A Granger Causality Test on the Impact of Public Debt on the Economic Growth of Sierra Leone

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Abstract

This study uses the grader causality, Johansen co-integration, and error correction model tests to establish the relationship between public debt on the economy of Sierra Leone from 1986-2015. The economic implications of using government debt as a drive to fund expansionary fiscal policy and inform policymakers to consider the economic viability of government-funded projects and the social cost of pursuing them. To achieve the core objective, this study analyses the impact of public debt on the Sierra Leone economy using the Vector Autoregression (VAR) model approach to investigate the impact of public debt on the key macroeconomic variables of real GDP, Domestic Debt (DDB) and External Debt (EXT). The study established that economic growth proxied by RGDP responds differently to the various components of public debt, which were external and domestic debts. Specifically, the external debt had an insignificant negative effect on economic growth in Sierra Leone. Domestic debt, on the other hand, had a significant positive effect on economic growth. The overall results of the study revealed that there exists a long-run relationship between total public debt and RGDP in Sierra Leone.

Keywords

Debt Management and Growth, Grander Causality Test on Debt, Debt and Economy Growth

1. Introduction

According to Reinhart & Rogoff (2009), there is a global discussion among poli-

cymakers regarding the dangers of crossing the threshold in the ratio between government debt and gross domestic product. Economists believe that growth can be hindered by the level of debt as most of the government revenue will be used to service debt facilities across the economy. The claim from Growth in a Time of Debt (GITD) that has attracted the most attention is that there is no association between debt and growth at low or moderate levels of debt, while there is a well-defined threshold (90%, in their estimation) of government debt relative to gross domestic product (GDP) above which economic growth is hindered. The GITD assumption has been used by many to push for debt reduction and to argue for rapid and deep cuts in federal spending so as to prevent the debt-to-GDP ratio from approaching this supposed benchmark.

A major source of financial meltdowns has been related to financial capitalism. Countries suffering from the worldwide crisis experienced a rise in both their domestic and external debt. When the global debt crisis burst out, both the private and public sectors were left with huge debts. There was an increase in austerity measures imposed by multilateral organizations at the expense of society. These resulted in years of falling incomes and high unemployment (IMF, 2012). Sierra Leone's economy proved resilient in the face of two major shocks between 2014 and 2015, the Ebola epidemic and the collapse of iron ore prices (Duramany-Lakkoh, 2020). Economic growth has continued, supported by new investments in mining, agriculture, and fisheries.

According to Claessens & Kanbru (2007) three important issues have been a highlight of global economic recovery; stabilization packages introduced by the International Monetary Fund (IMF), debt cancellation programmes including coorporation among borrowing countries to attract debt relief (Pattillo et al., 2002) and then protecting borrowers works best when layers of nations are involved on a democratic basis.

1.1. Statement of the Problem

Countries around the world, including Sierra Leone have failed to meet their requirements of running a balanced budget and have therefore been experiencing a deficit in funding their fiscal activities (Duramany-Lakkoh, 2021). An increase in the government budget deficit means that the government increases its demand for "loanable" funds from the private sector, looking to borrow money from its own citizens as well as from international investors. In a healthy economy, this suggests that the government begins competing with private borrowers for a hard and fast supply of savings and thus drives up interest rates. This increase in interest rates may reduce ("crowd out") private-sector investments in plants and equipment. This decline in investment means the general economy features a smaller capital stock and this smaller capital stock decreases future growth rates (Duramany-Lakkoh et al., 2021).

Economists have argued about what should obtain in financing deficit and keeping expenditure on the rise, giving the continuous rise in population (Bidzo, 2018). A high debt burden will result in slow economic growth and which in

turn will affect the standard of living. Sierra Leone is considered a highly indebted country and therefore requires a thorough investigation of the effects of both domestic and external debt on its economy.

1.2. Objectives of the Study

The paramount objective of this study is to assess the impact of public debt on the economic well-being of the Sierra Leone People, as highlighted in the problem statement.

Other general objectives of this study include:

- To examine the impacts of external debt on the economic growth of Sierra Leone;
- To examine the impacts of domestic debt on the economic growth of Sierra Leone;
- To examine the relationship between the independent variables obtained from the model with regards to the impact of one on the other.

1.3. Research Questions

The following questions are generated to better serve the purpose of this study:

- Are there any impacts of external debt on the economic growth of Sierra Leone?
- Are there any impacts of domestic debt on the economic growth of Sierra Leone?
- Is there any relationship between the independent variables obtained from the main model?

1.4. Motivation of the Study

This study brings out the economic implications of using government debt as a drive to fund expansionary fiscal policy and informs policymakers to consider the economic viability of government-funded projects and the social cost of pursuing them.

There is currently much cautionary talk in policymaking circles regarding the risks to the economy's future health posed by crossing a selected threshold within the ratio between government debt and gross domestic product. These fears are fuelled by a recent report by researchers (Reinhart & Rogoff, 2009). (Reinhart & Rogoff, 2009) have recently engaged during a prodigious attempt aimed toward collecting and analysing economic data and financial crises across dozens of nations and many years" (Irons & Bivens, 2010).

From the statement above and also backed by the continuous accumulation of government debt in Sierra Leone's fiscal spending, the relevance of this study cannot be overemphasized.

2. Literature Review

2.1. Theoretical Review

2.1.1. Public Debt

Public debt is one of the major macroeconomic indicators that dictate coun-

tries's image and reputation in the international markets. It is one of the determinants of Foreign Direct Investment (FDI), which in turn determines economic growth and development. According to Karazijiene & Saboniene (2009) public borrowing is an unavoidable phenomenon of economic growth. It is a means of stimulating economic growth by injecting money from foreign investors (external debt) into the economy as well as distributing assets (internal debt) among those that have surplus funds. Public debt is the total national or sovereign debt which includes debts of both local and central governments that shows how much of the public expenditures have been financed by domestic or external borrowings instead of taxation (Makau, 2008). Public debt is one of the means of financing government operations and also a means of raising money to monetise their debts, thereby eliminating interest payment. However, this practice only reduces public debt service payment rather than a total debt cancellation and can have a hyperinflationary effect if used free-handedly. Public debts can be external and domestic. Public external debt is accumulated through loans from international financial institutions such as World Bank and IMF, while public domestic debt is created through domestic financial instruments such as bonds, treasury bills, borrowing from commercial banks and overdrafts from central banks.

