Tax Elasticity in Sierra Leone: A Time Series Approach

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ABSTRACT: The fiscal authorities in Sierra Leone introduced series of reforms in the tax system ranging from continual revisions in tax rate to harmonization and instituting new taxes that are relatively easy to collect. Despite these measures, the output of the tax system as measured by the tax/GDP ratio remains very low averaging 11 per cent contributing to higher fiscal deficits. This study examined the base elasticity of the tax system in Sierra Leone and its major handles using annual data covering the period between 1977 and 2009. The Singer method of dummy variables was employed in order to make adjustment for the effect of discretionary tax measures and then compare buoyancy and elasticity measures. The empirical results indicated that buoyancy estimates were higher than elasticity estimates; and that short-run elasticities were lower than the static long-run elasticities. Estimation results further showed that discretionary tax measures were effective in mobilizing additional tax revenues and that the tax system was inelastic during the period.

Keywords: Tax elasticity; Tax Buoyancy; Tax Revenue; Sierra Leone
JEL Classifications: C13; C22; H21

1. Introduction

A core function of the tax system is to generate sufficient revenue to meet the expanding public sector requirements of the state. Nonetheless, most less developed countries (LDCs) face difficulties in generating revenue. In some LDCs, budget deficits and the unproductive use of public expenditures have limited the critical investments in both human resources and basic infrastructure that are necessary for sustainable economic growth (Eltony, 2002). Earlier studies on tax revenue issues have noted that the level of public expenditure in most developing countries is too low for the physical infrastructure and human capital needs of these countries[1]. In the last two decades, many LDCs have embarked on economic and financial reform programmes that included measures to raise tax revenues and restructure the tax system.

LDCs need to rely substantially on domestic revenue mobilization if the Millennium Development Goals (MDGs) are to be realized within the specified time frame. However, the experience with domestic resource mobilization of developing countries over the last 25 years has been mixed. In countries such as Botswana, Israel, Kuwait and Seychelles, the central government's share of tax revenue in GDP has been more than 40.00 per cent, on average, per annum. Countries such as Argentina, Sierra Leone, Niger, Guatemala and Burkina Faso have struggled to raise their revenue above 11.00 per cent on annual basis (Gupta, 2007). The growth in tax revenue must approximate the growth in public expenditure for macroeconomic stability to hold (World Bank, 1990). In LDCs, generally, the major taxes tend to have low elasticity and sometimes low buoyancy estimates. This is mainly due to the inherent weakness in economic structure where a good number of activities remain out of the tax net due to low income levels and the unorganized nature of most economic activities (Bilquess, 2004).

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[1] For more details, see Martinez-Vazquez (2001)

Tax collections in Sierra Leone are very low. For instance, the ratio of tax revenue to GDP was 5.60 per cent in 1987. The revenue shortfalls contributed to higher fiscal deficits (14.70 per cent of GDP in 1987) and larger domestic financing. The higher domestic financing may have fueled the inflationary pressure and precipitated an over-valued exchange rate. The underlying argument is that the yield of tax revenue is a function of the existing tax bases, the rates, and the probability of collecting the specific levies. Sierra Leone also suffers from over-dependence on a small number of tax revenue sources, which are vulnerable to external shocks. Some of these sources include import and export taxes on mineral products whose prices are determined outside the influence of Sierra Leonean authorities. Besides the volatility in prices of mineral products, the granting of numerous tax exemptions such as the abolishment of the export tax on agricultural products and the smuggling of mineral products (such as diamond and cocoa) across the porous borders considerably reduce the tax base.

In a bid to meet the challenges of enhancing revenue collection, various reforms were introduced in the tax system, ranging from frequent revisions in the tax rates, harmonization of tariffs, introduction of new taxes and to autonomous revenue agency. However, these reforms have not been part of a concerted effort to reform the entire tax system but part of the efforts to raise more revenue through budget pronouncements affecting the tax rates or tax brackets. For instance, following the passing of the Minimum Wages Act in 1997, there were seven income tax brackets and the tax rates ranged from 8.0 per cent to 50.0 per cent but the Income Tax Act of 2000 reduced the tax brackets to five with the rates ranging from 25.0 per cent to 40.0 per cent. The reforms were also aimed at increasing efficiency and improving working conditions for the tax administration, and to reduce inequalities, distortion, and corruption. The NRA Act of 2000 also provided for the establishment of an autonomous revenue agency (the National Revenue Authority). In this regard, tax elasticity[2] constitutes an important ingredient of a tax system.

Despite the reforms introduced in the Sierra Leonean tax system, the country is still embroiled in budget deficit partly due to poor revenue generation and moreover, very little is known about the performance dynamics of the reforms in terms of raising the revenue mobilization capacity of the tax system and how the reforms have affected each tax source. This study attempted to fill this gap by evaluating the revenue productivity of the overall tax system and of individual tax handles in Sierra Leone. The Singer dummy variable method was used to determine the productivity of the tax system with annual data covering the period between 1977 and 2009. Estimation results revealed that the tax system and its major handles are largely inelastic and that discretionary tax measures were effective in raising tax revenues.

The rest of the study is organized into four sections. Following the introductory section, an overview of the macroeconomic performance of Sierra Leone and its tax structure is presented in section two. Section three presents the relevant literature, theoretical framework and methodology. Section four provides the estimates of the models on tax buoyancy and elasticity and section five is the summary and conclusion of the research.

