

On the Sustainability of Fiscal Policy in Sierra Leone

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Abstract

The aim of this paper is to empirically investigate whether Sierra Leone fiscal policy is sustainable. In this regard, I employ different econometric methodologies used in the empirical literature to investigate the sustainability of fiscal policy. The empirical findings that emerged from this study are useful on one hand to creditors, serving as a guide for lending to the government, and, on the other hand to the government, cautioning policymakers to avoid public debt from exploding that could possibly lead to fiscal insolvency and/or debt distress. I start by testing for the stationarity properties of the primary balance, the necessary condition for a sustainable fiscal policy. The findings indicated that Sierra Leone fiscal policy is sustainable under the review period. Next, I test for cointegration relationship between government revenue and government expenditure, the alternative approach to test for a sustainable fiscal policy. On this note, I employ both the Dynamic Ordinary Least Square (DOLS) and the Johansen cointegration techniques. Both approaches confirmed the existence of a cointegration relationship between government revenue and government expenditure. The estimated cointegration coefficients show that fiscal policy during the review period is weakly sustainable and the cointegration between government spending and revenue is positive (but less than one) and statistically significant. This implies that for each percentage point of GDP increase in government expenditure, government revenues increase by less than one percentage point of GDP. Additionally, I proceeded to endogenously account for structural breaks in the cointegration relationship, which is relevant for Sierra Leone, a country that has witnessed significant changes over the years, including the Structural Adjustments Programme (SAP) in the 1980s, tax reforms in the 1990s and 2000s, etc. I found evidence of a significant structural break occurring in 1984. There also exists uni-directional causality running from government revenue to government expenditure. This causality result is in line with the tax-and-spend hypothesis as proposed by Friedman (1978). Finally, I estimate an error correction model and the error correction term shows that the speed of adjustment from the expenditure side works faster than that of the revenue side to correct the fiscal disequilibrium.

Keywords: fiscal sustainability, budget deficits, public debt, structural breaks

1. Introduction

Is Sierra Leone's fiscal policy sustainable? This question has occupied the centre of public finance debates after the Latin American debt crisis in the 1980s (Brown and Hunter, 1999). It became even more interesting to policymakers, creditors, and academics after the great financial crisis in 2008 when some countries' fiscal policies shifted towards an unsustainable trajectory characterised by late repayment of interest, debt rescheduling, and outright defaults. While a sustainable fiscal policy is necessary for a healthy economy, large and persistent deficits have been highlighted as reasons for slow growth (Fischer, 1993; Adam and Bevan, 2005) and general macroeconomic instability (Schmidt-Hebbel, 1996). In addition to the above policy question, I am also interested in knowing if Sierra Leone fiscal policy involves a structural break and the causal direction between government expenditure and revenue. Any causal direction between these two fiscal variables could offer valuable insight into how the government can manage the size of the deficits in the future.

The aim of this paper is to empirically investigate if Sierra Leone fiscal policy is sustainable. It is believed that such empirics are useful on one hand to creditors, serving as a guide for lending to the government, and, on the other hand to the government, cautioning policymakers to avoid public debt from exploding, leading to fiscal insolvency.

Following the work by Hamilton and Flavin (1986), there has been a large volume of research on fiscal

sustainability focusing mainly on the United States and European countries. Yet little has been done in the case of developing countries, especially Sierra Leone. Oshikoya and Tarawalie (2010), empirically test for the sustainability of fiscal policy in the West Africa Monetary Zone (WAMZ) countries, which comprise Ghana, Gambia, Guinea, Liberia, Nigeria, and Sierra Leone, using annual data from 1980-2008. They test for the cointegration relation between government expenditures and revenue and find that the fiscal behaviour for the countries is sustainable except for Sierra Leone. However, these countries don't have uniform fiscal policy due to the fact that each country is governed by different tax laws except for the case of the common external tariffs in the ECOWAS region. As a result, the sustainability of their fiscal policies needs to be assessed at a country level. This paper therefore complements the work of Oshikoya and Tarawalie (2010) by answering the above question only for Sierra Leone.

Comparing this work to Oshikoya and Tarawalie (2010), the contribution of this paper can be documented as follows: i) I use an extended data set, 1980-2016; ii) I identify structural breaks endogenously in the cointegration relationships between government spending and revenue; and iii) I test for fiscal sustainability by adopting two different approaches put forward on theoretical grounds – that is, stationarity tests of the primary-balance ratio, the cointegration relation between government expenditure and revenue.

Overall, the results show that the fiscal policy in Sierra Leone is sustainable, and the cointegration between government spending and revenue is positive (but less than one) and statistically significant. This finding implies that for each percentage point of GDP increase in government spending, government revenues increase by less than one percentage point of GDP. In terms of the error correction mechanism, the speed of adjustment from government expenditure tends to work faster compared to the speed of adjustment from revenues to restore fiscal equilibrium. Also, I find uni-directional causality running from government revenues to expenditure, with the government unable to raise the required revenue to finance the budgeted expenditure. Finally, I test to endogenous structural break, and I find evidence of significant structural shifts in fiscal policy occurring in 1984.

