

**Determinants of Tax Revenue in Liberia: An Empirical Investigation**

Roosevelt S. Prowd<sup>†</sup> and Genesis B. Kollie<sup>§</sup>

**Abstract**

The need for the Liberian government to mobilize sufficient revenue for development is becoming increasingly important amid slow growth, increasing demand for infrastructure and citizens' needs. This paper determines the factors that are likely to drive tax revenue performance. We gathered monthly time series data and employed the Johansen cointegration approach and VECM estimation technique. The empirical results reveal that, in the long run, tax revenue responds positively to real property, income and profit, property income, goods and service tax, administrative fees, import duties, excise tax, grant, loan, inflation and GDP Growth. Conversely, tax revenue responds negatively to social development contribution from agriculture and mining, real exchange rate and population growth. Given these findings, we recommend, among others, that Liberia over-reliance on direct tax (i.e., PIT and CIT) revenue be mitigated. In particular, we recommend the adoption of a VAT regime in the place of the current GST regime.

**Keywords:** Tax revenue performance, Liberia, Customs, Impulse Response Function, Domestic tax

**JEL Classification Codes:** H2, H25, H71

---

<sup>†</sup> Corresponding Author, Department of Economics, University of Liberia; Email: rooseveltprowd@yahoo.com / prowdrs@ul.edu.lr

<sup>§</sup> Department of Economics, University of Liberia; Email: kolliegenesisb@gmail.com / kolliegb@ul.edu.lr

## **1. Introduction**

Universally, the singular objective of every government is to maximize the welfare of its citizens. In doing so, the government is duty-bound to mobilizing revenues that will facilitate the financing of both recurrent and capital expenditures. Tax revenue is one of the sources of government revenues in both developing and developed countries (Abdixhiku et al., 2017; Miskam, Noor, Omar and Aziz, 2013; Karagoz, 2013). It aids in the planning and implementation of developmental agenda, bolsters private sector performance and the settlements of government's obligations/debts both locally and internationally, serves as a conduit to encourage and/or discourage certain activities, and plays an influential role in the redistribution of income from the top income earners to low-income earners.

As it stands, government revenue is generated from two sources (i.e., tax and non-tax revenue). The tax revenue consists of revenue generated from the income and wealth accumulation of individuals and corporations, taxes on international trade, taxes on goods and services, etc.; while the non-tax revenue consists of revenue generated from dividends from government-owned corporations, central bank revenue and capital receipts, penalties and fines, etc. The revenue collected (whether tax or non-tax) is used by government mainly for two purposes: to finance the provision of public goods and services and to fulfil their role as redistributor of wealth.

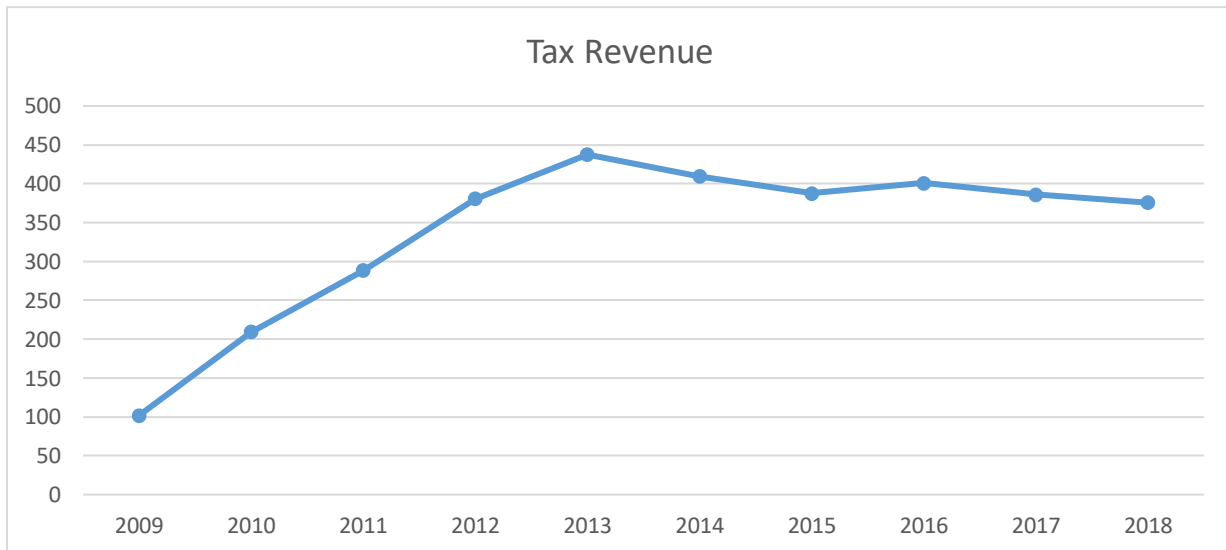
In the context of Sub-Sahara Africa (SSA), tax revenue is primarily generated from income of individuals (i.e. income tax). For example, income taxes contribute almost one-third of the overall revenues for many SSA countries (Agbeyegbe, Stotsky and WoldeMariam, 2006). The challenging task, however, is that these taxes are derived from a few contributors, sometimes with smaller tax bases. For example, in Liberia, corporate income taxes are derived from few major producers and service providers, such as beverage producers, concession companies, telecommunications, and commercial banks. And personal income taxes are gotten primarily from public sector employees and from large private enterprises. Another major challenge for tax administration in Liberia is that majority of income earners are from the informal sector. And accounting for personal income tax (PIT) in the informal sector is almost impossible (Agbeyegbe *et al*, 2006). Many at times, these taxes that are to be paid to government are evaded. According to Abdixhiku et al. (2017), tax evasion is common amongst poorer countries and firms or institutions that are smaller in size. They are usually associated with high risk of evasion as compared to larger ones. This tax evasion is influenced by low trust in government, particularly the judicial system (Batrancea et al., 2019), rise in corruption perception (Md Amin, 2010; Thanasegaran and Shanmugam, 2007), as well as high cost of tax compliance (Dewett and Navalur, 2010). Notwithstanding, Batrancea *et al.* (2019) recommend that trust and some traditional enforcement tools such as audits and fines be prioritized so as to enable tax payers be in full compliance. According to Bruckner (2012), broadening the tax base is a sure way to increase tax revenue.