2. Macroeconomic Performance and Tax Structure

Sierra Leone's economy has been in the doldrums since the 1980s as the economy performed poorly by most macroeconomic criteria. The performance of the economy can best be analyzed using key macroeconomic and fiscal indicators. The periodic growth rates of some macroeconomic variables from 1977 to 2009 are presented in Appendix I. It is clear that GDP declined continuously for a greater part of the period under review. The growth rate of real GDP fell from 3.0 per cent during the period 1977-1981 to 0.5 per cent for the 1982-1986 period and then decreased further to record a negative growth rate of 4.5 per cent for the period 1992-1996[3]. The strong showing in GDP growth in the period 2002-2007 is not reflected in the response of the overall tax system in Sierra Leone as tax revenues remain less buoyant. Tax responsiveness to changes in income is a crucial variable in projecting the tax revenues, and is a good criterion for a good tax system (Bilquess, 2004).

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[2] Tax elasticity is the responsiveness of tax revenues to income at a given rate structure.
[3] The growth rate of real GDP was even negative for the entire duration of the conflict, 1991- 2001, and became positive in the post conflict years as it grew from -0.9 per cent for the period 1997-2001 to 7.8 per cent in the five-year, 2002-2007.

The agricultural sector proves to be the most vibrant contributor to GDP as its share averaged 44.0 per cent per annum. In terms of sectoral contribution to national output, the services sector was next to agriculture and then followed by mining and quarrying and manufacturing and handicraft. The composition of GDP has implications for the productivity of the tax system and the type of reforms introduced in the national tax system. A huge agricultural base that is not easily taxable due to its subsistence nature implies an increase in real GDP that primarily resulted from expansion in agricultural activities can not lead to an appreciable increase in tax revenue. This means that the higher the agricultural contribution to GDP, the lesser the tax responsiveness to changes in income. This response is measured by tax elasticity and tax buoyancy. Thus, the major taxes tend to have low elasticity and sometimes even low buoyancies in developing countries. The detailed average contribution of each sector to GDP is shown in Appendix I.

Budget deficit/GDP ratio remained negative for the entire period, implying that aggregate expenditure was always greater than the total revenue. Budget deficit improves from -9.77 per cent in the period 1977-1981 to -7.59 per cent in 1982 -1986 and then further to - 4.97 per cent in the interval 1992 to 1996. The deficit situation worsened as the war further escalated deteriorating to -9.35 per cent in the period 1997-2001 from a negative growth rate of 5.0 per cent between 1992 and 1996.

It can be inferred from Figure 1 that Sierra Leone recorded its worst fiscal balance in 1989. The reason for such a poor showing was that internal revenue generation was at its lowest and external sources of funding also waned during this period due to the fall out between the government and its donor partners. Faced with an increasingly desperate economic situation, the Government had to declare a state of economic emergency[4].

While adverse external development contributed to the economic decline during the 1980s, the Government's inappropriate macroeconomic and fiscal management policies including wasteful public expenditure policies were the more fundamental causes of the economy's poor performance.

Figure 1. Central Government Finances
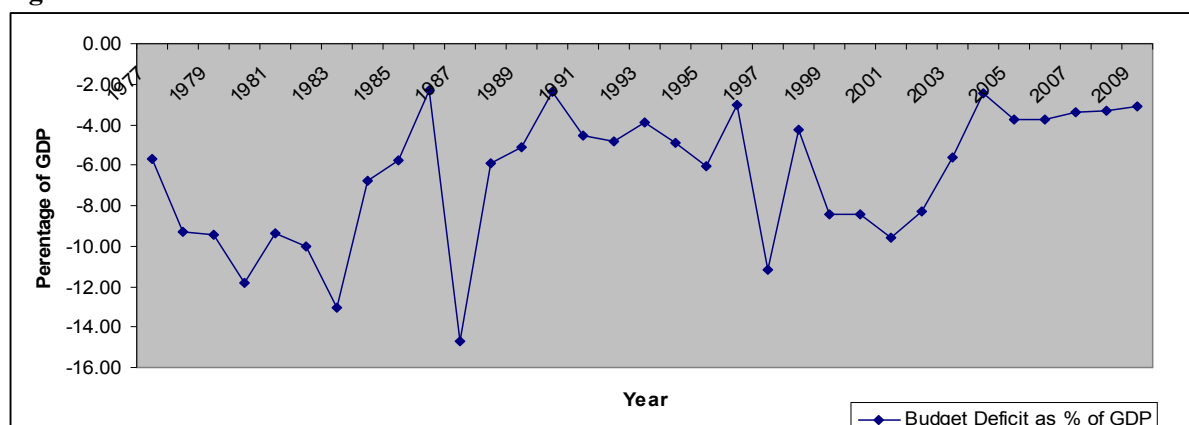
Source: International Monetary Fund (IMF), *International Finance Statistics CD-ROM (2008)*

The Government then implemented some reforms to salvage the deficit situation. For instance, financial subsidies to public enterprises were eliminated, liberalization of the exchange rate and trade regimes, decontrol of prices and interest rates, strengthening of revenue collection and expenditure controls and a revamping of mining policies. Despite these measures, the country continued to record fiscal deficit due to other pressing demands such as the surge in scheduled interest obligations, increased development expenditures, escalating defense expenditures and large pay rises granted to teachers and daily workers to avert strikes[5].

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[4] Most notable of the economic woes was the spiraling inflation rate of 165.00 per cent in 1987 (the highest in the country's history).