2. Theoretical Framework and Literature Review

Following Hakkio and Rush (1991), the government budget constraint is specified as:

$$B_t = (1 + r_t)B_{t-1} + G_t - R_t \quad (1)$$

where B_t represents the real stock of outstanding public debt, r_t represents the real interest rate, G_t is the real government expenditure inclusive of interest payment and R_t is the real tax revenue.

Given that equation (1) holds for each period, taking expectation and solving recursively for government real debt, I obtain the intertemporal government budget constraint for the period $n=t$ to $t=T$ ¹:

$$B_t = \sum_{\tau=t+1}^T \left[\prod_{j=1}^{\tau-t} \frac{1}{(1 + r_{t+j})} (R_{\tau} - G_{\tau}) \right] + \left[\prod_{j=t}^{T-1} \frac{1}{(1 + r_j)} B_T \right] \quad (2)$$

Assuming a constant interest rate r , equation (2) is simplified as:

$$B_t = \sum_{\tau=t+1}^T \left[\frac{1}{(1 + r)^{\tau-t}} (R_{\tau} - G_{\tau}) \right] + \left[\frac{1}{(1 + r)^{T-t}} B_T \right] \quad (3)$$

which implies that the present-value government budget constraint is specified as:

$$B_t = \sum_{\tau=t+1}^{\infty} \left[\frac{1}{(1 + r)^{\tau-t}} (R_{\tau} - G_{\tau}) \right] + \lim_{T \rightarrow \infty} \left[\frac{1}{(1 + r)^{T-t}} B_T \right] \quad (4)$$

An existing fiscal policy is sustainable based on the second term of equation (2.4). If the transversality condition:

$$\lim_{T \rightarrow \infty} \left[\frac{1}{(1 + r)^{T-t}} B_T \right] \quad (5)$$

holds, the present value budget constraint of the government is specified as:

¹ See Hamilton and Flavin (1986) or Hakkio and Rush (1991).

$$B_t = \sum_{\tau=t+1}^{\infty} \left[\frac{1}{(1+r)^{\tau-t}} (R_t - G_t) \right] \tag{6}$$

Equation (5) implies that the solvency conditions of the government must always be satisfied. This condition is known in the literature as a ‘no Ponzi game’, which means the rate at which public debt is growing is no more than the rate at which the interest rate is growing. This condition also rules out bubble financing – the option of servicing outstanding government debt by issuing new debt. In other words, it means that the government solvency condition must be satisfied in each period.

The empirical study on fiscal sustainability is conducted on various theoretical grounds. The first category applies unit root tests on primary deficits and/or the public debt series. The existence of unit roots is thus taken as evidence for unsustainable fiscal policy. This approach was first pioneered by Hamilton and Flavin (1986) for testing the sustainability of the United States’ fiscal policy from 1960-1984. These authors assume the interest rate is constant and test the following relationship:

$$\lim_{T \rightarrow \infty} \left[\frac{1}{(1+r)^T} B_T \right] = A_0 = 0 \tag{7}$$

as the null hypothesis where B_T is the stock of outstanding real public debt, and r is the real interest rate and:

$$\lim_{T \rightarrow \infty} \left[\frac{1}{(1+r)^T} B_T \right] = A_0 > 0 \tag{8}$$

as the alternative hypothesis.

Hamilton and Flavin (1986) insert equation (8) into equation (4), and rearranging it gives:

$$B_t = \sum_{\tau=t+1}^{\infty} \left[\frac{1}{(1+r)^{\tau-t}} (R_t - G_t) \right] + A_0 (1+r)^t \tag{9}$$

where G_t is the real government expenditure inclusive of interest payment, and R_t is the real tax revenue.

Hamilton and Flavin (1986) argue that the sufficient condition for the validity of the government intertemporal budget constraint is the stationarity of the primary deficits ($G_t - R_t$). If $A_0 = 0$ in equation (2.9), it is interpreted as evidence of stationarity in debt and primary deficits and hence a sustainable fiscal policy. On the other hand, if $A_0 > 0$, public debt/primary deficits will be non-stationary, which implies that the fiscal policy is unsustainable. Other studies that adopt this approach include Trehan and Walsh (1988; 1991), Kremers (1989), Wilcox (1989), and Smith and Zin (1991).

The second category in the empirical literature tests for the cointegration relationship between government expenditure and government revenue to determine the sustainability of the intertemporal budget constraint, hence testing the sustainability of fiscal policy. Hakkio and Rush (1991) propose and rewrite equation (2.4) with total government expenditure and revenue in real per capita terms as:

$$TG_t = G_t + rB_{t-1} = R_t + \sum_{\tau=t}^{\infty} \left[\frac{1}{(1+r)^{\tau-t-1}} (\Delta R_t - \Delta G_t) \right] + \lim_{T \rightarrow \infty} \left[\frac{1}{(1+r)^{T-t}} \Delta B_T \right] \tag{10}$$

where TG_t denotes total government spending on goods and services, transfer payments, and interest on government debt; G_t denotes government expenditures net of interest payment; and R_t is the real tax revenue. Hakkio and Rush (1991) argue that if R_t and G_t are integrated of order 1, that is, both variables are I(1) processes, then ΔR_t and ΔG_t are stationary. If both R_t and G_t follow a random walk with drifts, equation (10) can be rewritten as:

$$TG_t = \alpha + R_t + \lim_{T \rightarrow \infty} \left[\frac{1}{(1+r)^{T-t}} B_T \right] + \epsilon_t \tag{11}$$

Assuming the transversality condition holds – that is, the second term in equation (2.11) goes to zero – the testable equation for the sustainability of fiscal policy can be written as:

$$R_t = \alpha + \beta TG_t + \epsilon_t \quad (12)$$

If R_t and TG_t are both difference-stationary and cointegrated of order $I(1)$, Hakkio and Rush (1991) argue that the necessary condition for fiscal sustainability requires that government revenue and expenditure be cointegrated with $0 < \beta \leq 1$, which is also necessary for the transversality condition to hold in equation.