In Liberia, the importance of tax revenue cannot be overemphasized. A new government was ushered into office in 2018 and has formulated an ambitious 5-year national development plan known as the Pro-poor Agenda for Prosperity and Development (PAPD). The PAPD, which is aligned to the Economic Community of West African States (ECOWAS) Vision 2020 and Africa Agenda 2063, seeks to, inter alia, build trusted and capable state institutions that will be resilient and stable; provide income security to at least additional one million Liberians, and help to reduce poverty by 23 percent through investment in agriculture, human resource development,

infrastructure and social protection. In order to achieve the PAPD, the total cost is estimated at over US\$7.2 billion for a five-year period. However, under current domestic resource mobilization scenarios, the estimated target is US\$1.7 billion for the same period, thus leaving a huge financing gap of over US\$5.5 billion and creating the need for a more robust tax revenue mobilization strategy. Accordingly, Liberia Revenue Authority (LRA) has developed a vigorous Domestic Revenue Mobilization (DRM) strategy. The DRM strategy has the potential to guide ongoing customs reform and prioritization of capacity building efforts in Tax Administration, and at the same time, supports major policy reforms such as improving accountability between government and taxpayer, enhancing taxpayer compliance, and improving the enabling environment for economic development and private investment. In addition, the LRA has undergone several reforms such as the introduction of a desk audit system for large taxpayers, education of taxpayers through workshops, introduction of a new compliance management framework in 2017 and creation of a mobile app and e-filing system that allow taxpayers easily pay taxes even at the comfort of their bedrooms (World Bank, 2019).

Notwithstanding with these reforms, the country's tax to GDP ratio is far below World Bank's benchmark of 25 percent tax to GDP ratio. Moreover, aside from fiscal year 2013/2014 at which time the Liberia Revenue Authority (then, the Department of Revenue) exceeded its revenue target, the institution has experienced persistent revenue deficits over the last decade. For example, in 2016/2017 fiscal year, revenue fell below budgeted target by 12 percent. Similarly, in 2017/2018 and 2018/2019 fiscal years, there were 15 percent and 7 percent revenue deficits respectively. These continuous shortfalls in domestic revenue have further constrained government's ability to pay its employees and vendors regularly.

As indicated in Figure 1, tax revenue remained unstable over the last decade. Collection of tax revenue increased consistently from 2009 to 2013 but has since been very unimpressive. For instance, total tax revenue collection stood at US\$437.5 million in 2013, but plummeted to US\$409.4 million and US\$387.7 million in 2014 and 2015 respectively (World Bank, 2019).



**Figure 1:** Tax Revenue Collection (in millions of US dollar)  
**Source:** World Bank (2019)

However, policy makers could attribute these falls to the devastating effect of the Ebola Virus Disease (EVD) which hit Liberia in 2014/2015. Again, if this were the case, we could have seen a surge in tax revenue beyond the Ebola year. As can be seen, tax revenue has been falling since 2016 to date. Based on this scenario, it is important to identify the causes of the perpetual decrease in tax revenue for the Liberian economy. Such a knowledge would give policymakers the edge to identify areas of priorities so as to bolster government revenue from the context of taxation. With this in mind, this study seeks to empirically identify the determinants of tax revenue performance in Liberia with the aim of providing recommendations for areas of policy improvement. It also contributes to the existing literature on factors influencing tax revenue performance in developing countries.

The rest of this study is structured as follow: section 2 presents the literature review; section 3 discusses the research methodology as well as the data types and sources, and estimation technique used. Section 4 contains the empirical results and analyses; while section 5 summarizes the entire paper and presents policy recommendations.

## **2. Literature Review**

Tax revenue is a strong component of total government revenue in many SSA countries of which Liberia is of no exception. However, these tax revenues are seemed not to be stable in many SSA or poor countries (i.e. Liberia). In the work of Abdixhiku *et al* (2017), fall in tax revenue is mainly due to tax evasions. And these tax evasions can be explained by two major set of variables: firm-level and institutional variables. The authors alluded firm-level variables to consist of factors such as the size of a firm (i.e. large or small), the sector in which the firm operates (i.e. formal or informal). And institutional variables consist of factors such as corruption perceptions, trust and trust worthiness in governance, rise in tax burden, etc. Using World Bank Business Environment and Enterprise Performance Survey data set for 12,692 firms within 26 transitioning economies, they found that tax evasive activities of firms are influenced by low trust in government, rise in corruption perceptions, and high compliance costs. Besides, smaller firms, individual businesses and firms in the informal sectors had a high probability of getting involved in tax evasion than other firms with the opposite characteristics. Similar finding was obtained by Batrancea *et al* (2019). Using experimental scenario data for 44 countries, they argue that trust in the governance system is a sure way to increase voluntary tax compliance amongst taxpayers. They also argue that some traditional tools like routine audits, fines and penalties be enforced as they have high likelihood of increasing tax compliance.

In an earlier study, Castro and Camarillo (2014) analyzed the determinants of tax revenue for 34 OECD countries. Using both static and dynamic panel data techniques on data set from 2001 to 2011; the authors found that GDP per capita, the industrial sector, and civil liberties positively influenced tax revenue; while factors such as agricultural sector, and the share of foreign direct investment in gross fixed capital formation negatively impacted tax revenue for the 34 OECD countries studied. Their findings suggest that broadening the tax base, improving the industrial sector as well as improving agricultural production (i.e. value addition) could serve as an impetus for tax revenue generation. The finding of Castro and Camarillo (2014) is in line with earlier work done by Bucker (2012), who found that broadening the tax base increases tax revenue.

Agbeyegbe et al (2006) conducting a study for 22 SSA countries from 1980 to 1996 and applying the generalized method of moments estimation technique, found that exchange rate (currency) depreciation and rising inflation have negative impact on tax revenue generation. In a state of high inflation, consumers' purchasing power is reduced. And because their purchasing power is low, they tend to conceal information on their income/wealth – thus evading taxes that should have been paid.