[5] The relatively huge budget deficits were financed mainly from domestic borrowing, except for 1978 where foreign financing in the form of project and program loans and grants accounted for 51.0 per cent. Foreign borrowing can raise the level of external debt and future debt service obligations, but can not fuel domestic inflationary pressures in the manner that reliance on domestic bowing would have done, unless credits to the

The tax system in Sierra Leone is largely inherited from the British colonial period but has since then undergone tremendous changes. It is based on a self-assessment system and comprises direct and indirect taxes. Direct taxes include among others company income tax (CIT), personal income tax (PIT), payroll tax, property tax and entertainment tax. Indirect taxes comprise taxes on domestic goods and services such as sales tax, and excise duty. Moreover, indirect taxes encompass taxes on international trade transactions such as import duty, sales tax on imported goods and services, and excise duties on specific imported goods such as cigarettes and beer. Non-tax revenues include non-exclusive prospective licenses, exclusive prospective licenses, exploration licenses, mining lease and royalty on marine resources. The National Revenue Authority (NRA) is responsible for tax administration in Sierra Leone. Prior to the establishment of the NRA in 2000, this responsibility was shared between the Income Tax Department and the Customs and Excise Department located under different ministries. Local taxes are administered and collected by the local governments. A brief description of the tax structure including some key individual taxes is provided below.

The tax burden measured by the ratio of tax revenue to GDP, averaged 9.71 per cent over the period 1977-2007 (see Appendix II). The tax ratio exhibited no definite pattern of upward trend questioning the efficacy of the tax reforms undertaken during the period under review. The average tax ratio of 9.71 per cent is well below the average of SSA. The trend patterns exhibited in Appendix II also confirm Sierra Leone's tax status of being a poor developing country. Clearly, indirect taxes completely outweighed direct taxes throughout the period under study, indicating the heavy dependence on such taxes. The decline in tax to-GDP ratio between 1995 and 1999 was primarily due to the conflict and the decline was mirrored by all taxes. Compared with other SSA countries, the Sierra Leonean tax effort is less than the average of the sampled countries (see Appendix III). Furthermore, in all the selected years, Sierra Leone's tax burden is lower than all the sampled countries. A significant feature of the Sierra Leonean tax system is its heavy reliance on indirect taxation to generate tax revenue. On average, indirect taxes contributed 74.0 per cent to total tax revenue compare to 26.0 per cent of direct taxes. The revenue system in Sierra Leone has been heavily dependent on import taxes which represented about 42.0 per cent of total revenue (see Table 1).

Table 1. Relative Shares of Main Taxes in Total Tax Revenue in Sierra Leone

Year	Direct Taxes	Indirect Taxes	CIT	PIT	Excise Tax	Other[6] Taxes	Import Tax	Export Tax
1977 - 1980	26.3	73.7	16.0	10.4	17.7	15.1	25.2	15.0
1981 - 1984	28.6	71.4	16.0	12.6	24.5	16.2	24.1	5.5
1985 - 1988	27.0	73.1	16.2	10.8	21.1	5.5	41.7	1.8
1989 - 1992	23.6	76.4	15.8	7.8	24.9	8.4	42.0	0.2
1993 - 1996	21.2	78.8	12.9	8.3	26.4	4.6	46.8	-
1997 - 2000	22.7	77.4	10.2	12.5	20.8	2.7	53.1	-
2001	27.9	72.1	10.4	17.5	14.0	3.5	54.3	-
2002	27.6	72.4	13.0	14.6	14.4	3.5	54.0	-
2003	27.3	72.7	14.4	12.9	15.4	2.6	53.8	-
2004	29.4	70.6	14.9	14.5	14.3	3.0	52.0	-
2005	32.1	67.9	17.8	14.3	12.6	2.0	52.0	-
2006	30.3	69.7	15.2	15.1	15.6	1.6	48.7	-
2007	34.8	65.2	17.5	17.2	14.3	2.1	47.2	-
2008	35.6	64.4	17.8	16.0	15.2	3.4	46.9	-
2009	36.4	63.6	18.6	17.9	15.1	4.5	45.3	
Average	**27.2**	**72.4**	**14.6**	**13.0**	**18.2**	**5.4**	**45.7**	-

Sources: (i) IMF, *International Finance Statistics CD-ROM (2008;* and (ii) Sierra Leone's National Revenue Authority (NRA)

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private were cut. For instance, in 1990, domestic borrowing financed 82.0 per cent of the deficit while external borrowing financed the remaining 18.0 per cent.

[6] This category encompasses the sales tax that was introduced in 1990 following the abolishment of the turn over tax.

A further break down of taxes into major tax handles is also provided in Table 1 and that tax on goods and services (excise and sales tax) contributed on average about 28.0 per cent of total revenue.

The tax system in Sierra Leone has undergone tremendous changes. Tax reforms have constantly been used to raise the revenue productivity of the tax system. Motivations for tax reform have been due to the apparent failure of the tax system to generate adequate revenue required to meet expanding expenditure needs. These reforms range from changes in the tax rates, tax brackets, partial removal of exemptions, change in tax legislations, harmonization of custom duty rates, and introduction of new forms of taxes which are relatively easy to administer. Some of these reforms include the introduction of sales tax on imports and local manufactures and increase in excise duty rates on petroleum. The tax reforms before 1986 were limited mostly to income tax and were carried out on a very minimal scale.

3. Empirical Evidence on the Productivity of Tax Systems

The empirical literature on the productivity of tax systems is amorphous due to the difficulties in obtaining data on the discretionary component of tax revenues. Various models have been used by researchers in order to obtain tax revenue estimates that are associated with discretionary tax measures. In Africa, attempts have been made by some researchers, notably, Osoro (1993), Moyi and Muriithi (2003), Kusi (1998), Chipeta (1998) and Ariyo (1997). Some studies used the proportional adjustment (PA) technique, while others are restricted to estimating only buoyancies due to lack of sufficient data to compute elasticities. A summary of some key empirical studies is highlighted in Table 2.