Quintos (1995) uses methodology comparable to Hakkio and Rush (1991) but with a modified interpretation of the results. She introduces the concept of ‘strong’ and ‘weak’ conditions of fiscal sustainability. She proposes the following interpretation: i) strong sustainability requires the cointegration between revenue and expenditure with cointegrating vector $[1 \ -1]$, ii) while weak sustainability requires $0 < \beta < 1$; and iii) the fiscal deficit is not sustainable when $\beta \leq 0$.

Using the same equation as in Hakkio and Rush (1991) in terms of first differences, Quintos (1995) rewrites equation (4) as:

$$\Delta B_t = \sum_{\tau=t+1}^{\infty} \left[\frac{1}{(1+r)^{\tau-t}} (\Delta R_t - \Delta G_t) \right] + \lim_{T \rightarrow \infty} \left[\frac{1}{(1+r)^{T-t}} B_T \right] \quad (13)$$

For equation (13) to converge to a stable solution, the last term should converge to zero, that is:

$$\lim_{T \rightarrow \infty} \left[\frac{1}{(1+r)^{T-t}} \Delta B_T \right] = 0 \quad (14)$$

Quintos (1995) employs her modified methodology using United States quarterly data from 1947q1-1992q4 and finds that United States fiscal deficits are weakly sustainable. She further tests for structural shifts endogenously and finds that revenues and expenditures are not cointegrated post-1980, which implies that the United States fiscal policy was unsustainable in the subsample period.

Despite the large volume of literature on fiscal sustainability, most of the empirical studies are focused on the United States and other advanced economies or groups of countries, mostly in the Euro areas. There are few studies on developing countries, especially sub-Saharan African countries. Ndoricimpa (2013) then examines whether east African economies’ fiscal policy is sustainable. This researcher tests for cointegration between total government expenditures and revenues and finds evidence of weak fiscal sustainability in all the countries. Dada (2013) studied the sustainability of fiscal policy in Nigeria by adopting the cointegration approach. His result shows that under the investigation period, Nigeria fiscal policy was sustainable. Oyeleke and Adebisi (2010) examined the sustainability of fiscal policy in Ghana over the period of 1980-2010. They employed the error correction model to determine the long run relationship and find evidence of weak form of fiscal sustainability.

Much empirical studies have not been done for the case of Sierra Leone. Oshikoya and Tarawalie (2010), test for fiscal sustainability in the WAMZ countries (Sierra Leone, Gambia, Ghana, Guinea, Liberia, and Nigeria) using annual data spanning from 1980-2008. They employ both Engle and Granger’s (1987) and Johansen’s cointegration approaches and find evidence of fiscal sustainability in all countries except for Sierra Leone. This paper therefore complements the work of Oshikoya and Tarawalie (2010) by answering the above question only for Sierra Leone.

Unsustainable fiscal policy could lead to fiscal crises such as debt defaults, late repayment of interest on loans, slow growth etc. Also, during fiscal crises, the central bank may not have control over inflation. Some studies have applied the unit root tests to primary deficits and/or public debt series to investigate the sustainability following Hamilton and Flavin (1986), while other studies adopt the cointegration approach between government revenue and expenditure as a means of examining the sustainability of fiscal policy following the seminal work of Hakkio and Rush (1991). For the empirical analyses to be robust, I adopt both approaches to examine the sustainability of fiscal policy in Sierra Leone over the sample period of 1980-2016.

3. Data

To carry out the econometric analysis on fiscal sustainability in Sierra Leone, I use data on total government expenditure and total government revenue. Data sources are the world development indicators (World Bank dataset) and the National Revenue Authority of Sierra Leone. The data frequency is annual, spanning from 1980-2016. I compute real government revenue and expenditure, deflating nominal series by the GDP deflator. As Hakkio and Rush (1991) argue, an analysis based on ratios is more appropriate for growing economies. Indeed, McCallum (1984), among others, deems these ratios – per capita spending and revenue and spending and revenue as a fraction of GNP – as pertinent for a growing economy. With this concept in mind, the fiscal variables are expressed here as a percentage of GDP, as in Afonso (2005).

4. Methodology

The empirical procedure is carried out here by employing the standard methodology in the literature that tests for unit roots and/or cointegration in the budget variables. I summarise below the econometric methodologies adopted in this study.