A fundamental factor causing public debt to increase is the continuous over-reliance on external resources to complement capital formation in developing countries. The higher the interest payment and the higher the deficit on the current account, the heavier the debt burden. According to Abbas and Christensen (2010), excess government demand for domestic borrowing tends to increase domestic interest rates. The higher interest rates crowd out or increase the cost of financing new private sector investment and hence limit economic growth and development. Public debt represents a fixed contractual obligation with the economies' resources used as collateral to guarantee future repayment. Cashell, (2010) stated that the impact of public debt on the economic growth and development of many nations remains a controversial issue in both the academic and policy-making spectrum.

2.1.2. Sierra Leone Public Debt Structure and Composition

Public debt consists of all liabilities that are financial claim that requires payment of principal and/or interest by the debtor to the creditor at a date, or dates in the future. Public debt in Sierra Leone comprises public and publicly guaranteed disbursed and outstanding debt owed to residents and non-residents.

A government has various alternatives to borrowing for the purpose of financing a fiscal deficit. One way is to borrow directly from the central bank which is equivalent to the printing of money. The other alternatives are; borrowing from domestic commercial banks, borrowing from domestic non-bank sector and borrowing from external sources. Each method has its own implications for various aspects of the economy. Government usually adopts a mixed strategy and utilizes a number of options at same time that have more benefits for the present situation of the country (Government of Sierra Leone, 2018).

According to the last data point published by the National Public Debt of Sierra Leone in Table 1, the Sierra Leone public debt was 2078 million dollars in 2016, an increase of 153 million from 2015. This amount means that the debt in 2016 reached 54.88% of Sierra Leone GDP, a 9.61 percentage point rise from 2015, when it was 45.27% of GDP. Sierra Leone per capita debt in 2016 was 287 dollars per inhabitant rising by 16 dollars from 271 in 2015. The position of Sierra Leone, as compared with the rest of the world, worsened in 2016 in terms of GDP percentage. In 2016 Sierra Leone was country number 108 on the list of debt to GDP and 20 in debt per capita, out of 185 (Government of Sierra Leone, 2018).

Debt owed to residents in Sierra Leone (whether denominated in local or foreign currency) is classified as domestic debt and includes Government Treasury bills and bonds, promissory notes, domestic suppliers' payment arrears, outstanding obligations owed to state-owned enterprises as well as Ways and Means Advances of the Central Bank of Sierra Leone. A significant portion of Government Treasury securities are held by the commercial banks, and constitute a huge percentage of their financial assets. External debt is defined as disbursed and outstanding debt owed to non-residents, which are grouped into multilateral, bilateral and commercial creditor agencies. Sierra Leone's total public debt stock

Table 1. Sierra leone: evolution of debt.

Date	Debt	Debt (%GDP)	Debt Per Capita
	$	%	$
2016	2078	54.88	287
2015	1925	45.27	271
2014	1750	34.97	252
2013	1502	30.55	223
2012	1397	36.77	213
2011	1317	44.75	205
2010	1207	46.85	192
2009	1181	48.05	192
2008	1063	42.37	177
2007	910	42.17	156
2006	1945	103.90	342
2005	2156	130.90	391
2004	2183	151.60	412
2003	2214	160.35	436
2002	1988	158.82	411
2001	1958	180.66	423
2000	1727	183.69	387

Source: National Public Debt Sierra Leone 2016.

stood at Le8.08 trillion at the end of December 2015 compared to Le8.08 trillion at the end of December 2014 (an increase of about 23.16%). The increase was mainly a result of domestic borrowing for budget deficit financing as well as the increase in external debt on account of projects and programs disbursements coupled with the depreciation of the Leone against major loan currencies. The stock of external debt as of the end of 2015 amounted to Le5.64 trillion (69.71% of total debt stock) while domestic debt stood at Le2.45 trillion (30.29%).

Total debt service payments comprise amortization (principal repayment) and interest, including charges, commitment fees and commissions on external debt, and interest on domestic debt instruments and Ways and Means Advances. In absolute terms, while the debt service has increased over the years, the fiscal burden, that is, total debt service as a percentage of domestic budget revenue has been falling. This reflects the Government's increased ability to meet its debt service payment obligations as and when they fall due (Government of Sierra Leone, 2018).

2.1.3. The Twin Shocks and Outlook

Economic performance in 2015 was marked by the Ebola epidemic and the cessation of iron ore production. This led to an unprecedented contraction of 21.1 percent in real GDP. The growth of the non-iron ore economy was sluggish at 1.4 percent with the services sector bearing the brunt of adjustment. Currency stability in the first half of 2015 was aided by large Ebola-related inflows. Once the exceptional capital inflows abated, pressure on Leone increased over the second half of the year resulting in a currency depreciation of 12.3 percent relative to the U.S. dollar over 2015. The currency continued to depreciate throughout the first half of 2016 with year-on-year depreciation of the average official rate hitting about 25 percent in June 2016. The Central Bank increased the weekly foreign exchange auction amount from less than a million to 3 million per week to stabilize the official exchange rate. Nevertheless, inflation averaged 13.3 percent over 2015 reflecting currency depreciation trends. Total value of exports collapsed from 19.4 to 0.8 percent between 2014 and 2015 due mostly to the cessation of iron ore production and the continued decline in international prices for Sierra Leone's key mineral products. The total imports of goods also declined by about 14.6 percent in 2015, as Ebola related goods imports decreased along with the imports of fuel products. As a result, the trade deficit increased from US$339 million in 2014 to US$724 million in 2015. Reflecting the twin shocks, the fiscal deficit expanded from 2.3 percent of GDP in 2014 to 4.7 percent of GDP in 2015. The Ebola crisis has slowed the structural reform agenda, especially public finance management and government reforms, and it would appear critical that these reforms are resumed particularly given the much tighter current and expected fiscal environment (Duramany-Lakkoh et al., 2022).