The recent literature is now giving huge attention to the 'trade liberalization and tax revenue' nexus. Whether liberalizing trade (i.e. reduction of tariff) will lead to rise in government revenue or not is still debatable. In the work of Cage and Gadenne (2018), they argue that trade liberalization has long run growth impact. But its impact on fiscal revenues is not certain, and may be based on the composition or state of the economy. Using data set for 130 countries between 1792 and 2006, they found that developing countries sustain more loss in fiscal revenues due to trade liberalization. But more gain is acquired by developed / high income countries in the long run. This is usually done by acquiring gains from other sources of revenue within the economy. These findings are in line with earlier work done by Baunsgaard and Keen (2005). The authors used panel data for 111 countries over 25 years. In order to know whether countries in their sample have recovered from other sources the revenues they have lost from past episodes of trade liberalization, they found that high-income countries have clearly done so; while middle-income countries have been in the order of 45–60 cents for each dollar lost in trade tax revenue. On the other hand, revenue recovery has been very weak in low-income countries, accounting for less than 30 cents of each lost dollar. These findings suggest that domestic resource mobilization is a sure way to substitute for the loss that would arise from trade liberalization.

### **3. Research Methodology**

As stated previously, tax revenue performance is *sine qua non* to many developing countries. As a result, several approaches have been formulated by different countries to ascertain the determinants of tax revenue performance. The deviations, stochastic frontier, and the behavioral approaches are well documented in the tax revenue literature as the three (3) leading approaches used to determine tax revenue performance. The behavioral approach, in particular, measures tax revenue performance by comparing actual tax collection to the potential tax revenue. Potential tax revenue is generated through regression analysis. Gaalya (2015) posits that tax revenue performance is driven by structural, institutional, external, demographic as well as macroeconomic factors. We investigate these factors using the commonly used approach, behavioral approach, proposed by Bahl (1972) and Chelliah, Baas and Kelly (1975). The behavioral approach also used by Gupta (2007), Hisali (2012) and Gaalya et al (2017), among others, regresses the dependent variable (i.e., tax revenue performance) on a set of explanatory variables that are likely to influence tax revenue performance either positively or negatively.

### 3.1 Model Specification

Based on the assumptions of the behavioral approach as stated above, we specify the functional form of tax revenue performance in Liberia as:

$$R_t = f(K_t) \tag{1}$$

Where:

- $R_t$  = Total Tax Revenue Performance
- $K_t$  = Vector of revenue performance handles
- $t$  = Time subscript

For ease of estimation, we rewrite equation (1) in an econometric form as follows:

$$R_t = \beta_0 + \beta_1 K_t + \varepsilon_t \tag{2}$$

Where:

- $R_t$  = Is the endogenous variable or total revenue performance
- $K_t$  = Vector of exogenous variables or revenue performance handles.
- $\beta_i$  = Parameter to be estimated
- $\varepsilon_t$  = Error term

We transform equation (2) into equation (3), where the endogenous and the exogenous variables are clearly defined. The tax revenue performance functions can therefore be specified as follows:

$$TAX\_REVENUE_t = \beta_0 + \beta_1 DOMESTIC_t + \beta_2 CUSTOMS_t + \beta_3 EXTERNAL_t + \beta_4 MACROECONOMIC_t + \beta_5 DEMOGRAPHIC_t + \varepsilon_t \tag{3}$$

Where:

- DOMESTIC* = Domestic tax revenue, including property tax, income and profit, and administrative fees, etc
- CUSTOMS* = Revenue from international trade, including import duties, excise and other taxes
- EXTERNAL* = Revenue from grants and loans
- MACROECONOMIC* = Macroeconomic factors such as inflation, exchange rate volatility and GDP growth
- DEMOGRAPHIC* = Demographic factors such as population growth
- $\beta_i$  = Parameter to be estimated
- $t$  = Time subscript
- $\varepsilon$  = Error term

For clarity and simplicity, we further transform equation (3) and decompose all the variables as seen in equation (4):

$$TAX\_REVENUE_t = \beta_0 + \beta_1 PROPERTY_t + \beta_2 INCOME\_PROFIT_t + \beta_3 GOODS\_SERVICES_t + \beta_4 PROPERTY\_INCOME_t + \beta_5 ADM\_FEES_t + \beta_6 IMPORT\_DUTIES_t + \beta_7 EXCISE_t + \beta_8 OTHER\_TAXES_t + \beta_9 GRANT_t + \beta_{10} LOAN_t + \beta_{11} GDP\_GROWTH_t + \beta_{12} INFLATION_t + \beta_{13} REER_t + \beta_{14} POPULATION\_GROWTH_t + \varepsilon_t \tag{4}$$

Where all variables are defined in Table 1;  $\beta_i$  = are the parameters to be estimated;  $t$  = time subscript; and  $\varepsilon$  = error term

**Table 1:** Variables and sources

<b>Variable</b>	<b>Definition</b>	<b>Source</b>
Tax_revenue	Total tax revenue generated from both direct and indirect taxes	LRA's TAS Database
Property	Revenue generated from real estate properties including land and buildings	LRA's TAS Database
Income_profits	Revenue generating largely from corporate income and personal income taxes	LRA's TAS Database
Goods_services	Goods and services tax including excise on domestic goods, sales and service taxes	LRA's TAS Database
Property_income	Dividends from NPA, LPRC, FDA, RIA and other sources	LRA's TAS Database
Adm_fees	Revenue mobilized from Administrative fees across sector ministries and agencies	LRA's TAS Database
Import_duties	Customs duties levied on imported commodities including petroleum products	LRA's TAS Database
Excise	Taxes levied on the importation of alcoholic beverages, tobacco products, etc.	LRA's TAS Database
Other taxes	social development contribution from agriculture and mining	LRA's TAS Database
Grant	Grants received from bilateral partners and multilateral institutions	LRA's TAS Database
Loan	Loans acquired from financial and multilateral institutions	LRA's TAS Database
GDP_Growth	Growth Rate of Gross Domestic Product	IMF Database (2019)
Inflation	Consumer price Index	CBL Quarterly Bulletin
REER	Real Effective Exchange Rate	CBL Quarterly Bulletin
Population_Growth	Rate of Population Growth	IMF Database (2019)

**Source:** Authors' Computation

**Note:** LRA is Liberia Revenue Authority; TAS is Tax Administration System; CBL is Central Bank of Liberia; IMF is International Monetary Fund

### **3.2 Data and type**

This study uses monthly time series data to explore the factors influencing tax revenue performance at the Liberia Revenue Authority. The data cover the period July 2014 to November 2019, for which data are available. Table 1 displays the variables, definitions and the various data sources.