4.1 Unit Root Tests

The first step in examining the sustainability of fiscal policy is to check for a unit root in the fiscal variables—primary balance, government revenue, and government expenditures. If there exists a unit root in the series, characterised as a non-stationary process, it has no tendency to return to a long-run deterministic path. Also, the variance of the series is time-dependent and goes to infinity as time approaches infinity, which results in severe problems for forecasting. Non-stationary time series suffer long-lasting effects from random shocks. If the primary balance is non-stationary, it means that the fiscal policy is unsustainable. Also, if both government revenue and expenditure present a distinct order of integration, they will not converge to equilibrium in the long run, which characterises unsustainable fiscal policy. Several approaches have been proposed and applied in the empirical literature to test for stationarity. I adopt two conventional econometric techniques to test for the existence of unit root in the fiscal series, i.e.: the Augmented Dickey Fuller (henceforth ADF) and Phillips and Perron's (1998) technique (henceforth PP).

4.1.1 The Augmented Dickey-Fuller Test

Following the pioneering work by Dickey and Fuller (1979), which was popularised by Nelson and Plosser (1982), many studies have employed these tools in empirical macroeconomics. The standard ADF test is specified as:

$$\Delta Y_t = \alpha_0 + \alpha_1 t_1 + \delta Y_{t-1} + \sum_{j=1}^L \beta_j \Delta Y_{t-1} + \epsilon_t \quad (15)$$

where α_0 is the constant, α_1 is the coefficient on the trend term t , ΔY_{t-1} is the first difference operator to control for serial correlation in the error term, and from the estimation of δ , the 'tau' statistic is obtained and compared to relevant critical values. The null hypothesis is that δ is zero, i.e., there is a unit root. I reject this hypothesis when the computed statistic is more than the conventional critical values. The assumption made for the validity of the original Dickey-Fuller test is that the residuals in the regression are not serially correlated. If they are, the aim of the ADF is to add lags to the dependent variable in the above equation until the serial correlation is overcome.

4.1.2 Phillips and Perron Test

To correct for the possible serial correlation and heteroscedasticity in the residuals of the Dickey-Fuller test, Phillips and Perron (1998) proposed an alternative unit root test. These authors use the Newey-West (Newey and West, 1987) heteroscedasticity and autocorrelation consistent covariance matrix estimator, a non-parametric correction of the Dickey-Fuller test in which allowance is made for possible heteroscedasticity and serial correlation in the residuals. The asymptotic distribution and the critical values for the PP test statistic are the same as in the ADF test. The PP test has a null hypothesis if the series is I(1). However, the PP test was shown to exhibit an inferior small sample performance relative to the ADF test, and therefore should be used only as a complement to other approaches (see for example Schwert (2002), Campbell and Perron (1991), Agiakloglou and Newbold (1992), De Jong et al. (1992), and Liu and Praschnik (1993)). The test equation is specified as:

$$\Delta Y_t = \beta_0 + \beta_1 t + \rho Y_{t-1} + \epsilon_t \quad (16)$$

where β_0 is the constant, β_1 is the coefficient of the trend term t and from the estimation of ρ the ‘tau’ statistic is obtained and compared to relevant critical values. The null hypothesis is that ρ is zero, i.e., there is a unit root. The rejection criteria of the PP test are the same as those for the ADF and DF-GLS.

4.2 Cointegration

If both government revenue and expenditure are found to be stationary in levels after testing for unit roots, the test for cointegration is unnecessary, and I should conclude that the fiscal policy is sustainable.² However, if both series are found to be stationary only at first difference, the next step is to test for cointegration. The cointegration between total government revenues and total expenditures is the testable condition for fiscal sustainability (Quintos, 1995). I test for cointegration between government revenue and government expenditure by employing the Johansen and the Dynamic Ordinary Least Square approach based on their estimation power.

4.2.1 Johansen’s Cointegration Approach

The system-based approach proposed by Johansen (1988, 1991 and 1995) is a test for cointegration that allows for more than one cointegrating relationship, unlike the Engle-Granger method. The methodology takes its starting point from the VAR of order p given by:

$$y_t = \mu + A_1 y_{t-1} + \dots + A_p y_{t-p} + \epsilon_t \quad (17)$$

where y_t is an $n \times 1$ vector of variables that are integrated of order one and ϵ_t is a $n \times 1$ vector of innovations.

This VAR can be re-written as:

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \epsilon_t \quad (18)$$

If the coefficient matrix Π has reduced rank $r < n$ then there exists $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta'y_t$ are stationary and r is the number of cointegrating relationships. The elements of α and β are known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector.

4.2.2 Dynamic Ordinary Least Square Approach

Additionally, we test for the cointegration relationship between government revenue and expenditure by employing the dynamic ordinary least squares (DOLS) proposed by Stock and Watson (1993). This methodology is asymptotically equivalent to the Engle-Granger cointegration approach and has the advantage of performing better in small-sample properties by controlling for potential endogeneity among the variables in the regression by the inclusion of lead and lags.

The DOLS is estimated based on the regression below:

$$R_t = \alpha + \beta G_t + \sum_{t=-k}^k \lambda_k \Delta G_{t-k} + \quad (19)$$

where Δ represents the first difference operator, ϵ_t is the error term, and k is the lead/lag order. There is no unique method for choosing the lead and lag order (Argyrou and Luintel, 2007). If k is too large compared to the sample size, estimates from the regression above will not be feasible (Saikkonen, 1991). In view of the small samples in this study, we set the lead and lag to 1.

