outlier (AO)			Conclusion
		Break 1 (Prob)	Break 2 (Prob)	Test Statistics	Break 1 (Prob)	Break 2 (Prob)	Test Statistics	
Growth	Level	2000 (0.000)	2012 (0.002)	-5.942*	1999 (0.012)	2011 (0.413)	-3.528*	I(0)
FDI (% of GDP)	Level	1985 (0.095)	2010 (0.002)	-14.813*	1984 (0.978)	2009 (0.003)	-4.211	I(0)
Trade Openness	Level	1991 (0.050)	2008 (0.000)	-4.765	1995 (0.009)	2007 (0.009)	-4.874	I(2)
	1st Difference	1985 (@)	2010 (0.334)	-4.355	1984 (0.134)	2009 (0.348)	-2.767	
	2nd Difference	2010 (0.016)	2016 (0.114)	-3.765	2009 (0.975)	2012 (0.975)	-7.09*	
Terms of Trade	Level	1993 (0.000)	2002 (0.006)	-4.52	1994 (0.000)	2003 (0.000)	-3.929	I(1)
	1st Difference	1994 (0.883)	2012 (0.341)	-7.274*	1993 (0.488)	2011 (0.422)	-3.552	
Real Effective Exchange Rate	Level	1982 (0.000)	1985 (0.000)	-9.411*	1982 (0.002)	1988 (0.002)	-2.193	I(0)
Inflation Rate	Level	1986 (@)	1991 (0.000)	-4.713	1985 (0.002)	1992 (0.000)	-2.193	I(2)
	1st Difference	1986 (@)	1992 (0.490)	-1.731	1985 (0.314)	1994 (0.636)	-2.619	
	2nd Difference	1985 (@)	1987 (@)	-6.716*	1986 (0.731)	1990 (0.668)	-2.194	
Investment (% of GDP)	Level	2008 (0.000)	2013 (0.000)	-6.675	2007 (0.000)	2013 (0.017)	-2.728*	I(0)
5 % Critical Values								
IO: -5.490 AO: -5.490								

Note: (i) * means stationary at 5% (ii), @ means test statistics value could not be determined

4.4 Results of the Estimated Model

Table 4.10 shows the parsimonious model of economic growth of Sierra Leone. Based on model 1, the model with investment (% of GDP) included without FDI, investment has a positive effect on economic growth and is significant at the 1% level of significance. However, the effect occurs with a one-year lag. Essentially, the coefficient of 0.24 indicates that if the investment GDP ratio increases by 1 percentage point, real GDP growth (economic growth) increases by 0.24 percentage point.

Considering model 2, which is the model with FDI (% of GDP), without including aggregate investment, the model result shows that Foreign Direct Investment (FDI) has a positive effect on economic growth, and this effect is significant both contemporaneously (same year) and after two years. Specifically, when FDI as a percentage of GDP increases by 1 percentage point, real GDP growth increases in the same year by 0.66 percentage points. However, after two years, real GDP growth increases by 0.77 percentage points.

In the case of model 3, which is the model with both aggregate investment and FDI, the result shows that while FDI is among the determinants in the parsimonious model, aggregate investment is not. This suggests the importance of FDI for economic growth in Sierra Leone, compared to domestic investment, which adds to FDI to form aggregate investment. Specifically, FDI has a positive effect on economic growth in a contemporaneous sense (same year effect) with a coefficient of 0.486. Thus, when both FDI and aggregate investment are included in the model, the effect of FDI is dampened, and the lagged effect becomes insignificant at the conventional level of significance (1% and 5%).

In terms of the choice of the appropriate model, model 3 is preferred to model 2 because it has a lower Bayesian Information Criteria (BIC). In addition, it has a higher adjusted R^2 . The BIC and adjusted R^2 are 287.00 and 0.48 for model 3, respectively, while they are 289.88 and 0.41 for model 2, respectively.