### **3.3 Econometric techniques**

We estimated the baseline regression model in equation (4) using the following econometric techniques: Firstly, we used the Augmented Dicky-Fuller (ADF), Phillips-Peron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests for non-stationarity to determine the order of integration of the datasets used in this study. Secondly, we used the Johansen cointegration test which informs us of which estimation technique to select. Thirdly, we estimated the unrestricted cointegrating relation in equation (4) and conducted hypothesis testing. P-values, standard errors and t-statistics are used to determine the order of significance of the hypothesis tests. However, the results emanating from vector Autoregressive (VAR) or Vector Error Correction (VEC) model are difficult to interpret; we, therefore, used innovation accounting (such as Impulse Response Function and Variance Decomposition) to interpret our results. Finally, to ensure that the results are not spurious, we conducted various diagnostic tests (i.e., stability and Serial Correlation).

### **3.4 Unit Root Test**

When conducting time series analysis, it is important to check for the order of integration or stationarity properties of the variables to be estimated so as to avoid spurious regression. Spurious regression comes about when the coefficient of determination and test statistics are high and seem to be significant but the outputs are without any economic meaning (Granger and Newbold, 1974; Enders, 2014). With this in mind, we check for the stationarity of the variables by using the Augment Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests. In a case where the two tests produced conflicting results, we used the Kwiatkowski-Phillips Schmidt-Shin (KPSS) test to resolve the contradiction(s).

### **3.5 Cointegration test**

This study uses the maximum Likelihood estimators, proposed by Johansen (1988) to investigate the factors that drive (both long-run and short-run) tax revenue performances in Liberia. This approach circumvents the limitations that are encountered in the two-step approach suggested by Engle and Granger (1987); and can test and estimate in the presence of multiple cointegrating vectors. In addition, these tests afford researchers the opportunity to test restricted versions of the cointegrating vector(s) and the speed of adjustment parameters. The multivariate model can be generalized to allow for higher order autoregressive progress as follows:

$$\Delta Y_t = \Pi \Delta Y_t + \sum_{i=1}^{p-1} \Pi_i Y_{t-1} + U_t \quad (5)$$



where

$$\Pi = \left( I - \sum_{i=1}^p A_i \right) \text{ and } \Pi_i = - \sum_{j=i+1}^p A_j$$

From the above equation (5), the rank of matrix,  $\Pi$ , is equal to the number of independent cointegrating vectors. In an event where  $\Pi=0$ , the matrix is null and equation (5) is the usual vector autoregressive (VAR) model in first difference; if  $\Pi=n$ , the vector process is a unit root process, or in other words, it is non-stationary. If, in intermediate case,  $\Pi=1$ , then there is a single cointegrating vector and the expression  $Y_{t-1}$ , in equation (5) is the Error-Correction Term (ECM), which shows the speed of adjustment to long run equilibrium. Finally, if  $1 < \Pi < n$ , then there are multiple cointegration vectors.

Note; however, that the number of cointegrating vectors is equal to the number of characteristics roots that differ from zero. Therefore, checking the significance of the characteristic roots of  $\Pi$  is essential to determining the number of cointegrating vectors. To this end, two test statistics (trace and maximum eigenvalues) have been suggested. The two test statistics are as follow:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \tag{6}$$

$$\lambda_{max}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{7}$$

Where,  $\hat{\lambda}_i$  = the eigenvalues or the estimated values of the characteristic roots obtained from the estimated rank of matrix,  $\Pi$ , and  $T$  = number of observations usable. When the values of  $r$  are well-defined, these test statistics are known as  $\lambda_{trace}$  and  $\lambda_{max}$ . The latter test statistics tests the null hypothesis that the number of cointegrating vectors is less or equal to  $r$  against the alternative hypothesis of  $r + 1$  cointegrating vectors. It is worth noting that if the estimated value of the characteristic root is close to zero,  $\lambda_{max}$  will be small. The former test statistics test the null hypothesis that the number of cointegrating vectors is less or equal to  $r$  against the alternative hypothesis. In equation (7), the term  $\ln(1 - \hat{\lambda}_i)$  becomes more negative and the  $\lambda_{trace}$  gets larger, the further the estimated characteristics root is from zero. Monte Carlo is used to obtain the critical values of the  $\lambda_{trace}$  and  $\lambda_{max}$  statistics.

### 3.6 Impulse Response Function

The individual coefficients of the estimated VAR/VEC models are difficult to interpret; therefore, researchers and other practitioners are oftentimes interested in using “Innovative accounting” to interpret their results. To this end, we employed the Impulse Response Function (IRF) to analyze the determinants of tax revenue performance in Liberia.

Since this method is well documented and has been used by several researchers, we will provide only a brief information about its importance. The Impulse Response Function (IRF) traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables.

### ***3.7 Post estimation evaluation: Diagnostic checking***

We conducted post estimation evaluations to establish whether the estimated model mimic a white noise process. In so doing, the following diagnostic tests are carried out: characteristics' roots to determine model stability and Breuch-Godfrey LM test for serial correlation, respectively.

## **4.0 Empirical Results and Analyses**

### ***4.1 Descriptive Statistics***

Table 2 presents the descriptive statistics of the variables employed in this study. The table, in particular, displays the minimum, maximum, median, standard deviation, mean values and the total number of observations of each of the variables used in the analysis. As shown in the table, the data employed cover the period July 2014 to November 2019, indicating 77 observations for each variable. For the sample period, tax revenue registered an average value of US\$31.86M with a maximum value of US\$43.93M and a minimum value of US\$20.73M. Among the Domestic tax variables, Income and profits (income\_profits) recorded the highest average contribution to total revenue performance whereas Other\_taxes registered the lowest average contribution to total revenue performance.