4.3 Fiscal Sustainability Model

The testable model for fiscal sustainability is given below:

$$R_t = \alpha + \beta T G_t + \epsilon_t \quad (20)$$

² See figure 2.1 for the empirical procedure.

where R_t and TG_t are total government revenue and expenditure respectively.

The approach adopted here to test for fiscal sustainability is based on the second strand in the empirical literature, as we are testing for the cointegration between total government revenue and total government expenditure in the regression equation above. Unlike testing for the stationarity of the discounted public debt series, this approach has an advantage over the former in the following ways. First, this approach avoids the unrealistic assumption of a constant interest rate as in Wilcox (1989). Second, the fiscal variables used in this approach (total government revenue and total government expenditure) are mostly available over a long period unlike public debt data, which is not available for long periods in most developing countries.

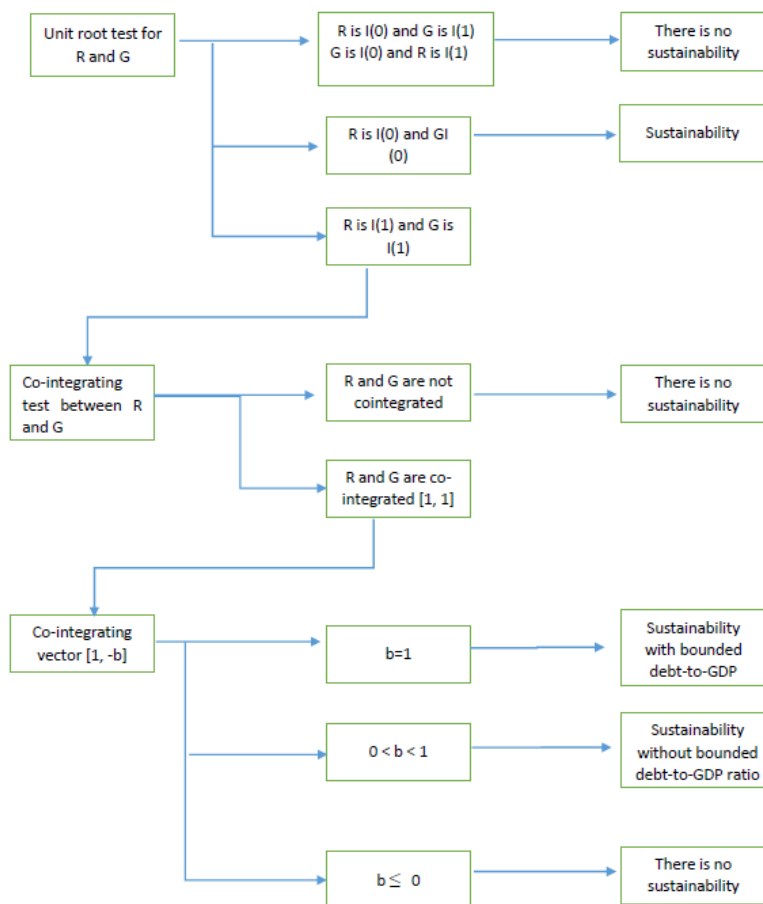


Figure 1. Empirical Procedure to Test for Fiscal Policy Sustainability

5. Empirical Results

In this section, I present the results from all the econometric procedures that emerge from the study.

5.1 Unit Root Test Results

When both series of revenues and spending are found to be stationary, it is accepted that these are necessary conditions for the sustainability of fiscal policy – it is not necessary to proceed to check for a cointegration relationship. If both series are found to be non-stationary at levels, but are first difference stationary, I proceed to check whether both series are cointegrated. In an event that the series contain distinct orders of integration, then fiscal policy will be unsustainable as both series will not converge to long-run equilibrium. Table 1 shows the unit root tests in levels and first difference for the full sample.

Table 1. Unit Root Tests Results

ADF TEST			
Variables	Constant	Trend	First Difference
Revenues	-2.74	-2.59	-6.09***
Expenditures	-2.59	-4.17	-4.70**
Primary Balance	-3.82***	-4.09**	
PP TEST			
Revenues	-2.77	-3.70	-6.05***
Expenditures	-2.79	-2.90	-8.55***
Primary Balance	-2.95**	-3.79**	

ADF-lags selections were based on the Schwarz Information Criterion. ***, ** and * represent statistical significance of 1%, 5% and 10% respectively PP lags selections were based on the Newey-West Bandwidth using Bartlett Kernel Criterion. ***, ** and * represent statistical significance of 1%, 5% and 10% respectively

I start with the interpretation of the primary balance ratio as a means of sustainable fiscal policy. The ADF and PP tests both have the null hypothesis that the series being examined is non-stationary (i.e., there is unit root). For the ADF, the test statistics are -3.82 and -4.09 for constant and trend, which are significant at 1% and 5% respectively. The PP tests have statistics of -2.95 and -3.79 for constant and trend respectively, which are both significant at 5%. The null hypothesis of unit root in primary balance is rejected by both tests. Following Hamilton and Flavin (1986), I conclude that the fiscal policy in Sierra Leone under the review period is sustainable.