Table 2. Summary of Some Key Empirical Studies

Author	Coverage	Methodology	Major Findings
Osoro (1993)	Tanzania, 1969-1990	Proportional Adjustment	Tax reforms failed to raise the revenue productivity of the tax system and that elasticities are less than unity for the major taxes and the total tax system.
Kusi ((1998)	Ghana, 1960-1993	Proportional Adjustment	Tax reform process contributed greatly to the growth of revenue productivity as elasticities are greater than unity for the major taxes.
Moyi and Muriithi (2003)	Kenya, 1973-1999	Proportional Adjustment	Tax reforms had positive impact on the overall tax structure and on the individual tax handles.
Bilquess (2004)	Pakistan, 1974-2003	Divisia Index	The use of discretionary measures has been relied upon significantly as a source of revenue augmentation.
Indraratna (1991)	Sri Lanka, 1960-1994	Proportional Adjustment	The tax structure is inelastic and that the pre-reform and post-reform periods did not reveal a significant difference in elasticities.
Ehdaie (1990)	Malawi and Mauritius, 1965-1985	3SLS in the context of a macro model	Discretionary measures are highly significant
Davoodi and Grigorian (2007)	Armenia, 1993-2004	Cross-country panel regression	Institutional weaknesses in tax and customs administrations are key factors in tax-generating capacity and that lower income tax buoyancy also explains the low tax-to-GDP ratio
Kargbo, B.I.B. 2010	Sierra Leone	3SLS and DI	Discretionary measures are statistically significant and that tax reforms failed to increase the productivity of the tax system. Agriculture and mining have negative impacts on tax revenue shares.

3.1. Theoretical Foundations of Tax Buoyancy and Elasticity Models

A traditional function of the tax system is to bring in sufficient revenue to meet the growing public sector requirements. In order to match this function, a desirable property of the tax system is that income elasticity should be equal or greater than unity. Such property ensures that revenue growth keeps pace with output growth without frequent discretionary changes and it also imparts automaticity, or build-in stability, to the tax system. Thus, it ensures mitigation of cyclical variations in GDP over the course of the business cycle. Low tax buoyancy and elasticity can be attributed to many factors. Important among these are tax evasion and low compliance resulting mainly from inefficient tax administration, corruption and high tax rates.

The concept of 'tax elasticity' is therefore defined to measure percentage increases in the tax revenue resulting from the endogenous changes in its base caused by a percentage rise in GDP. The income elasticity of a tax can be broken down into tax-to-base and base-to-income elasticities. Therefore, the elasticity of a tax is essentially the product of the elasticity relative to the base and the elasticity of the base-to-income.

The elasticity of the tax system and its major handles is affected as the GDP composition alters. Hence, the composition of the tax base exhibits significant changes over relatively long periods, especially in a developing country. Government actions can affect tax revenue through various policies such as, changing the real value of the exchange rate, the level of public debt, the level of interest rate, and the rate of inflation. These factors are important in determining the tax bases at a given moment in time and in determining how these bases change over time with direct effect on buoyancy and elasticity of the tax system. The fact is that individual tax systems, tax revenue, tax bases and GDP are all interrelated. Variations in individual tax revenue can therefore be traced not only to variations in its own tax system through discretionary tax changes, but also to endogenous changes in its base. The base, in turn, is endogenously affected by changes in its own and other tax systems through the price mechanism, changes in investment, savings and income (Ehdaie, 1990). It is apparent that a given tax revenue depends not only on its tax base but also on changes on its own tax system as well the changes on the system of other taxes.

3.2. The Research Methodology

Traditionally, the buoyancy or elasticity of a tax can be obtained by a linear regression equation of the form;

$$T = \alpha Y^{\mu} \varepsilon \qquad (1)$$

Logarithmic transformation of equation (1) yields;

$$\ln T = \ln \alpha + \mu \ln Y + \varepsilon \qquad (2)$$

Where α is a constant indicating tax yield when the base is set to zero, μ is the marginal rate of taxation, T is total tax revenue, Y is income (GDP) and ε is the stochastic disturbance term.

Equation (2) is in double log form; and therefore, provides an estimate of tax buoyancy because it measures the percentage response on the tax revenue. Income elasticity is rather tedious to estimate because it requires an estimate of what would have happened if changes to the tax structure had not been made as explained inter alia. Researchers (example, Mansfield, 1972; Osoro, 1991; and Ariyo, 1997) have used series of models to cleanse the tax revenue for discretionary tax measures and then used the set of cleaned data to estimate the elasticity of the tax system. A descriptive analysis of the various models employed in this research is thus provided. In estimating the elasticity of a tax system, either the time series data on tax revenues need to be adjusted to eliminate the effects of discretionary tax measures, or a suitable estimation methodology has to be adopted, or a combination of the two. The most appropriate model would clearly depend upon the availability, nature and reliability of information on tax revenues, discretionary changes in the tax structure and tax bases.

Two methods have traditionally been employed to eliminate the effect of discretionary tax changes. The first is the Historical Time-Series Tax Data (HTSTD) adjusted to DTMs. The second is the unadjusted HTSTD with time trends or dummy variables as proxies for DTMs. The HTSTD adjusted to DTMs approach attempts to eliminate discretionary tax changes[7] from the HTSTD and then uses the adjusted HTSTD to estimate tax elasticity by first estimating a single-equation model.

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[7] Discretionary tax measures referred to the legal changes in the tax rates, tax bases, tax allowances and credits, and of tax administrative efficiency.

Normally, one can use either the proportional adjustment (PA) technique or the constant rate structure (CRS) procedure to adjust the HTSTD for discretionary effects[8].