For the control variables of the model, which are: Trade Openness, Terms of Trade, Real Exchange Rate and Inflation, the model result shows that Terms of Trade (TOT) has a positive and significant effect on economic growth at the 1% level with both contemporaneous and one-year lag effects. Also, the Real Effective Exchange Rate (REER) has a significant negative effect on economic growth in Sierra Leone in a contemporaneous sense. This means that when the real exchange rate depreciates, the effect on exports is stronger than its effect on imports, which results in an increase in output and higher growth. However, this effect is reversed in the second year, as the effect of the real effective exchange rate is positive after two years. This implies that the depreciation of the real exchange rate reduces growth after two years. In terms of net impact on the current and delayed effects, the impact is positive ($-0.037 + 0.051 = 0.014$). Hence, the overall impact of a real depreciation is an increase in economic growth. The effect of inflation on economic growth in Sierra Leone is found to be negative, and this is significant at the 1% level in a contemporaneous sense and after two years. This implies that macroeconomic instability, reflected in high inflation rates, reduces economic growth in Sierra Leone.

Table 4.10: The Parsimonious Growth Model

Model Variables	Model (1)	Model (2)	Model (3)
Growth (Lag 1)	-0.320** (0.131)		-0.372** (0.144)
Foreign Direct Investment (% of GDP)		0.655*** (0.215)	0.486** (0.201)
Foreign Direct Investment (% of GDP) (Lag 2)		0.765*** (0.252)	
Investment GDP Ratio (Lag 1)	0.240*** (0.0831)		
Terms of Trade	0.180** (0.0685)	0.178*** (0.0516)	0.229*** (0.0467)
Terms of Trade (Lag 1)	0.167*** (0.0441)		0.162*** (0.0548)

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Real Effective Exchange Rate			-0.0373** (0.0138)
Real Effective Exchange Rate (Lag 1)	-0.0643*** (0.0187)	-0.0881*** (0.0293)	
Real Effective Exchange Rate (Lag 2)	0.0624** (0.0261)	0.128*** (0.0373)	0.0508** (0.0199)
Inflation		-0.106** (0.0418)	-0.0953** (0.0460)
Inflation (Lag 1)	-0.118** (0.0516)		
Inflation (Lag 2)			-0.0580* (0.0329)
Trade Openness (Lag 1)		-0.183** (0.0841)	
Constant	4.210** (1.763)	2.964 (3.342)	4.616* (2.483)
Observations	41	41	41
R-squared		0.511	0.583
Adjusted R-Squared	0.49	0.41	0.48
BIC	286.03	289.88	2870.0

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Note: Terms of trade enter the model in first difference form

In terms of the test for growth persistence or inertia, the model result shows that there is no growth inertia in Sierra Leone because the coefficient of lagged growth is negative and significant. What it instead reveals is that when economic growth increases in Sierra Leone in a given year, there is a tendency for it to decrease in the following year. This suggests that due to exogenous factors and domestic structural factors, a sustained increase in economic growth is not common from one year to another. Specifically, the coefficient of the lagged dependent variable is -0.372 and is significant at the 5% level. Thus, when economic growth increases by one percentage point in a year on average, it reduces by 0.4 percentage points in the following year.

We subjected the selected model of real GDP growth (model 3) to a battery of diagnostic tests (as was done for model 1 and model 2). Table 4.11 shows a diagnostic test of model residuals for the three models. The residual diagnostics show that the residuals of the preferred model are normal, homoscedastic and are not serially correlated. Also, the functional form test shows that the functional form of the three models is correct. The same conclusion applies to model 2. However, for Model 1, serial correlation is observed in the residuals. Thus, it was re-estimated using the Newey-West method to correct for the existence of serial correlation to have a meaningful comparison with the preferred model. Figure 3 shows tests for the stability of model 3, the preferred model. The result shows that the estimated model of economic growth is stable in its parameters.