**Table 2:** Descriptive Statistics

	<b>Obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Median</b>	<b>Maximum</b>	<b>Minimum</b>	<b>Skewness</b>	<b>Kurtosis</b>	<b>Jarque-Bera</b>	<b>Prob</b>
<b>Dependent variable</b>										
Tax_revenue	77	31867.19	5388.066	31534.95	43931.16	20738.64	0.268873	2.485759	1.776181	0.411441
<b>Domestic tax variables</b>										
Property	77	425.8379	322.3795	379.7418	1825.253	77.37371	1.692767	6.950089	86.83366	0.000000
Income_profits	77	12406.68	3894.866	12094.50	24535.82	119.7166	0.408468	4.337119	7.877334	0.019474
Goods_services	77	4165.012	1813.464	3526.646	11921.80	2213.251	1.904402	7.128330	101.2232	0.000000
Property_income	77	3768.853	2215.480	3409.055	11588.81	0.000000	0.976175	4.418970	18.68901	0.000087
Adm_fees	77	1255.445	305.9551	1200.954	2220.961	22.76573	-0.166719	6.073886	30.67153	0.000000
Other_taxes	77	524.1576	1518.748	0.005376	6850.000	0.000000	3.112269	11.64690	364.1898	0.000000
<b>Customs variables</b>										
Import_duties	77	7629.534	1283.664	7600.904	11117.75	5433.608	0.510182	3.081955	3.361884	0.186199
Excise	77	728.3228	259.2065	734.9279	1332.935	0.000000	0.085387	3.061685	0.105776	0.948486
<b>External sector variables</b>										
Grant	77	2461.286	6388.651	0.000000	31754.89	0.000000	3.415163	14.24085	555.0741	0.000000
Loan	77	3527.929	12643.02	0.000000	74267.23	0.000000	4.059479	19.54769	1090.010	0.000000
<b>Macroeconomic variables</b>										
GDP_growth	77	1.179221	2.534516	0.700000	8.800000	-1.6	1.951801	6.789903	94.97138	0.000000
Inflation	77	14.20299	7.827529	10.90000	31.32000	6.000000	0.923390	2.329533	12.38456	0.002045
REER	77	113.7194	37.38171	97.00000	210.4000	76.56000	1.146896	3.189137	16.99536	0.000204
<b>Demographic variable</b>										
Population_growth	77	4.270364	0.201324	4.243000	4.578000	3.942000	0.034923	1.817788	4.499700	0.105415

Source: Authors' computations

Similarly, for the customs variables, import duties, on average, outperformed excise in terms of their contributions to revenue performance at the Liberia Revenue Authority. In particular, for the study period, import duties recorded an average performance of US\$7.629M while excise recorded US\$0.728M.

We considered Grant and Loan as external contributions to total revenue. As shown in the table, on average, loans outpaced grants over the sample period, with loans recording a mean value of US\$3.527M and grants registering a mean value of US\$2.461M. GDP growth, inflation and Real Effective Rate of Exchange (REER) constitute our macroeconomic variables. For the sample period, GDP growth recorded a minimum value of -1.6 percent and a maximum value of 8.8 percent. The negative growth rate could be attributed to the Ebola Virus Disease which hit Liberia in 2014/2015, coupled with a drastic fall in the price of Iron Ore and Rubber at about the same time. It is important to stress that Iron Ore and Rubber are Liberia's key exportable commodities. The average rates for inflation and REER are 14.2% and 113.7L\$/1US\$ respectively. Inflation and REER also recorded a maximum and minimum values of 31.32% and 210.4 L\$/1US\$, and 6% and 76.56 L\$/1US\$ respectively. The large variations between the maximum and minimum values of inflation and exchange rate can be attributed to the unauthorized printing of Liberian Dollar banknotes in 2017 (Prowd, 2020) as well as a rise in trade deficit in recent years. Population growth is the only demographic factor considered in this study. During the sample period, Population recorded a minimum value of 3.942 million, a maximum value of 4.578 million and a mean value of 4.243 million.

#### ***4.2 Unit Root Test***

We employed Augmented Dickey Fuller (ADF) and Philips-Perron (PP) unit root tests to determine the stationarity properties of the variables used in this study. The ADF and PP test results are reported in Table 3 below. As shown in the table, all of the variables used have become I (1) series after first difference.

**Table 3: Unit root tests**

Variables	ADF test		PP test		Verdict
	Level	First difference	Level	First difference	
<b>Dependent variable</b>					
Tax_revenue	-0.725889	-7.545276***	-0.803959	-12.80350***	I(1)
<b>Domestic tax variables</b>					
Property	0.477586	-6.630783***	-1.555208	-8.830628***	I(1)
Income_profits	-0.874453	-6.918484***	-1.644034	-16.13168***	I(1)
Goods_services	-0.551716	-5.953044***	-1.132230	-18.61432***	I(1)
Property_income	-0.927595	-10.14238***	-2.639183	-32.91977***	I(1)
Adm_fees	-0.770714	-14.08553***	-1.042661	-16.58699***	I(1)
Other_taxes	-7.821953	-11.79793***	-7.821953	-26.75225***	I(1)
<b>Customs variables</b>					
Import_duties	-0.597618	-11.88996***	-0.687291	-12.03761***	I(1)
Excise	-0.864619	-9.824228***	-1.419838	-14.11160***	I(1)
<b>External sector variables</b>					
Grant	-8.116263	-7.210481***	-8.265069	-38.64637***	I(1)
Loan	-8.656055	-8.966598***	-8.666863	-54.46814***	I(1)
<b>Macroeconomic variables</b>					
GDP_growth	-3.353376	-8.637053***	-3.365023	-8.637050***	I(1)
Inflation	0.938473	-9.458673***	1.215135	-9.457653***	I(1)
REER	1.850305	-3.901886***	4.059607	-3.901886***	I(1)
<b>Demographic Variable</b>					
Population_growth	2.489185	-8.602325***	4.515204	-8.602325***	I(1)

**Note:** \*\*\* indicate rejection of null hypothesis at 1% significance level.

**Source:** Authors' computations based on dataset.

### **4.3 Cointegration Test Results**

We employed the Johansen Cointegration test to choose between the Vector Autoregressive (VAR) model and the Vector Error Correction Model (VECM) estimation techniques. The result of the cointegration test is reported in Table 4. As Shown in the table, from the Maximum Eigen value statistics, there are four (4) cointegrating equations among the variables, suggesting that the null hypothesis of at most four (4) cointegrating equations cannot be rejected. We, therefore, conclude that there is a long run relationship among the variables used in this study. Such a conclusion suggests that the VECM estimation technique is appropriate, especially since the cointegration equations are more than one.