An alternative method of estimating elasticity is the dummy variable technique developed by Singer (1968). The Unadjusted HTSTD with Proxies for DTMs estimates tax elasticity directly from the HTSTD using econometric methods. This involves the use of dummy variables to represent important discretionary changes in tax rates and tax structures for every year when such policy shifts occur. This procedure is used when the methods mentioned earlier cannot be utilized to 'clean' the data series of the impact of discretionary changes in the tax system. The Singer Method incorporates dummy variables (simple or mixed) proxies for important discretionary changes in the tax system for every year that such policy shifts occurred. From equation (1), the tax functional form can also be expressed as:

$$\log(T)_i = \log \alpha + \beta \log(Y)_i + \sum \theta_i D_i + \varepsilon_i \qquad (3)$$

Where,

α = Constant;

β = Elasticity coefficient;

θ_i = Impact or coefficient of the discretionary change; and

D_i = dummy variable (simple or mixed) as proxy for the ith DTM taken during the period under review. The summation sign in equation (3) creates room for the possibility of multiple changes in the tax system during the study period .In the Sierra Leonean case, introducing a dummy variable for some key exogenous tax policy change into equation (3) leaves the empirical model as:

$$\log(T_i) = \log \alpha + \beta_1 \log(Y)_i + \beta_2 \log(Y)_{i-1} + \sum_{i=1}^{4} \theta_i D_i + \varepsilon_i \qquad (4)$$

The lag of GDP is included to account for administrative lags in tax collection as tax policy guidelines announced in budget speeches normally require time to be implemented. If there are severe administrative lags, the lagged value will be more significantly related to the dependent variable. Two dummies are also introduced in equation (4) to capture the effect of two major tax reforms in Sierra Leone; the introduction of sales tax in 1990 and the administrative reforms of 2000. The other two dummy variables (shift and slope) are meant to account for the impact of the war on tax revenue bases and productivity (see Appendix IV on data sources and methods).

4. Model Estimation and Discussion of Results

Before embarking on the econometric analyses, a visual inspection of the graphs in Appendix V demonstrates that the variables in levels are strongly trending; thus, signifying the need to carry out unit root tests. The results of the unit root tests, based on the ADF, indicate that all the variables under consideration exhibit unit roots at different critical levels. However, none of the variables was found stationary in levels. The variables are found stationary after differencing once implying that the variables are integrated of order one. The unit root results are presented in Table 3.

The unit root tests reveal that all the variables are not stationary, thus, exploring cointegration test becomes necessary. The Engle-Granger Two-Step (EGTS) is applied to test for the existence of cointegration. The EGTS is applied on the residuals after obtaining the static long-run regression for each stochastic equation. The residuals are saved and then tested for stationarity. A non-stationary residual implies that the variables in the equation generating the residual are not cointegrated and the results are presented in Table 4. It is clear from Table 4 that all the stochastic tax revenue equations are cointegrated based on the unit root test of the residuals.

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[8] A major problem with the PA and CRS techniques is that they are unable to completely adjust the HTSTD to discretionary changes. On its part, the PA method uses budget estimates of discretionary tax changes that are difficult to obtain in many developing countries. The CRS technique, on the other hand, requires information on the distribution of tax bases by rate categories, which are also not readily available.

Table 3. Unit Root Test Using Augmented Dickey-Fuller

Variable		ADF (0)		ADF (1)		ADF (2)		Decision
		Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept	
LnTR	Level	-2.4227	-2.2964	-2.9546	-2.7250	-3.1987	-3.0474	I (1)
	ΔLevel	-4.0208**	-4.1008**	-2.3892	-2.5234	-1.9653	-2.1606	
Ln GDP	Level	-1.0966	-0.4835	-1.1470	-0.5039	-1.3787	-0.7370	I (1)
	ΔLevel	-4.8568**	-4.9617**	-2.8039	-2.9897	-1.9394	-2.1606	
Ln Xp	Level	-1.6636	-1.8493	-1.8404	-1.9053	-2.2185	-2.3175	I (1)
	ΔLevel	-5.2312**	-5.2240**	-3.3454*	-3.4280*	-2.6416	-2.7852	
Ln Xd	Level	-1.7931	-0.8353	-2.2369	-1.1716	-2.2215	-0.3849	I (1)
	ΔLevel	-4.7062**	-5.2411**	-4.6944**	-5.7719**	-2.9567	-4.2629	
Ln Xm	Level	-1.3345	-1.9122	-1.5322	-2.3377	-1.5718	-2.7889	I (1)
	ΔLevel	-4.7274**	-4.7071**	-3.4629**	-3.5310*	-3.4840*	-3.6683*	
Ln Xc	Level	-2.4159	-2.8354	-1.9994	-2.3044	-1.8084	-2.7889	I (1)
	ΔLevel	-4.7274**	-4.7071**	-3.4629*	-3.5310*	-3.4849*	-3.6684*	
Ln Tp	Level	-1.6916	-1.8985	-2.2368	-2.6634	-1.5070	-2.0771	I (1)
	ΔLevel	-5.2840**	-5.7182**	-4.0126**	-4.4371**	-3.7744*	-4.2369**	
Ln Td	Level	-2.2503	-2.7906	-2.4186	-2.2894	-2.6239	-2.4775	I (1)
	ΔLevel	-7.5851**	-7.5575**	-4.2472**	-4.3180**	-3.2084*	-3.2429*	
Ln Tm	Level	-2.1749	-2.9940	-2.2033	-1.5981	-1.9890	-2.4537	I (1)
	ΔLevel	-4.9172**	-5.4511**	-4.6048**	-3.5741*	-3.5897*	-3.7677*	
Ln Tc	Level	-2.5612	-2.0772	-2.5424	-2.0398	-2.4239	-2.0033	I (1)
	ΔLevel	-5.6852**	-6.1330**	-3.6136*	-4.0132**	-3.2523*	-3.7992*	