Figure 3: Stability Test Result of the Growth Model

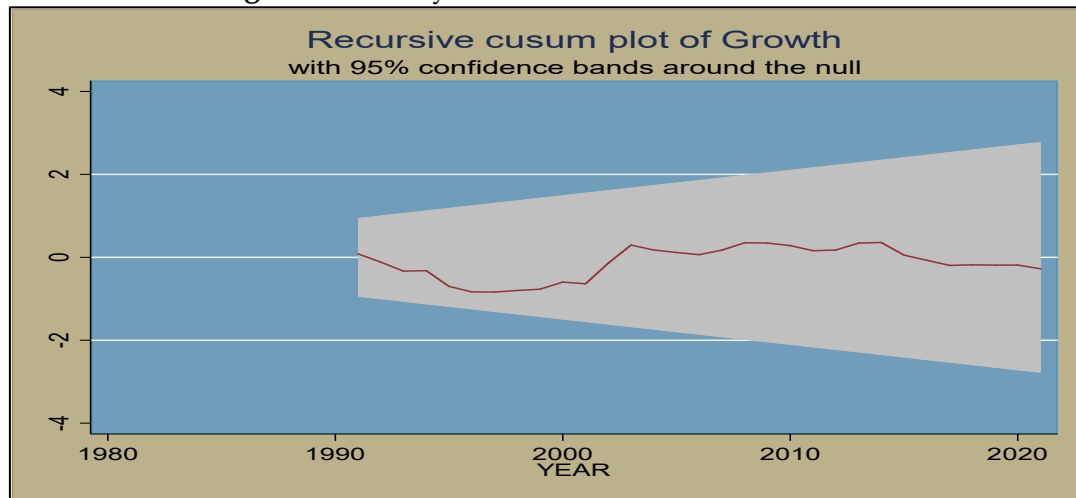


Table 4.10: Diagnostic Test of Model Residuals for the Three Models

Diagnostic	Model 1	Model 2	Model 3
Residual Normality	Chi Sq. = 1.73 P-value = 0.421	Chi Sq = 7.33 P-value = 0.026	Chi Sq = 3.75 P-value = 0.154
Residual Homoscedasticity	Chi Sq. = 41.00 P-value = 0.427	Chi Sq = 38.21 P-value = 0.326	Chie Sq = 41.00 P-value = 0.427
Residual Serial Correlation	<u>1st order</u> Chi Sq. = 11.273 P-value = 0.001 <u>2nd order</u> Chi Sq. = 11.352 P-value = 0.003	Chi. Squared 1st order = 5.38 P-value = 0.020 2nd order = 6.78 P-value = 0.034	<u>1st order</u> Chi. Sq = 2.044 P-value = 0.152 <u>2nd order</u> Chi. Sq = 2.185 P-value = 0.335
Functional Form of Model	F(3,29) = 0.69 P-value = 0.563	F(3,30) = 0.93 P. value = 0.440	F(3,30) = 1.23 P. value = 0.316
Conclusion	There is no homoscedasticity and residuals are normal. However, there is serial correlation in the residual. Functional form is correct.	There is no homoscedasticity and serial correlation and the residuals are normal. Also, the functional form is correct.	There is no homoscedasticity and residuals are normal. However, there is serial correlation in the residual. Functional form is correct.

5. Conclusion

Investment, which is the change in the stock of existing capital, is a critical element for the sustainable growth of a nation. In light of this, the production function is defined in terms of both labour and capital. However, domestic savings alone may not be sufficient to grow the economy sufficiently on a sustainable basis. Thus, calling for external financing or augmentation of domestic capital. However, external augmentation of domestic capital could be in the form of a loan, which goes with interest payments, with consequences for exchange rate depreciation and inflation. Moreover, the terms of the loan may not be favorable. Hence, foreign direct investment, which is not debt-related, is an alternative source of augmenting domestic capital. Foreign direct investment, however, goes into sectors that the investors are interested in investing in, given their

objective function for investing abroad. The objective of the study was to investigate the effects of foreign direct investment on economic growth in Sierra Leone.

We estimated a model of real GDP growth using annual data from 1980 to 2022, with the application of tests for stationarity in order to avoid spurious regression. Tests for stationarity using the Dickey-Fuller GLS test and a battery of structural break tests were applied, which show that, apart from terms of trade, which is stationary after taking the first difference, all the variables of the theoretical model of real GDP growth are stationary in level. A linear model of real GDP growth was then estimated in an autoregressive distributed lag (ARDL) context using the Ordinary Least Squares (OLS) by obtaining a parsimonious model from an over-parameterised model. The model reduction process was based on dropping insignificant variables from the over-parameterised dynamic model based on p-values.

The model results show that foreign direct investment (FDI) has a significant positive effect on economic growth, and this effect is significant both contemporaneously and after two years. Specifically, a one percentage point increase in foreign direct investment increases real GDP growth by 0.49 percentage points in the same year.

Hence, more efforts to strengthen domestic policies that encourage more investment into various sectors of the economy of Sierra Leone are useful, as more foreign direct investment is associated with more growth. This is more important for inclusiveness when it is encouraged in all sectors.

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Conflict of Interest Statement

The paper is an article from the PhD (Development Studies) Thesis of Alpha Junior Kougbaka, in the Institute of Geography and Development Studies, Faculty of Environmental Sciences, Njala University, Sierra Leone, with Dr. Robert Dauda Korsu as main Supervisor.

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