**Table 4:** Johansen Cointegration Test (Max-Eigen Value)

<b>Hypothesized No. of E(s)</b>	<b>Eigenvalue</b>	<b>Max-Eigen Statistic</b>	<b>0.1 Critical Value</b>	<b>Prob.**</b>
None	0.928003	194.7036	-	-
At most 1	0.821867	127.6667	-	-
At most 2	0.748293	102.0823	-	-
At most 3 *	0.663958	80.69841	69.65642	0.0087
At most 4 *	0.637532	75.09656	63.72587	0.0074
At most 5	0.526478	55.31921	57.79720	0.1618
At most 6	0.449031	44.10973	51.85258	0.3955
At most 7	0.381362	35.53740	45.89363	0.5823
At most 8	0.328479	29.46754	39.90652	0.6268
At most 9	0.265039	22.78737	33.92711	0.7247
At most 10	0.245895	20.88452	27.91596	0.4658
At most 11	0.178940	14.58980	21.83670	0.5461
At most 12	0.143467	11.45986	15.71741	0.3442
At most 13	0.072470	5.567008	9.474804	0.4016
At most 14	0.000462	0.034210	2.976163	0.8797

**Source:** Authors' computations

### **4.4 Vector Error Correction Model**

The Johansen cointegration test performed in table 4 suggests that VECM is the appropriate model to estimate for this study. However, the results emanating from VECM are difficult to interpret. This is because its estimates are over-parameterized. As a result, the Impulse Response Function (IRF) and the Variance Decomposition have been suggested in most empirical analyses. We performed the IRF and the analysis can be found in the proceeding section.

### **4.5 Impulse Response Function (IRF)**

The IRF traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. In this study, the IRF analysis is carried out for only one variable of interest, which is tax revenue. In particular, we analyze how tax revenue responds to itself and a shock in any of the exogenous variables overtime. The IRF analysis is reported in figure 2, with the tabular analysis in the Appendix section.

As indicated in figure 2, there is an inconsistent trend in tax revenue from the short run to the long run. For example, a standard deviation shock in tax revenue causes tax revenue to decline sharply from period one to two before declining gradually in period three. Nevertheless, it improves in

period four and remains positive throughout. The inconsistency in tax revenue can be attributed to a host of factors including: tax evasion/avoidance, narrow tax base, corruption, little or no tax incentives, weak enforcement, and limited awareness and outreach.

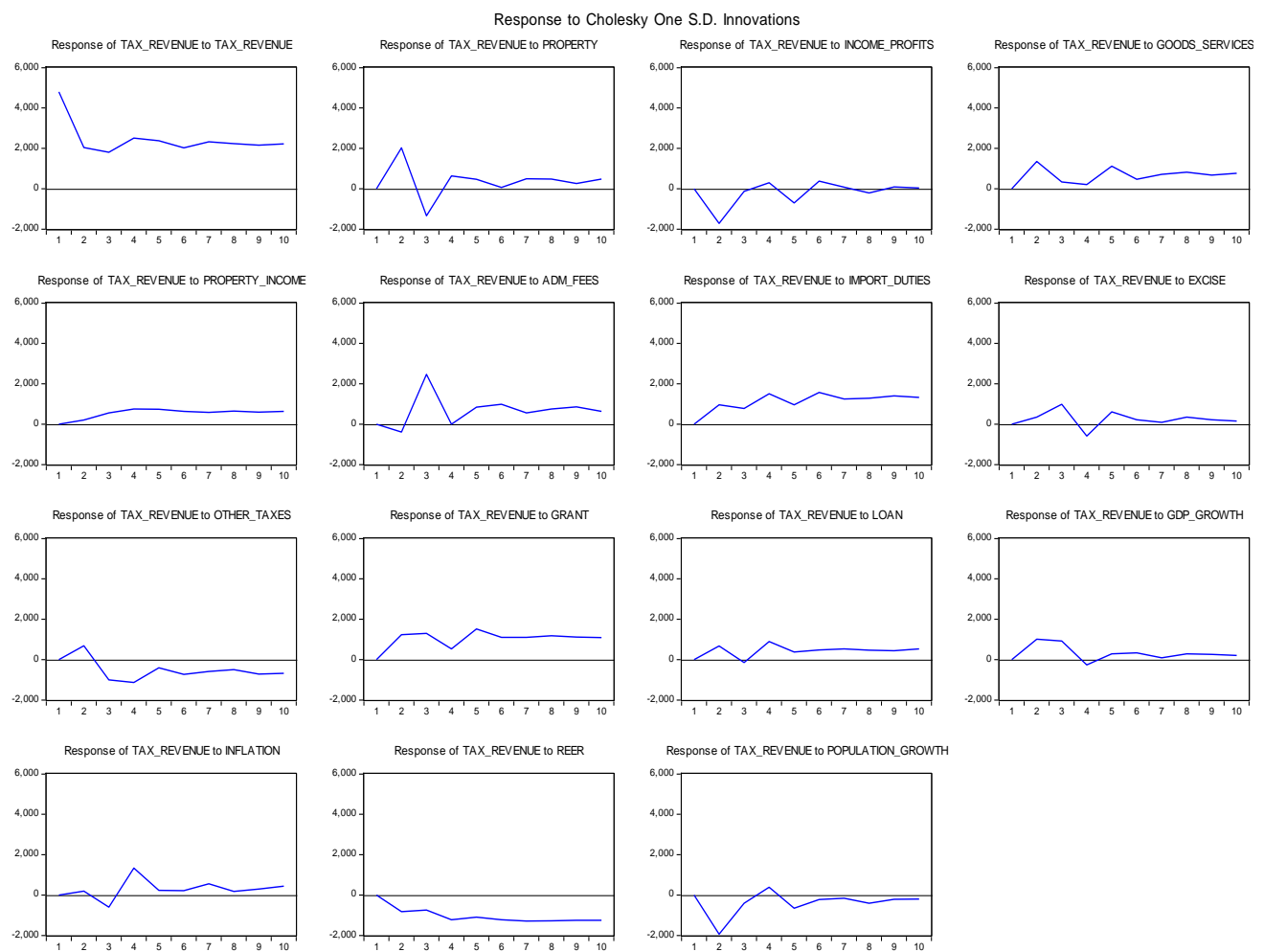
We furthered our analysis by examining the behavior or response of tax revenue over a ten-period interval when each of the exogenous variables is shocked. From domestic tax perspective, we investigate the response of tax revenue given a one standard deviation shock in property tax, taxes on income and profit, taxes on goods and service, property income, and administrative fees. The IRF results reveal that most of the domestic tax variables have great revenue potential. In particular, the results show that for a one standard deviation shock in Property tax, tax revenue responds by increasing sharply in period two. However, it registers a sharp, negative decline in period three, then improves in period four and remains positive overtime. The sharp fall in property tax could probably be attributed to the fact that most property owners are not yet captured in the tax net. This goes to mean that only a handful of property owners in the urban areas are captured within the property tax bracket. Additionally, even if property owners were captured in the tax bracket, their payment schemes are at times inconsistent. In some instances, property owners who paid taxes in previous years default on payment, say, in the current year. Nevertheless, property tax, according to the IRF graph, is likely to improve tax revenue especially in the long run. In this case, efforts to bolster property tax compliance should be enhanced by tax policymakers so as to improve overall tax revenue performance.