Notes: (i)   Critical values for ADF with Intercept at 1% and 5% are -3.6661 and -2.9621

    (ii)   Critical values for ADF with Intercept and Trend at 1% and 5% are -4.2949 and -3.5670

    (iii) Δ represents first difference operator

    (iv)   ** (*) implies significant at 1% (5%) level

Table 4. Cointegration Test Results

Static Model Residuals	ADF (0)	ADF (1)	ADF (2)	Decision
LnTR	-5.2292**	-4.8028**	-5.1161**	Cointegrated
LnTc	-4.2684**	-4.7908**	-4.5075**	Cointegrated
LnTm	-3.6570**	-4.4801**	-4.0238**	Cointegrated
LnTd	-5.6894**	-4.8169**	-4.4924**	Cointegrated
Ln Tp	-3.9740**	-4.7235**	-4.4037**	Cointegrated

Notes: (i) Critical values for ADF at 1% and 5% are -2.6443 and -1.9525

    (ii) ** (*) implies stationarity of the residual at the 1% (5 %) level of significance.

Estimates of Short-run and Long-run Tax Buoyancy and Elasticity

The nominal measure of buoyancy of the total tax system and its major handles is obtained by the estimated regression coefficients presented in Table 5. The estimation accounted for serial correlation by assuming an AR(1) process.

Two dummies are introduced to account for the principal tax reforms. The first dummy is based on the IMF technical assistance advice in 1987. Reforms in the ensuing years after the IMF mission included the introduction of sales tax on imports and local manufactures, and increase in excise duty rates on petroleum. The second dummy is introduced to capture the impact of tax administration reforms (the establishment of the autonomous revenue agency) in 2000. Note that there are other reforms undertaken during the period under review but to prevent overloading the tax equation with dummies, emphasis is on these two fundamental reforms. Dummy variables reflecting the impact of the civil war on the tax system were also included in the estimation process but none proved to be significant. The elasticity (both short-run and long-run) estimates are shown on Table 6.

Table 5. Short-run and Long-run Tax Buoyancy Estimates

Tax Category	Short-run	Long-run
Total Tax System	0.810 (4.335)**	0.948 (3.354)**
Import Duties	0.929 (2.254)*	1.086 (2.008)*
Domestic Transaction Taxes	1.092 (2.357)*	1.291 (2.259)*
Corporate Income Tax	0.889 (5.119)**	1.002 (2.330)*
Personal Income Tax	0.587 (3.222)**	0.518 (3.050)**
ECM(-1)	-0.713 (-4.230)**	

Source: Computed by the Author
Note: t values in parenthesis and ** (*) implies statistical significance at the 1% (5 %) level of significance.

Table 6. Short-run and Long-run Elasticity Estimates

Tax Category	SR Elasticity Coefficient	LR Elasticity Coefficient
Total Tax System	0.681 (2.291)*	0.891 (2.238)*
Import Duties	0.549 (2.041)*	0.677 (3.304)**
Domestic Transaction Taxes	0.663 (5.239)**	0.799 (4.111)**
Corporate Income Tax	0.586 (4.864)**	0.619 (2.365)*
Personal Income Tax	0.415 (2.121)*	0.686 (2.334)*
ECM(-1)	-0.879 (-4.379)**	

Source: Computed by the Author
Note: t values in parenthesis and ** (*) implies statistical significance at the 1% (5 %) level of significance.

Tax Buoyancy and Elasticity

A comparison of buoyancy and elasticity estimates is significant as it reveals the revenue impact of discretionary policy, while a tax by tax comparison of the two measures points to the taxes for which discretionary changes are most important. In general, when buoyancy estimates are higher than elasticity estimates, it means that discretionary tax policies are effective in raising tax yield and the converse is also true. When buoyancy estimates are the same with elasticity estimates, it means discretionary tax policies have neutral effect on tax revenues (Osoro, 1995).

The elasticity estimates from the tax elasticity model are used in this section to compare the estimates of elasticity and buoyancy. The results in Table 7 indicate that buoyancy estimates exceeded the elasticity estimates in all the cases except for personal income tax[9]. A direct interpretation of the result of the personal income tax is that discretionary measures implemented during the period under review were not helpful in raising the yield of the tax. The largest difference between buoyancy and elasticity relates to domestic transactions tax. In fact, for domestic transactions tax, discretionary policy yielded a 0.49 per cent change in revenue arising from a 1.0 per cent GDP growth. Thus, the growth in revenue from domestic transactions tax was mainly explained by the discretionary changes undertaken over the period. The buoyancy and elasticity coefficients relating to corporate income tax were almost the same, suggesting that not much happened with this type of tax in terms of discretionary measures.

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[9] The results displayed in Table 6 depict only the long-run estimates.

Import duties also show the same trend with a difference of 0.409, which again suggested that discretionary tax policies were responsible for the growth in yield. The major cause for the growth of revenue from import tax was the rationalization and harmonization of import duty rates.