I proceed to test for sustainability using an alternative approach – the cointegration relationship between total government revenue and expenditure. The ADF test statistics for revenues are -2.74 and -2.59 for constant and trend respectively and for expenditures are -2.59 and -4.17 for constant and trend respectively. These statistics are found to be insignificant. Therefore, I fail to reject the null hypothesis of unit root in these series and conclude that both revenues and expenditures are non-stationary. However, they are found to be stationary at first difference with ADF test statistic of -6.09 and -4.70, which are significant at 1% and 5% respectively. The PP test statistics for revenues are -2.77 and -3.70 for constant and trend respectively and for expenditures are -2.79 and -2.90 for constant and trend respectively. I fail to reject the null hypothesis of unit root in these series as the test statistics are insignificant and conclude that both revenues and expenditures are non-stationary. However, they are found to be stationary at first difference with PP test statistic of -6.05 and -8.55, which are significant at 1%.

As discussed above, the test results do not allow me to reject the null hypothesis of unit roots in both government revenue and expenditure in levels for both constant and trend terms at the conventional 5% significance level. However, both variables are found to be stationary at first difference. Having confirmed both government revenue and expenditure are I(1) series, I proceed to test for cointegration.

5.2 Cointegration Test Results

For comparability, I interpret the cointegration coefficient as in the empirical literature on fiscal policy sustainability³. Table 2 summarises the interpretation of the cointegration coefficient as in the empirical literature.

Table 2. Interpretation of the Cointegration Coefficient

Coefficient	Value	Conclusion	Implications
β	1	Strong form of sustainability	
β	$0 < \beta < 1$	Weak form of sustainability	Government Expenditure is growing faster than revenue
β	≤ 0	Unsustainability	Fiscal crises, debt defaults, late repayments etc.

As the results of stationarity indicate the existence of unit root in both revenues and expenditures, the next step is to check for cointegration. We employ both DOLS and Johansen's system approach. We start with the DOLS test, which is performed by running a DOLS regression, and test the residual for unit root. The ADF test statistic is compared to the critical value to determine whether there is cointegration or not. If the ADF test statistic is greater than the critical value, we conclude that a long-run relationship exists, and the variables are cointegrated, which means the fiscal policy is sustainable. We fail to reject the hypothesis if the opposite occurs. The result of the DOLS is presented in Table 3

³ See Quintos (1995), Afonso (2005) for survey.

Table 3. DOLS Cointegration Test Result

Cointegration test without	Break full sample
Estimated equation $R_t = \alpha + \beta TG_t + \epsilon_t$	DOLS 1980-2016
α [p-value]	3.46[0.201]
β [p-value]	0.21[0.048]
F-Wald test, $H_0: \beta = 1$ [p-value]	64.65[0.000]
F-Wald test, $H_0: \beta = 0$ [p-value]	4.17[0.005]
t-ADF stat. on ϵ_t	-3.42**
5% critical value	-3.21
S.E. of regression	2.098

** represent statistical significance of 5%

The result shows that the value of the ADF test statistic is -3.42, which is greater than the 5% critical value of -3.21, which suggests that government revenue and expenditure are cointegrated, indicating sustainable fiscal policy. The estimated cointegration β is 0.21, indicating that for each 1% point of GDP increase in government expenditure, government revenue increases by approximately 0.21% of the GDP⁴. Government expenditure exhibits a higher growth rate than government revenue for the period under consideration in Sierra Leone. Shown in Leone. The Wald test for coefficient restriction with a null hypothesis of $\beta = 1$ (strong form of sustainability) is rejected at 1% and the alternative hypothesis of $\beta = 0$ (unsustainability) is rejected at the 5% significance level.

These results imply that the strong form of fiscal sustainability as well as unsustainability are rejected for Sierra Leone. The cointegration coefficient β satisfies the inequality constraint $0 < 0.21 < 1$. Following Quintos' (1995) definition, we conclude that the fiscal policy in Sierra Leone is weakly sustainable with cointegration vector [1 -0.21].

In addition to the DOLS test, we perform Johansen's cointegration, or the system approach. The trace test as well as the maximum eigenvalue test are performed to test for the number of cointegrating vectors in the system. Lütkepohl, Saikkonen and Trenkler (2001) suggest that in a small sample simulation, the trace test performs better and is superior to the maximum Eigen test. They do, however, suggest using both tests. As such, we report both tests for robustness in Table 4.

Table 4. Johansen Cointegration Test Results

Null	Alternative	Rank Test	5% Critical Value	prob
Panel A Unrestricted	Cointegration	Trace Statistic		
$r = 0$	$r = 1$	23.73490*	15.4947	0.0023
$r \leq 1$	$r = 2$	9.478016*	3.84166	0.0021
Panel B Unrestricted	Cointegration	Max-Eigen Stat.		
$r = 0$	$r = 1$	14.25688	14.26460	0.0521
$r \leq 1$	$r = 2$	9.478016*	3.841466	0.0012
	Vector			
	[1 -0.457]		0.000	

* denotes rejection of the hypothesis at the 0.05 level., r indicates the number of cointegrating vectors**MacKinnon-Haug-Michelis p-values.