For income and profit, the IRF graph shows that a one standard deviation shock causes tax revenue to fluctuate in the short run, with mostly negative declines. However, it improves in the long run but still have marginal impact. Although unexpected, this result is not surprising. Evidently, Liberia is over-dependent on direct taxes compared to other taxes, which creates serious problems for the revenue authority especially due to the fact that it gives taxpayers more incentives to invade taxes. As a result of tax invasion/avoidance, the personal income tax (PIT) is levied on only a small number of taxpayers. Another probable reason for the unsurprising nature of the result is that, the Liberian economy has been under-performing in recent years. As a result, companies and other businesses have furloughed. In other words, those institutions' profit margins have reduced; and they have either laid off workers or shut down their establishments. In this case, the public sector is constrained to contribute more income tax than before. Policy wise, efforts that are geared towards strengthening the private sector should be prioritized; such as creating an enabling environment that attracts investors, improving the ease of doing business, etc.

Taxes on goods and services include, among others, excise tax on domestic goods, sale tax on goods, sale tax on services, motor vehicle taxes, and withholding revenue from maritime. The IRF graph shows that a one standard deviation shock of taxes on goods and services causes tax revenue to increase astronomically from period one to two but it nosedives in period three and four. Additionally, compared to period six and nine, tax revenue performs better in periods five, seven, eight and ten. Although tax revenue response displays an inconsistent pattern, it is positive throughout. This affirms that taxes on goods and services can be used to grow tax revenue. As such, policymakers should consider increasing GST or transitioning from GST to VAT, which is simple to implement and has more revenue mobilization potential than GST.

Turning our attention to property income, the IRF graph indicates that the response of tax revenue to a one standard deviation shock in property income is positive throughout, albeit with some fluctuations. Dividends from the Liberia Petroleum Refinery Company, Roberts International Airport, National Port Authority, Forestry Development Authority, GSM license fees, log and wood products export fees, withholding from mining, sale of assets, among others constitute property income. The finding suggests that when proper mechanisms are put in place to bolster property income, tax revenue performance will meaningfully improve in the short run as well as in the long run. Institutional capacity building for efficiency and effectiveness coupled with the institution of anti-corruption measures should be prioritized.

**Figure 2: Impulse Response Function Graphs**



Aside from period 2, the response of tax revenue to a one standard deviation shock in administrative fees is positive throughout, which is an indication that fees collected across sector ministries could increase revenue performance in the long run. This further suggests that when proper systems and control are instituted across sector ministries, more fees will be collected, and by extension, tax revenue will experience a surge.



Tax revenue responds positively to a one standard deviation shock in import duties from the short run to the long run. Here, import duties represent duties pay on the importation of petroleum products and goods (other than rice and ECOWAS trade levy). With such a positive response from tax revenue, increasing import duties could increase tax revenue significantly in both the short run and the long run. It is worth noting that in 2017, Liberia adopted ECOWAS 5-category common external tariff (CET) and abandon her own tariff structure. The decision to adopt the CET mandates Liberia to levy 0% import duties on basic social goods, 5% import duties on raw materials, capital goods and specific inputs, 10% import duties on intermediate goods, 20% import duties on final consumption goods and 35% import duties on specific goods for economic development. However, being mindful of the attended inflationary pressure associated with these rates, Liberia devised a five-year CET migration plan, splitting each of the latter four import duties rates into five broad rates for the five-year migration period. Currently, the country is implementing year two of the migration plan. This means that import duties rates can still be adjusted upward to spur tax revenue performance. However, the upward adjustment should be done with caution.

Besides period four, the response of tax revenue to a one standard deviation shock in excise tax is positive throughout. Although the key motive behind the imposition of excise tax is to restrict or discourage the importation and consumption of certain harmful commodities including alcohol and tobacco products; however, we find that excise tax has great revenue potential in Liberia. Therefore, policymakers should design effective ways of collecting excise tax (i.e. stamping of all excisable commodities at any port of entry).

A one standard deviation shock to other taxes (i.e. social development contribution from agriculture and mining), causes tax revenue to respond negatively overtime, reflecting that such taxes have no potential to grow tax revenue. Probable cause of this negative contribution could be attributed to the slump in world commodity prices in recent years. Given that world commodity prices are still very much low, the findings of this study suggest that, tax practitioners and policymakers should divert their energies elsewhere.

Tax revenue responds positively to a one standard deviation shock in both grant and loan. Although, for loan, in period 3, the response of tax revenue is negative. These findings imply that foreign aid increases tax revenue performance. The rationale is that foreign aid such as loan comes with repayment burdens; as a result, policymakers are constrained to mobilize higher taxes. These findings were anticipated and are well aligned with the studies of Gaalya et al (2017) and Brautigam (2000) who find that external revenue leads to tax revenue performance for developing countries.

Tax revenue responds positively to a one standard deviation shock in economic growth overtime, except for period four. The result implies that economic growth is a key driver of the level of tax revenue performance in Liberia. In other words, when the economy is performing well, tax revenue tends to perform better. The reverse holds true – that is, when the economy is performing poorly, tax revenue tends to decline. Policymakers should therefore institute appropriate fiscal and monetary policies instruments to grow the Liberian economy so as to spur domestic tax revenue. Also, tax authority should consider limiting taxes on economic factors that drive economic growth (i.e. investment).