Table 7. Tax Buoyancy versus Tax Elasticity

Tax Category	Buoyancy	Elasticity	Difference
Total Tax System	0.948	0.891	0.057
Import Duties	1.086	0.677	0.409
Domestic Transaction Taxes	1.291	0.799	0.492
Corporate Income Tax	1.002	0.619	0.383
Personal Income Tax	0.518	0.686	-0.160

Source: Computed by the Author

Import Duties

The impact of the tax reform measures can be seen in the performance of import tax revenue in terms of estimates of buoyancy and elasticity. The estimated import tax buoyancy is above unity while the elasticity is 0.677. The elasticity performance could be attributed to many factors, some of which include, the compression of imports resulting from the acute foreign exchange shortages during the late 1980s and early 1990s, the valuation of imports at the artificially over-valued exchange rate and the use of specific duty rates rather than *ad valorem* rates in computing duties payable, and evasion and laxity in tax collection. The superior performance of the buoyancy in relation to the elasticity is purely due to discretionary tax measures, such as harmonization of the custom tariff structure, adopted during the period under review.

Personal Income Tax

The estimated income tax buoyancy for was 0.518 and the elasticity was 0.686. One observes that the income tax performance was not encouraging during the period under review. The low productivity of personal income tax during the study period stemmed partly from the low taxation of non-wage income earners, especially income earners in the retail trading and commercial sector. Another reason is the decline in real wages of employees in the formal sector due to the high levels of inflation that the country experienced. Informal sector employment provides the bulk of employment in Sierra Leone as 92 per cent of the total usual employment is in the informal sector[10]. The ease with which income tax on salaried workers is assessed and collected based on the PAYE system provided another justification for the less concerted attention to taxes on self-employed incomes. The existence of a crowd of nontaxable allowances such as transport, leave, housing, medical, education, and others also limits the base of employee income tax.

Corporate Income Tax

The estimated corporate income tax buoyancy and elasticity were 1.002 and 0.619, respectively. The performance of the corporate income tax revenue reflected the sharp decline in industrial production, and thus the base of company tax, following the general economic malaise in the years preceding the civil war. Capacity utilization of these industries worsened during the decade-long war as the country's ability to import raw materials and spare parts was thwarted as foreign exchange became scarce. This development also adversely affected revenue mobilization from company income tax, excise duty and sales taxes as the bases of these taxes were gradually eroded.

Domestic Transactions Tax

The buoyancy of this tax was estimated at 1.291 and elasticity at 0.799. These estimates were partly due to the decline in real private consumption expenditures, the base on which the tax is imposed, but more to the poor administration of the sales tax (a major component of the domestic transactions tax). The increase in the incidence of absolute poverty due to growing unemployment resulted in a sharp decline in real private consumption expenditure, and thus domestic transactions tax

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[10] For more details, see Employment and time spent on activities in Sierra Leone, 2005.

revenue. The other major component of domestic transactions tax is the excise taxes which were imposed on few manufactured products, thereby making the collection relatively easy and evasion relatively difficult. In addition, revenue from petroleum tax until early 2000 was counted as part of excise tax revenue, thus makes the productivity of excise tax to increase as prices of petroleum products rose.

5. Conclusion

A number of salient findings were obtained from this empirical models research. Taxes are not wholly reactive to changes in income as most elasticity estimates are below unity. The estimates of buoyancy and elasticity indicate that, overall, the use of discretionary measures has been relied upon extensively as a source of revenue augmentation in Sierra Leone. The relatively higher coefficients obtained for the buoyancy estimates compared to the elasticity estimates point to the role of discretionary measures in maintaining a steady source of tax revenue for the government. The use of discretionary measures to raise additional tax revenues is not only peculiar to Sierra Leone as other studies have shown the use of such measures is a wide spread practice in LDCs (Chipeta, 1998; Kusi, 1998; Moyi and Muriithi, 2003; and Osoro, 1993).The tax base(s) could not expand as GDP grows resulting to low elasticities. Some of the factors that prevented the tax base(s) to broaden are numerous tax exemptions granted to newly established industries and mining companies, tax incentives, duty waivers and loopholes for evasion.

It can also be inferred from the results that short-run elasticities are lower than the long-run elasticities and that the statistical significance of the error terms showed the speed of adjustment in the tax system. This trend possibly explains the presence of administrative lags in the tax collection system as tax policy guidelines announced in budget speeches normally require time to be implemented.

A highly buoyant and elastic tax structure is significant for a typical developing country as it ensures an increase in tax revenue without tampering with the tax rates that have undesired political consequences. Thus, it is important for policy makers to know the elastic nature of the major tax handles in a given economy. The policy implications of the study are clear.

Buoyancy estimates outweighed the elasticity estimates implying that discretionary measures have been used in the past as a tool to raise revenues. The potency of the tax reforms is not realized as elasticity estimates are below unity. Tax reforms should become systemic, a continuous process to keep the economy competitive instead of being sporadic or discretionary. The tax reform should concentrate on rationalizing rate reduction, broadening the base and improving tax administration. Above all, a proper design of such reform, however, requires quantitative information on the impact of changes in each individual tax system not only on its corresponding tax revenue and base but also on the other individual tax yields and bases as this study exposed that a single change in one tax handle may have an impact on others and hence the entire tax system.

The low elasticity of import duties is surprising given that the base grew faster than GDP. This partly suggests evasion practices by importers to defraud the tax system among other things. Moreover, discretionary exemptions and concessions of tax rates erode the tax base and devoid of fairness in the treatment of taxpayers. Exemptions are quite often granted to local manufacturers, raising the possibility that imported equivalents subject to the sales tax would remove the discriminatory element. Goods and services must be treated equally and at uniform rates so that persons spending equal amounts of money with varying composition of goods and services should pay the same amount of consumption tax. The implication of this is that consumption tax must be neutral between goods and services and should have a base as broad as possible to make it a major gadget of revenue collection. The low estimate of import elasticities also suggests that despite the substantial reforms, significant review and rationalization of the custom duty rates, further improvements are still required in the area of reduction of custom duty rates and exemptions.