Despite the resumption of iron ore production, the country continues to face a growing balance of payment challenges. The current account deficit is expected

to widen to 17.7 percent in 2016, up from 16.6 percent in 2015, despite narrowing trade balance, net services and net income. The decline in current transfers, including Ebola related service imports, and decreased factor income payments in the mining sector. Resumed iron ore delivery to China will boost exports, but persisting low world prices will keep the value of shipments below 2013 levels and moderate earnings. The widened current account deficit will be financed mainly by growing FDI inflows to the agriculture and food processing sectors and portfolio investment to cover incurred losses in the mining sector. Nevertheless, the balance of payment will display a deficit financed by the use of IMF resources. Therefore, the gross international reserves will remain unchanged at around 5 months of non-iron ore-related imports.

On the fiscal side, domestic revenue mobilization remains challenging in the context of declining aid and weak recovery in the urban sector. Despite a modest increase of 0.4 percent of GDP in domestic revenue, total revenue and grants are expected to decrease from 15.7 percent in 2015 to 14.1 percent in 2016 as foreign aid scales down to its pre-Ebola level. Both budget support and project grants are projected to decrease by a cumulative amount equivalent to 2 percent of GDP in 2016, from a peak of 5.2 percent in 2015 (Duramany-Lakkoh et al., 2022).

2.1.4. Debt and Economic Growth

The existing literature on the analysis of public debt and economic growth tends to indicate a negative relationship. According to Modigliani (1961), Buchanan (1958), and Meade (1958), debt may be a burden to future generations because it reduces the stock of personal capital, which successively reduces the flow of income. Specifically, debt can negatively impact the economic process by crowding out private investments. If the proportion of government operations funded through debt is significantly high, interest rates may substantially increase in the long run. An increase in debt won't be costless to future generations despite benefiting the present generation.

Modigliani (1961) argues that the gross burden of public debt can only be offset in part or in total if borrowed funds are used to finance productive public capital formation, which in turn improves the real income of future generations. The interest accruing from both domestic and external debt is often paid through taxes. This reduces the available lifetime consumption of taxpayers and their savings. As a result, capital stock and economic processes reduce.

Krugman (1988) coined the term "debt overhang" to describe the negative relationship between public debt and economic growth. Debt overhang refers to when the ability of a country to repay its external debt reduces below the contractual value of the debt. Cohen (1993), on the other hand, argues that the relationship between public debt and economic growth is non-linear. This means that an increase in external public debt promotes investment up to a certain level or threshold. Beyond the edge, debt overhang will discourage investors from providing capital to the government. Eventually, economic process begins to say no as interest rates increase. High debt can affect economic process negatively

through different channels. One of the most important channels is long-term interest rates. High long-term interest rates can displace private investment, thereby reducing potential output growth. Increased public financing needs are likely to extend sovereign debt yields. Therefore, we expect a net flow of capital or funds from the private to the public sector. This increases interest rates and reduces private spending by households and firms.

According to Krugman (1988), external debt affects economic growth through its adverse effects on investments. As domestic and foreign investors reduce their supply of capital, the extent of investment reduces. This results in a discount in the economic process. Public debt also can negatively affect the economic process through higher future distortionary taxation, inflation, and greater uncertainty about prospects and policies. Extreme cases of the debt crisis can also trigger a banking or currency crisis; thus, causing a reduction in economic growth.

2.1.5. The Solow's Theory

Robert Solow and T.W. Swan introduced Solow's model in 1956. Their model is additionally referred to as the Solow-Swan model or just the Solow model. In the Solows model, other things being equal, saving/investment and increased rates are important determinants of economic process. Higher saving/investment rates cause accumulation of more capital per worker and hence more output per worker. On the opposite hand, a high increase features a negative effect on economic process just because a better fraction of saving in economies with a high increase has got to go to keep the capital-labour ratio constant. In the absence of technological change & innovation, an increase in capital per worker would not be matched by a proportional increase in output per worker because of diminishing returns. Hence capital deepening would lower the speed of return on capital. In simpler terms, the model suggested that the key variable in growth is labour productivity: output per worker i.e. how much an average worker in the economy is able to produce. This model assumes that output (Y) is produced using technology (A), physical capital (B), and labour (C). This relationship can be expressed thus:

$$Y = \{A, B, C\} \tag{2.1}$$

where:

Y = is aggregate output;

A = is the number based on the current state of technology;

B = is a quantitative measure of the size of the stock of manufactured capital and;

C = is the quantity of labour used during the period of time.

This model is based on three assumptions; firstly, increasing capital relative to labour creates economic growth since people can be more productive given more capital. Secondly, poor countries with less capital per person will grow faster because each investment in capital will produce a higher return than de-

veloped countries with enough capital. Finally, countries will reach a steady state where an increase in capital no longer results into increase in economic growth.

2.1.6. The Classical Economic Growth Theory

This theory was postulated by Adam (1984), who argued that in a free market economy, specialization and division of labour could result from increases in the growth of a nation. The theory reached its climax of recognition in work done by David Ricardo (1951). In this theory, he proposed that the output of a nation depends on the quantity of input or factors of production such as land, labour and capital and technological innovation. Therefore, by this theory, economic growth (Y) can be summarised as a function of population growth (P), increase in investment (I), land growth (L) and total labour productivity (O). This model can be written thus:

$$Y = f\left(P, I, L, O\right) \tag{2.2}$$

where:

 Y = indicates Economic growth;

 P = indicates Population growth;

 I = indicate Increase in investment;

 L = indicates land;

 O = indicates Labour productivity.

This theory further states every economy has a steady state GDP and any deviation from this steady state is just temporary and will eventually return to this state. This concept means that when there is economic growth, population will increase. The increase in population will thus create an adverse effect on GDP due to the higher demand on limited resources from a larger population which lowers GDP to its steady state. When the GDP falls below its steady state, population will decrease and thus reduces the demand for limited resources thereby raising GDP to its steady state.