Panel A shows the result of the trace test. The null hypothesis of no cointegration for $r = 0$ is rejected at 5% significance level. The trace statistics of 23.73 and 9.48 are more than the 5% critical values of 15.50 and 3.84, and the probability values 0.0023 and 0.0021 are less than the conventional probability value of 0.05. In summary, the trace test indicates the existence of a cointegration relationship between government revenue and expenditure. Panel B shows the result of the maximum eigenvalue test and the hypothesis of at most one cointegrating relationship is not rejected. The maximum eigenvalue 9.47 is more than the 5% critical value of 3.84. In summary,

⁴ Noting that government revenue and expenditure are both expressed as a percentage of GDP

the maximum eigenvalue test indicates that the system has at most one cointegration.

Having established that the Johansen approach confirms that both government revenue and government expenditure are cointegrated, which implies sustainable fiscal policy, I proceed further to interpret the cointegration coefficient. In the last panel, the estimated cointegration vector β is 0.46, indicating that for each 1% point of GDP increase in government expenditure, government revenue increases by approximately 0.46% of the GDP. Government spending exhibits a higher growth rate than government revenue for the period under consideration in Sierra Leone. This result also confirms that the fiscal policy is sustainable in Sierra Leone but only in a weak sense. The cointegration coefficient β is larger in Johansen’s approach compared to the DOLS.

The DOLS and Johansen approach both confirm that the fiscal policy in Sierra Leone is weakly sustainable. However, under such conditions, unfavourable fiscal shocks will put the economy’s budgetary operations toward an unsustainable path, and the government will find it difficult to market its debt instrument. The DOLS and Johansen approach to cointegration assumes the cointegrating vector remains constant over the time series period (stable cointegration). However, such an assumption only holds for specific cases and not in general cases, because there are factors such as technological progress, financial and economic crises, policy and regime change, wars, and institutional development that will change the long-run relationship among variables. I therefore proceed to further test for cointegration between government revenues and spending by accounting for an endogenous structural shift in the deficits process.

Table 5. Summary of Cointegration Test Results

Dependent Variable	DOLS Cointegrating Vector	Johansen approach Cointegrating Vector
Revenues	[1 -0.21] **	[1 -0.46] ***

** and *** indicates 5 and 1% significance level, respectively.

5.2.1 Cointegration Relationship Accounting for Structural Break

Bai and Perron (2003) have shown that the size and power of multiple break tests can be significantly distorted by a small sample size. With this in mind and owing to the small sample size for Sierra Leone, I test for single break endogenously in the cointegration equation by adopting the Gregory-Hansen (1996) approach.

Gregory and Hansen (1996) extend and modify the Engle-Granger (1987) cointegration approach to allow for an endogenous break in a univariate series. Given that the series are I(1), Gregory and Hansen (1996) introduce four different models to consider for structural change in the cointegration relationship. The focus here is on model 3 (regime change) denoted as C/S as it is the most relevant for empirical discussion of fiscal policy sustainability (Gabriel and Sangduan 2011).

Model 3: Shift in regime denoted as C/S and defined as:

$$Y_t = \alpha + \beta D_t + \delta X_t + \Phi X_t D_t + \mu_t \tag{21}$$

where δ denotes the cointegrating slope coefficients before the regime shift and Φ denotes the change in the slope coefficients. GH tests are residual based; the null hypothesis of no cointegration corresponds to a unit root in the OLS residuals of models C, C/T, C/S and C/S/T, and break point in the cointegrating relationship is calculated at the point where the t-statistic is at minimum.

Table 6. Gregory-Hansen Cointegration Test Results

	Model 3 Test Statistics	Change in Break Date	Regime			Reject H_0 of No Cointegration
			Asymptotic 1%	Critical 5%	Value 10%	
ADF	-5.22	1984	-5.47	-4.95	-4.68	Yes
Zt	-5.99	1984	-5.47	-4.95	-4.68	Yes
Za	-39.92	1984	-57.17	-47.04	-41.85	Yes

Note: Critical values are from Gregory-Hansen (1996a).

The null hypothesis of no cointegration is rejected. The findings here confirm the earlier result that government

revenues and expenditures are cointegrated and that the fiscal policy is sustainable but with a structural shift in deficits in 1984. The break date corresponds to the policy measure introduced by the government in 1983 to severely cut its spending to reduce the size of the deficits. In the 1980s, Sierra Leone's economy deteriorated sharply, experiencing a decline in government revenues from 16% in 1980 to 5% in 1985. Coupled with the fall in imports and official exports of diamonds reducing the tax base, the increasing laxness of the central government eroded the efficiency of revenue mobilisation (World Bank, 1994). The government responded with severe expenditure cuts as a means of reducing the deficits owing to the fall in revenues generation. Government expenditures declined from 31% of GDP in 1981 to 18% in 1986. Payroll expenditure declined from 48% of total recurrent expenditures to 22% in 1986. In addition, development expenditures also fell from 4.9% of the GDP to 2.2%; together with government outlays for goods and services, recurrent expenditures fell from 31.5% in 1980 to 22% in 1984.⁵

5.3 Vector Error Correction Estimates

Having established a cointegration relationship among the variables, the appropriate procedure is to estimate the vector error correction model (VECM) to ascertain whether fiscal policy reacts to deviations from the long-run equilibrium trajectory. Estimates of ECM will provide us information as to whether the adjustment comes through the revenue or expenditure side, or both. In the VECM, if the dependent variable is government revenue, a negative error correction term gives rise to deficits and must be accompanied by an increase in revenues to move the economy towards a surplus to eliminate the disequilibrium resulting from the deficits. Likewise, if the error correction term takes a positive value, it gives rise to a surplus. In this regard, government revenues may be allowed to decline until the disequilibrium term becomes zero, leading to a balanced budget scenario.