It can be inferred from the results of the decomposed tax to base elasticities that the tax bases are not too responsive to increases in GDP. Hence, the planned introduction of a broad-based and general consumption tax to replace some of the current taxes administered by the NRA is a step in the right direction if implemented properly as it is a major option available for raising additional revenue. VAT is an attractive tax because it does not significantly distort businesses' and consumers' decisions.

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Appendix I: Selected Macroeconomic and Fiscal Indicators of the Sierra Leonean Economy (Sub-period Averages)

Indicator	1977- 1981	1982-1986	1987-1991	1992-1996	1997-2001	2002-2007
Real GDP growth (%)	2.94	0.54	1.32	- 4.52	- 0.90	7.80
Sectoral Composition of GDP (%) Agriculture	34.20	39.40	44.60	42.10	55.40	45.60
Mining	6.70	9.40	12.50	20.70	14.40	17.50
Manufacturing	5.70	5.90	4.60	9.00	3.70	3.20
Interest Rate	7.40	10.80	17.60	21.70	9.50	10.4
Revenue (% of GDP)	14.17	3.93	3.06	8.07	10.80	12.75
Expenditure (% of GDP)	22.00	6.53	4.88	11.39	17.99	15.51
Budget Deficit (% of GDP)	- 9.77	- 7.59	- 6.54	- 4.97	- 9.35	- 4. 10
Import Goods and services (% of GDP)	31.16	18.40	20.53	26.56	27.23	40.75
Export of goods and services (% of GDP)	21.07	12.84	25.96	21.98	15.39	23.89
Current Account (% of GDP)	-12.34	2.41	-3.94	-9.53	-11.25	-8.56
Inflation Rate	11.56	45.02	98.16	38.60	15.34	12.57
External Debt (Millions of US dollar)	345.10	687.90	1134.80	1518.60	1210.40	1085.20

Sources: (i) Calculated from International Monetary Fund (*IMF), International Finance Statistics CD-ROM (2008);* and
(ii) Statistics Sierra Leone, *National Accounts,* Various Issues

Appendix II: Tax Ratios in Sierra Leone, 1977-2007

Year	Tax Revenue as % of GDP	Direct Taxes as % of GDP	Indirect Taxes as % of GDP
1977	14.11	4.30	9.81
1978	18.47	4.94	13.53
1979	16.61	4.08	12.53
1980	13.94	3.38	10.56
1981	14.78	3.87	10.91
1982	10.41	2.62	7.79
1983	7.41	2.45	4.96
1984	6.42	2.02	4.40
1985	5.72	1.76	3.96
1986	3.82	0.99	2.83
1987	4.69	1.12	3.57
1988	5.86	1.78	4.08
1989	8.54	1.84	6.70
1990	7.03	1.48	5.55
1991	7.74	1.9	5.84
1992	4.99	1.41	3.58
1993	10.25	2.48	7.77
1994	11.00	2.49	8.51
1995	9.00	3.56	5.44
1996	8.53	1.57	6.96

1997	4.65	0.68	3.97
1998	6.33	1.16	5.17
1999	6.28	1.82	4.46
2000	10.12	2.95	7.17
2001	12.00	3.36	8.64
2002	11.31	3.14	8.17
2003	11.33	3.12	8.21
2004	10.91	3.25	7.66
2005	10.07	3.28	6.79
2006	9.18	2.89	6.29
2007	11.00	3.89	7.11
Average	**9.71**	**2.57**	**7.14**

Sources: (i) Calculated from IMF, *International Finance Statistics CD-ROM (2008),*
and (ii) Sierra Leone's National Revenue Authority (NRA)

Appendix III: Tax Revenue as a Share of GDP in Some African Countries for Selected Years

Country	1990	1995	2000	2004
Cameroon	9.80	9.40	11.70	-
Gambia, The	18.20	21.00	19.10	-
Ghana	11.40	11.40	-	22.40
Kenya	19.30	20.50	16.80	16.90
Sierra Leone	5.30	9.00	10.20	11.00
Botswana	27.50	16.60	-	-
Burundi	15.60	16.70	12.40	-
Lesotho	35.10	41.80	32.40	41.70
Sample Average	**17.80**	**18.30**	**17.10**	**23.00**

Source: World Development Indicators*, CD-ROM (2008)*

Appendix IV: Data Sources and Methods

     The data for this study were obtained from *World Development Indicators 2007* and the *Government Finance Statistics Yearbook 2005 and 2006*. Information on tax reforms and data on the classified taxes were obtained from the NRA of Sierra Leone. The proxy bases for income taxes are domestic factor incomes derived from the data on the sources of income side of the national accounts. Since the sales tax has been levied at retail and wholesale levels, private final consumption is used as the proxy base and hence the proxy base for the entire domestic transactions tax. The proxy base for import duty is the value of imports obtained from the balance of payments. The proxy base for corporate income tax is value added in non-agriculture and the proxy base for the overall tax system is GDP. The four major individual taxes considered in this study are; tax on domestic transactions, import tax, corporate income tax and personal income tax. Thus, these four major taxes serve as dependent variables for the individual tax revenue equations.

     Value added in non-agriculture is computed by deducting the value of agriculture and its allied sectors, value of government services and the contribution of Non-Profit Institutions Serving Households (NPISH) from GDP at market prices. g_i is obtained by subtracting the value of two adjacent years of a given tax base. Openness is the share of imports to GDP. Estimations were done in logarithmic form so that the coefficients are interpreted as elasticities.

Appendix V: Historical Series Graphs of Endogenous Variables