2.1.7. Keynesian Theory of Public Borrowing

The Keynesian theory of public borrowing was adopted as the theoretical framework of this study. The Keynesians view fiscal policy as the best policy that brings about growth and development in any economy since it acts in the interest of the general public. According to Keynes, when the government embark on borrowing to finance its expenditure, unemployed funds are withdrawn from the private pockets and as such the consumption level of the private individuals is unaffected. Aggregate demand, output and unemployment will increase if these funds are then injected back into the economy by the government. This according to Keynes is the multiplier effect of government expenditure.

Given the national income model as follows;

$$Y = C + I + G + \left(X - M\right) \tag{2.3}$$

The change in output will be equal to the multiplier times the change in government expenditure

$$\Delta Y = \frac{1}{1-b} \Delta G \qquad (2.4)$$

where, $\quad \dfrac{1}{1-b} = K$

$\qquad \Delta Y = K \Delta G$

$$\frac{\Delta Y}{\Delta G} = K \qquad (2.5)$$

Therefore, the change in output all over the change in government expenditure is equal to the multiplier. This shows that public borrowing can be used to influence macroeconomic performance of the economy.

2.2. Empirical Review

Panizza & Presbitero (2014) used the variable instrument approach to investigate the causal effect of public debt on economic growth in OECD countries. Their analysis revealed a negative relationship between debt and economic growth. However, they did not find any causal effect of public debt on economic growth after correcting for endogeneity. Although this study sheds light on the causal relationship between public debt and economic growth, its findings are inconclusive. Thus, they could not be applicable in other countries.

According to Mukui (2013), external public debt and debt servicing had a negative effect on economic growth in Kenya. The researcher also noted that rate of inflation and domestic savings had negative effects on economic process. By contrast, capital formation and foreign direct investment had a positive effect on economic growth. These findings were based on Kenyan data for the period 1980 to 2011, which was analysed using a linear model. Although the study used Kenyan data, it did not estimate the effect of domestic debt on economic growth.

Zouhaier & Fatma (2014) in their study of economic growth in 19 developing countries found that external public debt as a percentage of GDP and GNI had a negative and statistically significant effect on economic growth. Similarly, the external public debt had a negative effect on investment in the 19 countries. Although this study focused on developing countries such as Kenya, its findings are inconclusive. Additionally, it did not identify the channels through which external debt affects economic growth.

Hassan & Mamman (2014) examined the contribution of external debt to the economic process in Nigeria over the amount 1970 to 2010, through the utilization of a standard least square model. The authors' results showed an inverse relationship between external debt and economic growth in Nigeria. However, Hassan & Mamman (2014) showed that debt service payments have a positive impact on economic process in Nigeria. The authors explained that because the country pays its debts, it avoids the buildup of interests and penalties thereby attracting aid, foreign direct investments and other international opportunities that boost the economy in the long run.

Using OLS regressions, Boboye & Ojo (2012) studied the consequences of external debt on economic process in Nigeria. They found that external debt had a negative effect on national income and per capita income of Nigeria. The increase in debt level led to the devaluation of the country's currency, retrenchment of workers, regular industrial strikes, and poor education. As a result, the extent of economic process and development declined. This study sheds light on the effect of public debt on economic growth in the context of a developing African country. However, it ignores the effect of domestic debt on economic process.

Abbas and Christensen (2010) studied the impact of domestic debt on economic growth and development for three low-income countries from 1975 to 2004 using the granger causality regression model. The study showed that moderate levels of marketable domestic debt as a percentage of GDP have significant positive non-linear impacts on economic growth, but debt levels exceeding 35% of total bank deposits have a negative impact on economic process.

Adofu and Abula (2010) investigated the relationship between domestic debt and economic growth in Nigeria from 1986 to 2005 using the ordinary least square approach. Their findings indicated that domestic debt has negatively affected economic growth of Nigeria and recommended that the government must discourage taking further domestic debt. The suggested that the government should instead concentrate on widening tax revenue base of the country.

The theoretical and empirical literatures reviewed revealed that the correlation between public debt and economic growth depends on the situation of the country under study. It was established that public debt has a significant influence on economic growth and development. The impacts were considered to be either negative or positive depending on the components of public debt and the utilization of the monies obtained from the debts.

3. Methodology

3.1. Theoretical Framework

According to Sala-i-martin (1997), economic theories do not identify the precise factors or variables that determine economic process. In response to the present challenge, he proposes a cross-sectional model of the form:

$$\gamma = \alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \varepsilon \tag{2.6}$$

where Y is a vector of economic growth rate and $x_1, \cdots, x_n$ are vectors of potential explanatory variables that vary from study to study. In this regard, researchers often use a variety of variables, which they believe best explain economic growth based on theoretical literature and the unique economic situation of each country. For instance, Hassan & Mamman (2014) modeled real gross domestic product (RGDP) as a function of external debt, debt service payment, export, inflation, and exchange rate. Uma et al. (2013) noted that real gross domestic product is determined by total domestic product, total external debt, and interest rate on total external debt. In addition to those variables, Ajayi & Oke (2012)

added the rate of exchange as an element that determines GDP growth in an open economy.

Theoretical literature indicates that capital and labor affect productivity, which in turn determines GDP. This can be expressed as $Y = f(K, L)$, Where Y is GDP; K and L are capital stock and labor force respectively.

On the basis of the above analysis, this study adopts the Keynesian theory of public borrowing which is similar to that described by Sala-i-martin et al. (1997) as the theoretical framework. This school of thought views fiscal policy as the best policy that brings about economic growth and development and acts in the interest of the general public. This model states that government expenditure creates a multiplier effect in an economy. Keynes also used the national income model to measure growth thus:

$$Y = C + I + G + (X - M) \qquad (2.7)$$

where:

$Y = $ *Output or Growth*;
$C = $ *Consumption*;
$G = $ *Government Spending*;
$X = $ *Export*;
$M = $ *Import*.