If the dependent variable is government expenditure and the disequilibrium term takes a positive value (significant or insignificant) so that the budget will be in surplus, the government can afford to increase its spending until the disequilibrium term converges to zero, leading to a balanced budget scenario. Conversely, if the error correction term is negative, which implies the budget is in deficit, government should decrease its spending to restore a balanced budget. The result of the error correction model is shown in Table 7.

Table 7. Vector Error Correction Estimates

Dependent Variable	Government	Revenue		
Parameters	Coefficients	St-error	t-stat	p-value
α_r	-0.129	0.147	-0.87	0.383
Dependent Variable	Government	Expenditure		
Parameters	Coefficients	St. error	t-stat	p-value
α_g	-0.245**	0.171	-1.432	0.002

*** indicate 1 % significant level

From the results above, when revenue is the dependent variable (revenue adjustment model) the error correction term α_r is negative and statistically insignificant. As such, the budget is in deficit and should be accompanied by an increase in revenue to restore fiscal equilibrium. The estimated coefficient of -0.129 implies that about 12.9% of the fiscal disequilibrium in government budget deficits is corrected annually by government revenues. The error correction term α_g when government expenditure is the dependent variable (expenditure adjustment model) is negative and statistically significant, which implies the budget is in deficit. The estimated coefficient is -0.245, which implies that about 24.5% of the disequilibrium in government budget deficits is corrected annually by government expenditures. Though both coefficients are of the expected sign, spending adjustments work faster than revenue to restore budget balance to correct the fiscal disequilibrium.

5.4 Granger Causality Test

As a complement to the previous sustainability test, I test for causality between government revenue and spending following the intuitive notion of a variable's forecasting ability (Granger, 1969). Granger causality

⁵ For a detailed analysis, see World Bank (1994).

should be interpreted as a forecast, i.e., whether one thing that happens before another thing helps predict it (Hamilton, 1994). Revenue is said to Granger cause expenditure when both the lagged and present values for government revenue help in forecasting government expenditure. Based on the Granger causality/block exogeneity Wald test, we can obtain the information about the direction of causality between variables. The Granger causality test results are presented in Table 8.

Table 8. VAR Granger Causality/Block Exogeneity Test Results

Dependent Variables	Excluded Variable	Chi-sq.	df	p-value
Revenue	Spending	0.0592	2	0.9708
Expenditure	Revenue	8.167**	2	0.0168

** indicates 5% significance level

The Granger causality/block exogeneity Wald test suggests that when expenditure is excluded from the revenue equation, I fail to reject the null hypothesis that expenditure does not Granger-cause revenue because the p-value of 0.9708 for the chi-square is greater than the 5% significance level. Conversely, when revenue is excluded from the expenditure equation, we can reject the null hypothesis that revenue does not Granger cause expenditure because the p-value of 0.0168 for the chi-square is less than the 5% significance level. Based on the above result, I conclude that there exists a unidirectional causality running from revenue to spending – that is, the decision to tax is taken before the decision to spend. A similar conclusion was reached by Oshikoya and Tarawallie (2010) for Sierra Leone and Wolde-Rufael (2008) for Ethiopia, Ghana, Kenya, Nigeria, Mali, and Zambia. This result conforms to the tax and spend hypothesis.

6. Conclusion

The purpose of this paper is to empirically investigate whether Sierra Leone's fiscal policy was sustainable for the period 1980-2016. I performed a battery of tests as in the empirical literature. I start by testing for the stationarity properties of the primary balance, the necessary condition for a sustainable fiscal policy. This approach implies that an existing fiscal policy is sustainable if the primary balance ratio (primary balance-to-GDP ratio) is stationary. I test this by employing both the ADF and PP tests. The results from both tests confirm that the primary balance is stationary. On this, I conclude that the fiscal policy in Sierra Leone over the review period was sustainable. I proceed further to test for the cointegration between government revenue and government expenditure, the alternative approach to test for a sustainable fiscal policy. On this note, I employ both the DOLS and the Johansen system cointegration techniques. Both approaches confirmed the existence of a cointegration relationship between government revenue and government expenditure. The estimated cointegration coefficients show that fiscal policy during the sample period was weakly sustainable. Additionally, I proceeded to endogenously account for structural breaks in the cointegration relationship, which is relevant for Sierra Leone, a country that has witnessed significant changes over the years, including SAP in the 1980s, tax reforms in the 1990s and 2000s, etc. I found evidence of a structural break occurring in 1984 that coincided with major reforms of government expenditure. There also exists uni-directional causality running from government revenue to expenditure. This causality result is in line with the tax-and-spend hypothesis as proposed by Friedman (1978). Finally, the error correction term shows that the speed of adjustment from the expenditure side works faster than that of the revenue side to correct the fiscal disequilibrium.

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