3.2. Research Design

This study is quantitative in nature and adopts evidence from Granger Causality. This methodology is considered appropriate because it uses secondary data to analyse the relationship between the variables included in the model, that is, RGDP and its relationship with external and domestic debts. According to Cooper & Schindler (2006), the concern in the causal analysis is how one variable affects or causes changes in another variable. Furthermore, Cooper & Schindler (2006) noted that a research design is the structure of the research and the glue that holds the components of the research together. The study consists of three macroeconomic variables for the period of thirty (30) years from 1986 to 2015 which results in thirty (30) observations. The extent of the period is meant to ensure accuracy of analysis especially for the purpose of generalizing the findings according to Mugenda & Mugenda (2003), target population should have observable characteristics to which the researcher intends to generalise the results of the study.

3.3. Specification of Model

In this study, the method of Granger Causality Vector Autoregression Model (VAR) is adopted to estimate the effects of public borrowing on economic growth in Sierra Leone. The following model is specified in order to test the causal relationships;

$$RGDP = f(PUB) \qquad (3.1)$$

where:

RGDP = Real gross domestic product; and PUB = Public debt.

Public borrowing can be further specified as follow:

$$PUB = f(EXT, DDB) \tag{3.2}$$

where:

EXT = *External debt outstanding*;

DDB = *Domestic debt*; *and*

For this study to capture the stated objective, Equation (3.1) for public debt-growth nexus is represented in a VAR model as:

where:

$RGDP_t$ = *Proxy for economic growth*;

PUB_t = *Proxy for public debt*;

U_t = *A zero mean white noise error term.*

For this study to examine whether domestic or external debt promotes economic growth, public debt, external debt and domestic debt are disaggregated. This will enable the results to show whether the domestic debt or the external debt helps to promote and enhance economic activities in Sierra Leone. In order to test the above hypotheses, the usual Wald F-statistic test is utilized, which has the following form:

$$F = \frac{(RSS_R - RSS_U)/q}{RSS_U/(t - 2q - 1)}$$

where:

RSS_R = The sum of squared residuals from the equation under the assumption that a set of variables is redundant, when the restrictions are imposed (restricted equation);

RSS_U = The sum of squared residuals from the complete (unrestricted) equation;

T = *The sample size*;

q = *The lag length.*

The hypotheses in this test are:

H_0: PUB does not Granger cause RGDP, *i.e.,* $\{\alpha_{11}, \alpha_{12}, \cdots, \alpha_{1k}\} = 0$, if $Fc <$ critical value of F H_1: PUB does Granger cause RGDP, *i.e.,* $\{\alpha_{11}, \alpha_{12}, \cdots, \alpha_{1k}\} \neq 0$, if $Fc >$ critical value of F

And

H_0: RGDP does not Granger cause PUB, *i.e.,* $\{\beta_{21}, \beta_{22}, \cdots, \beta_{2k}\} = 0$, if $Fc <$ critical value of F

H_1: RGDP does Granger cause PUB, *i.e.,* $\{\beta_{21}, \beta_{22}, \cdots, \beta_{2k}\} \neq 0$, if $Fc >$ critical value of F

The results related to the existence of Granger causal relationships among economic growth and public debt indicators.

3.4. Data Source

The study uses time series to examine the relationship between public debt and

economic growth in Sierra Leone during the period 1986 to 2015. Data for Real GDP is calculated annually at a base year price. The data for public and domestic debt was obtained from the Bank of Sierra Leone, output or growth data obtained from the World Bank, government spending, consumption, export and import data derived from Statistics Sierra Leone. The data is collected in order that estimation can reflect a real value of the series. The data collected is secondary data obtained from the above-mentioned institutions, and the study depends on the adequacy of the data obtained.

3.5. Estimation Technique

To achieve the core objective of this study in analysing the impact of public debt in the Sierra Leone economy, this section adopted a Vector Autoregression (VAR) model to investigate the impact of public debt on the key macroeconomic variable of real GDP. The granger causality test was used to analyse the effects of public debt on real GDP. The adoption of the VAR framework was informed by the most objective of the study.

A VAR model is an n-equation, n-variable linear model in which each variable is in turn explained by its own lagged values, (plus current, depending on the variant of the VAR and past values of the remaining $n − 1$ variables. It is an easy framework that gives a scientific thanks to capturing rich dynamics in multiple statistics, while its statistical toolkit is straightforward to use and interpret.

A unit root test was performed on each variable in my model using the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests. After testing for unit roots, the test for co-integration (long run relationship between variables) was conducted. This study uses Johansen (1991) definition of co-integration. Johansen's co-integration procedure was used to test for the possibility of at least one co-integrating vector between variables in the models developed for the Sierra Leonean economy in this study. After the above testing is established, the study adopts Granger causality, to know the direction of causality between public borrowing and economic growth in the economy.

3.6. Variables Justification

Gross domestic product is a measure that reflects the value of goods and services produced per individual in the economy in a given year and is measured in Le' Billion. It is used to capture economic process and development during this study because it captures the entire output produced by each individual within the country and intrinsically provides a more accurate figure.

External debt stock is employed as a proxy for capturing the total external debt of the economy during a given period. It is measured in Le' Billion.

Domestic debt stock is used as a proxy for capturing the total domestic debt of the economy in a given period. It is measured in Le' Billion.

4. Results and Discussions

This section analyses, presents and discusses the empirical results of the impacts

of public debt on economic growth of Sierra Leone. The chapter attempts to accomplish the objectives of the study and to provide answers to the research questions that prompted this study. This section tests the data collected for normality, stationarity of the variables, co-integration test, and the long run regression analysis for the same sample covering the period 1986-2015 followed by the granger causality.

4.1. Stationarity Tests of Variables

The Unit Root Test

Table 2 and Table 3 below shows the result of the unit root tests for the variables. With evidence of unit roots, the series is said to be integrated of order one − $I(1)$, meaning that they must be modeled in the first difference ($\Delta y_t = y_t - y_t - 1$) to make them stationary. A time series is stationary if it does not change overtime, which implies that its values have constant variability. This enables me

Table 2. Augmented dickey-fuller unit root test.

	Level		First Difference		Level of Significance	Order of Integration
	t. Statistic	P. Value	t. Statistic	P. Value		
RGDP	−1.046798	0.7226	−5.149141	0.0003	5%	1(1)
EXT	−0.378478	0.9003	−4.387133	0.0018	5%	1(1)
DDB	3.495196	1.0000	−3.673205	0.0104	5%	1(1)
	Critical Values					
	Level		First Difference			
1%	−3.679322		−3.689194			
5%	−2.967767		−2.971853			
10%	−2.622989		−2.625121			

Source: Researcher's computation from unit root test (ADF).

Table 3. Philips-Perron unit root test.

	Level		First Difference		Level of Significance	Order of Integration
	t. Statistic	P. Value	t. Statistic	P. Value		
RGDP	−1.046798	0.7226	−5.149141	0.0003	5%	1(1)
EXT	−0.378478	0.9003	−4.387133	0.0018	5%	1(1)
DDB	3.495196	1.0000	−3.673205	0.0104	5%	1(1)
	Critical Values					
	Level		First Difference			
1%	−3.679322		−3.689194			
5%	−2.967767		−2.971853			
10%	−2.622989		−2.625121			

Source: Researcher's computation from unit root test (PP).

to avoid the problems of spurious regressions that are associated with non-stationary time series models. After testing for unit roots, we proceeded to test for co-integration (long run relationship between variables).

Table 2 and Table 3 shows the test result of the Augmented Dickey-Fuller and Philips-Perron statistic for all the time series variables used in the estimation. The result of the ADF and PP test statistics showed that the three variables i.e., RGDP, EXT and DDB were not stationary in their level form but were stationary after the first difference. The null hypothesis of the presence of unit root in the series was rejected as indicated by their probability values which were less than 0.05 and the values of their calculated ADF and PP (in absolute terms) statistics which were higher than their critical values at first difference. In this case, the data series are said to be integrated of the order one i.e., 1(1).

4.2. Johansen Co-Integration Test

Given all variables are integrated of order one, i.e., they are $I(1)$, it confirms the need to test for the existence of a long run relationship (cointegration) using the Johansen approach. The test results are shown as follows:

The results of the co-integration test are reported in Table 4 and Table 5 below and this allows the study to examine the long run relationship among the variables. The result shows that there was at least one co-integration relationship among the variables in the model. The evidence of multivariate co-integration test results suggests that external debt, domestic debt and economic growth are co-integrated. That is, these variables move together in the long run. Table 4 and Table 5 below also confirm multivariate co-integration test results of Eigenvalue and trace statistic. The Trace statistic and the Max-Eigen statistic (Table 4 & Table 5) indicated three co-integrating equations at the 0.05 level. The results of the Johansen Co-integration tests above strongly rejected the null hypothesis of no co-integration, i.e., no long-run relationship between the dependent and the independent variables in favor of at least 3, co-integrating vectors. This implies that there is long-run relationship between the dependent variable and the explanatory variables.

4.3. Error Correction Estimates

The coefficient of the explanatory variables in the error correction model measures the short-run relationship of the dependent variable and the explanatory variables. When conducting error correction technique, an over-parameterised model is usually expressed to deal with the problem of misspecification in the model. This is followed by the parsimonious model, which is derived after some stepwise elimination of relatively insignificant parameters in the over-parameterised model. The result in Table 6 indicated that most of the variables and their lags are not significant. This is expected possibly because of multicollinearity. The R^2 of the over-parameterised model presented below, however indicated that all the explanatory variables in the model accounts for 98.9171% of the systematic variation in RGDP. The f-statistical value of 71.77267 with the probability

Table 4. Test for Johansen co-integration using trace statistic.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.613780	49.10041	29.79707	0.0001
At most 1*	0.509423	23.41399	15.49471	0.0026
At most 2*	0.143596	4.185339	3.841466	0.0408

Source: Researcher's computation from E-views 9. Trace test indicates 3 cointegrating eqn(s) at the 0.05 level; *denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) *p*-values.

Table 5. Test for Johansen co-integration usingMax-eigenvalue

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.613780	25.68642	21.13162	0.0106
At most 1*	0.509423	19.22865	14.26460	0.0076
At most 2*	0.143596	4.185339	3.841466	0.0408

Source: Researcher's computation from E-views 9. Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level; *denotes rejection of the hypothesis at the 0.05 level; ** MacKinnon-Haug-Michelis (1999) *p*-values.

Table 6. Result of the over parameterized RGDP model in Sierra Leone (ECM 1).

Variable	Coefficient	Standard error	t-Statistic	Prob.
C	0.00112	0.00197	0.568505	0.5811
D(RGDP(−1))	−0.779323	0.27465	−2.837517	0.0162
D(EXT)	−0.00000552	0.00000215	−2.572352	0.0259
D(EXT(−1))	−0.00000524	0.0000034	−1.539336	0.152
D(EXT(−2))	−0.000000225	0.00000275	−0.081866	0.9362
D(DDB)	0.0000435	0.0000118	3.693279	0.0035
D(DDB(−1))	0.0000873	0.0000195	4.469149	0.0009
D(DDB(−2))	−0.0000285	0.0000166	−1.710582	0.1152
ECM(−1)	−0.870081	0.33151	−2.624598	0.0236
R-squared	0.989171			
Adjusted R-squared	0.975389			
F-statistic	71.77267			
Prob (F-statistic)	0.000000			
Durbin-Watson stat	1.750459			

Source: Researcher's computation from E-views 9.

value of 0.000000 indicated that the whole model is significant. The error correction term i.e., ECM (−1) is negative and statistically significant at the 5% level.

Its coefficient of −0.870081 implied that the speed at which the short-run equation converges to equilibrium in the long-run is high.

The research, however, simplifies the error correction model by estimating a parsimonious model (ECM 2), which is developed from the over-parameterized model (ECM 1). The above results in Table 7 below show that external debt stock (EXT) has a negative but not significant relationship with RGDP in Sierra Leone. External debt servicing has a negative but not significant relationship with RGDP. The value of the coefficient of determination (R^2) of 0.923031 shows that the exogenous variables in the ECM equation, EXT and DDB explains over 92% of the systematic variations in RGDP while the remaining 8% variations in RGDP are caused by factors outside the model captured in the stochastic term (μ). Considering the degree of freedom, the Adjusted R^2 dips down a little to 0.899940. This confirms the integrity and degree of fit of the model.

Furthermore, the f-statistical value (39.97409) is highly statistically significant at the 5% level going by its probability value of 0.000000. This implies that EXT and DDB taken together, have a significant linear relationship with the dependent variable, RGDP. The Durbin-Watson statistic of 1.4605562 is indicative of the presence of a low positive serial autocorrelation in the model. The coefficient of the ECM (−1) is significant with the appropriate negative sign, indicating that the adjustment is in the right direction to restore the long-run relationship. Its coefficient of −0.893909 means that the present value in RGDP adjusts rapidly to previous changes in EXT and DDB specifically by about 89%.

4.4. Granger Causality Test

The result of *VAR* Granger's causality test between the variables under study is provided in Table 8 below. However, the focus of the study is on the causal relationship between public debt burden and socio-economic growth in Sierra Leone.

Table 7. Result of the parsimonious RGDP model in Sierra Leone.

Dependent variable: D(RGDP)				
Variable	Coefficient	Standard error	t-statistic	Prob.
C	0.003991	0.002748	1.452257	0.1619
D(RGDP(−1))	−1.043054	0.252601	−4.129256	0.0005
D(EXT(−1))	−0.000004	0.000004	−1.186486	0.2493
D(DDB(−1))	0.00015	0.000002	8.569639	0.0000
ECM(−1)	−0.893909	0.414923	−2.154398	0.0436
R-squared	0.923031			
Adjusted R-squared	0.89994			
F-statistic	39.97409			
Prob. (F-statistic)	0.000000			
Durbin-Watson stat	1.460562			

Source: Researcher's computation from E-views 9.

Table 8. VAR granger causality/Block Exogeneity Wald Tests.

Date: 24/10/18 Time: 15:44

Sample: 1986 2015

Included observations: 27

Dependent variable: RGDP

Excluded	Chi-sq	df	Prob.
EXT	3.871419	2	0.1443
DDB	7.901411	2	0.0192
All	8.046967	4	0.0899

Dependent variable: EXT

Excluded	Chi-sq	df	Prob.
RGDP	8.095203	2	0.0175
DDB	9.828105	2	0.0073
All	12.30597	4	0.0152

Dependent variable: DDB

Excluded	Chi-sq	df	Prob.
RGDP	1.814085	2	0.4037
EXT	4.272756	2	0.1181
All	4.411563	4	0.3532

The null hypothesis states that external debt (EXT) and domestic debt (DDB) together does not Granger cause real gross domestic product (RGDP) even though DDB exclusively do Granger cause RGDP, and RGDP does not Granger cause EXT and DDB. However, it shows that the rule of thumb states that the probability of the f-statistic must be less than 0.5 to show a causal relationship at the 5% level. The probability for our causal variables RGDP (dependent variable) and EXT (independent variable) is 0.1443. Therefore, we accept the null hypothesis and conclude that there is no causal relationship between external debt and real gross domestic product in Sierra Leone. But, the probability for our causal variables RGDP (dependent variable) and DDB (independent variable) is 0.0192. Therefore, we reject the null hypothesis and conclude that there is one-way causal relationship between domestic debt and RGDP in Sierra Leone. It is generally implied that no causal relationship exists between external debt burden and real gross domestic product while a one-way causal relationship exists between domestic debt burden and real gross domestic product in Sierra Leone. However, all EXT and DDB on RGDP have a probability of 0.0899 which shows an acceptance of the null hypothesis and no causal relationship between external debt and domestic debt in all and real gross domestic product in Sierra Leone. Furthermore, RGDP (independent variable) and DDB (independent variable) exclusively and in all have a causal relationship on EXT (dependent variable), for which we reject the null hypothesis due to the probabilities of 0.0175

(RGDP on EXT), 0.0073 (DDB on EXT) and 0.0152 (RGDP and DDB in *All* on EXT).

4.5. Discussion of the Regression Results

The result of the Johansen co-integration test above revealed that there exists a long-run relationship between external debt, domestic debt and real gross domestic product in Sierra Leone. The result of the parsimonious ECM equation indicated that external debt has an insignificant negative relationship with real gross domestic product in Sierra Leone implying that external debt has been unproductive in terms of its contribution to the development of the country. However, DDB has a positive and highly significant relationship with RGDP in Sierra Leone. The value of the coefficient of determination (R^2) of 0.923031 showed that the exogenous variables in the ECM equation, EXT and DDB explain about 99% (ECM 1) and over 92% (ECM 2) of the systematic variations in RGDP. The f-statistical values, 71.77267 and 39.97409 for ECM 1 and ECM 2, were statistically significant at the 5% level going by their probability values of 0.000000 and 0.0000090 respectively, implying that EXT and DDB taken together, have a significant linear relationship with the dependent variable, RGDP. The error correction method revealed that the lagged error correction terms in ECM 1 and ECM 2 are high and statistically significant judging from their high and negatively signed coefficient. Finally, the Granger Causality test revealed that no causal relationship exists between external debt burden and RGDP while a one-way causal relationship exists between domestic debt burden and RGDP in Sierra Leone and also a causal relationship between RGDP and DDB together on EXT in Sierra Leone.

5. Summary of Findings

This study was to examine the link between public debts on the socio-economic growth of Sierra Leone. The main objective in that regard is to observe the impacts of public debts on the performance of the Sierra Leone economy. The study agreed that the elements of public debt are the combination of domestic and external debts. The variables for domestic debt were treasury bills, treasury bonds, Government stock, overdrafts from commercial banks and advances from commercial banks. The study used a quantitative research design in order to establish a relationship between public debt and economic growth by conducting a regression analysis and using co-efficient of determinations to explain the rates of change in dependent variable (RGDP) as a result of a unit change in each independent variable (EXT *and* DDB). The study used secondary data collected from the Central bank of Sierra Leone, the Ministry of Finance and Economic Development, the International Monetary Fund's international financial statistics, and the World Bank data bank. External debt stock has an insignificant negative relationship with real gross domestic product in Sierra Leone implying that external debt has been unproductive in terms of its contribution to the de-

velopment of the country. The insignificance of the relationship between external debt and RGDP growth could be explained in part by the fact that Sierra Leone has underdeveloped capital markets. This negative relationship is likely to be high if the proceeds of external debt are mismanaged or invested in unproductive ventures, which in turn constrains access to funds for servicing debts. A significant increase in external debt also discourages investments by increasing uncertainty concerning government policies. An increasing external debt stock often creates expectations that the government is likely to resort to distortionary measures to meet its debt obligations. As a result, the private sector investors are likely to postpone their investments, which in turn reduce economic growth (the crowding out effect). However, domestic debt has a positive and highly significant relationship with RGDP. Thus, domestic debt can increase economic growth by minimizing the crowding out effect of external debt on investments in the private sector.

From the study, it was established that a unit increase in EXT will result in a decrease in RGDP by 0.000004 and conversely, a unit increase in DDB will lead to a 0.000150 increase in RGDP. The study further reveals that the independent variables are responsible for about 92% of the change in the dependent variable.

6. Conclusion

The main objective of this study was to determine the effect of public debt on economic growth in Sierra Leone using time series data from 1986 to 2015. The study established that economic growth proxied by RGDP responds differently to the various components of public debt, which were external and domestic debts. Specifically, the external debt had an insignificant negative effect on economic growth in Sierra Leone. Domestic debt, on the other hand, had a significant positive effect on economic growth. The study employed the Augmented Dickey-Fuller test and also the Philips-Perron test to test for unit root (stationarity of the data), Johansen co-integration test, Error Correction Method (ECM) and the Granger causality test. The overall results of the study revealed that there exists a long-run relationship between total public debt and RGDP in Sierra Leone.

Specifically, the first objective of the study was to examine the impact of domestic debt on the economic growth of Sierra Leone. The findings of the study revealed that DDB has a positive and highly significant relationship with RGDP. It was therefore concluded that domestic debt is superior to external debt in terms of overall economic growth and that domestic debt accumulation contributes significantly to the development process of the nation as it increases the level of government expenditure leading to a rise in aggregate demand, output and employment in Sierra Leone. However, it must be noted that domestic borrowing consumes a significant proportion of government revenue which poses a risk to fiscal sustainability. DDB is characterised by higher interest rates compared with those on external debt, which is contracted mainly on concessional

terms, and it is therefore expensive to maintain. There is therefore an urgent need for the government to formulate and implement debt reduction schemes for domestic debt. Such schemes should recognize the fact that outright reductions in domestic debt could increase liquidity in the system which may pose a risk to macroeconomic stability. The second objective of this study was to ascertain the effect of external debt on Sierra Leone's economic growth. The study analysis discovered that EXT has an insignificant negative relationship with RGDP in Sierra Leone. It was therefore concluded that external debt has not been instrumental in enhancing the economic growth and development of the Sierra Leonean economy and an increase in the level of debt servicing costs to the various external creditors to the economy would reduce the level of economic growth and development in the country. Finally, the third objective was to examine whether there is a relationship between the independent variables of external (EXT) and domestic (DDB) debt. The study through the granger causality test revealed that even though EXT does not cause DDB, on the contrary, the test revealed causation of DDB on EXT, which meant that DDB being the first point of reach affected EXT or that EXT depends on DDB. This relationship is likely due to the weak domestic capital market that mostly necessitates the need for government to reach out for external funding.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix. Data Set for Empirical Estimation

YEAR	RGDP1 (Billion Leones)	RGDP2 (Billion Leones)	EXT (Billion Leones)	DDB (Billion Leones)	Public Debt (Bilion Leones)
1986	3922.44528	4637.017515	500.67	112.6	613.27
1987	3924.276113	4972.332712	675.9	117.29	793.19
1988	4018.707232	4620.291556	732.78	122.39	855.17
1989	4200.001789	4654.019685	856.45	127.95	984.4
1990	4403.429033	4809.92925	967.34	134.04	1101.38
1991	4530.310695	4923.056893	1000.56	140.74	1141.3
1992	4746.939078	3987.040535	1107.17	148.15	1255.32
1993	4647.120366	4041.844376	1128.42	156.38	1284.8
1994	4837.328595	3963.134132	1409.61	165.58	1575.19
1995	4580.401602	3646.093179	1457.17	175.93	1633.1
1996	4637.017515	3710.039141	1863	187.66	2050.66
1997	4972.332712	3491.997098	2318.24	201.06	2519.3
1998	4620.291556	3554.329745	2214.33	234.57	2448.9
1999	4654.019685	3483.979408	2181	287.66	2468.66
2000	4809.92925	3715.759078	3224.12	300.27	3524.39
2001	4923.056893	3479.977252	3112.34	356.57	3468.91
2002	3987.040535	4399.29386	3013.4	345.32	3358.72
2003	4041.844376	4809.005419	4196.34	395.67	4592.01
2004	3963.134132	5126.300945	4897.36	513.18	5410.54
2005	3646.093179	5357.245707	5133.54	1112.28	6245.82
2006	3710.039141	5583.531174	5185.96	1112.38	6298.34
2007	3491.997098	6033.46022	1646.31	1141.71	2788.02
2008	3554.329745	6359.163611	1886.79	1314.84	3201.63
2009	3483.979408	6561.897004	2670.35	1321.84	3992.19
2010	3715.759078	6912.726599	3308.03	1519.33	4827.36
2011	3479.977252	7349.268397	3871.22	1482.29	5353.51
2012	4399.29386	8465.017355	4247.76	1785.89	6033.65
2013	4809.005419	10218.61074	4596.06	1971.18	6567.24
2014	5126.300945	10684.24957	5642.09	2449.93	8092.02
2015	5357.245707	8483.425495	7048.05	2814.88	9862.93

Source: IMF International Financial Statistics Data Base (updated 2015), World Bank's Economic and Financial Data Site: http//dev.worldbank.org, and publications and reports by the Ministry of Finance and Economic development of Sierra Leone, the Bank of Sierra Leone and Statistics Sierra Leone.