The response of tax revenue to a one standard deviation shock in inflation is positive throughout except for period three. This finding implies that inflation<sup>1</sup> may increase tax revenue performance in the long run. The result is somewhat surprising, as it contradicts the Tanzi's effect. Tanzi's effect is an economic condition where a higher level of inflation depresses tax revenue performance. Notwithstanding, Friedman (1942) recognizes mild level of inflation as a tool for generating extra tax revenue.

For real exchange rate, tax revenue response is negative from period one to ten, reflecting that a depreciation of the Liberian dollar against the United States dollar, decreases tax revenue in the short run as well as in the long run. Consequently, policies geared toward exchange rate stabilization should be implemented by the monetary authority.

Tax revenue's response to a one standard deviation shock in population growth is negative, except for period four. This indicates that as the population grows, tax revenue declines. Probable reason accounting for this negative correlation could be that majority of the population is unemployed and without income. Even for those who are employed and earning incomes, their incomes are so low that their contribution to tax revenue is negligible. Thus, policymakers should consider high-quality job creation as a priority.

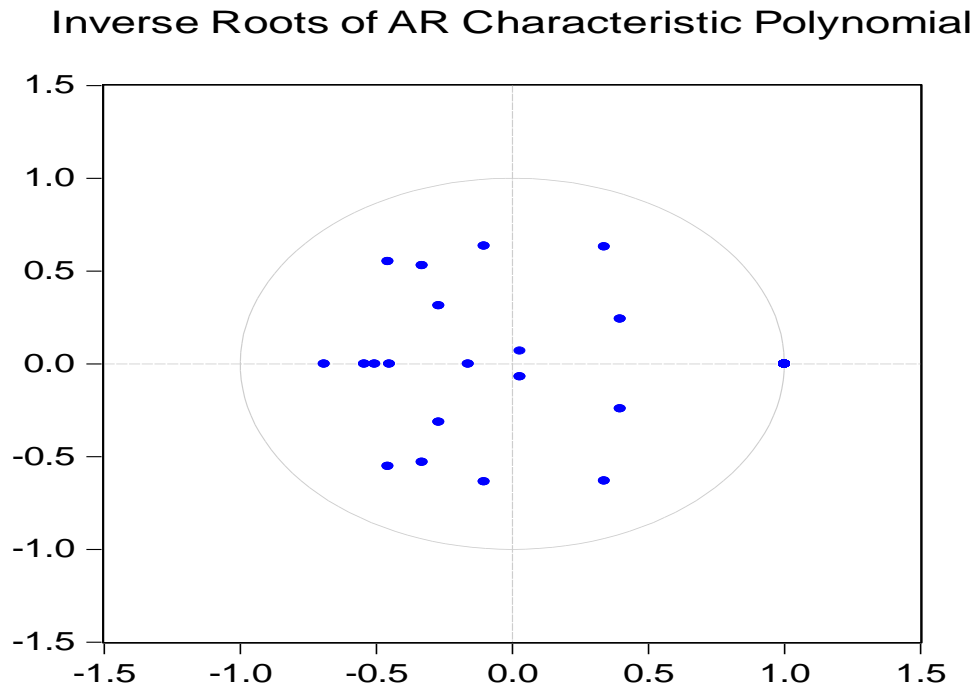
#### ***4.6 Model stability test***

To ensure that the results obtained from the Impulse Response Function are robust and reliable, it is important to examine the stability of the VEC model. We therefore performed the characteristics' roots test to determine model stability and the result is reported in figure 3. As indicated in the figure, all roots have moduli less than one and are confined inside the unit circle, suggesting that the model is stable. This further affirms that the results emanating from the model estimation are reliable and can be used for policy purposes.

---

<sup>1</sup> Creeping or mild inflation rate of around 2% has been identified by Economists to increase economic growth, which later improves tax revenue performance.

**Figure 3:** Inverse Roots of AR characteristic Polynomial



**4.7 Serial Correlation Test**

We performed a Lagrangian Multiplier (LM) serial correlation test to verify whether or not the residuals of the series are correlated with their past values – something which undermines the validity of the model estimates. The LM test results are reported in table 5. From the table, the null hypothesis of “no serial correlation at lag or h” cannot be rejection. Therefore, we conclude that the model passes the serial correlation test and it estimates are valid for policy purposes.

**Table 5:** VEC Residual Serial Correlation LM Test

Lags	LM-Stat	Prob
1	221.6139	0.5513
2	220.5716	0.5709
3	200.1852	0.8818
4	226.1671	0.4656

**5. Conclusion and policy recommendations**

**5.1 Conclusion**

Amid slow growth and lack of infrastructure and sufficient human capital, coupled with the growing demands for citizens’ needs, the need for the Liberian government to mobilize enough revenues is becoming increasingly important. To this end, we assess the determinants of tax revenue in Liberia with a broad goal of advancing salient commendations that would bolster tax

revenue mobilization. We garnered monthly time series data from the Liberia Revenue Authority's Tax Administration System (TAS) database, the Central Bank of Liberia Quarterly Bulletin and the World Economic Outlook (IMF Database). The data cover the period July 2014 to November 2019. To begin our analysis, we performed the ADF and PP unit root tests, and these tests' results showed that all of the variables were integrated of order one after first differencing. Furthermore, we performed the Johansen cointegration test and, with four cointegrating equations, the result showed that the VEC, rather than the VAR model, was appropriate for estimation. However, due to the overparameterization of the VEC model and the difficulties associated with the interpretation of its atheoretical coefficients, we performed the Impulse Response Function (IRF). The IRF results revealed that, in the long run, tax revenue responds positively to real property, income and profit, property income, goods and services tax, administrative fees, import duties, excise tax, grant, loan, inflation and GDP Growth. Conversely, tax revenue responds negatively to Other taxes, real exchange rate and Population Growth. To ensure that the results emanating from our estimation can be reliably considered for policy purposes, we carried out several post estimations tests, and their results showed that our findings are robust and highly reliable.

### ***5.2 Policy recommendations***

Given the findings of this study, we recommend the followings to the Government of Liberia, particularly the Liberia Revenue Authority:

- That the real property tax regime be expanded. Currently, the property tax regime is predominantly underutilized and so expanding it offers a great prospect of improving the narrowed tax base. As a precursor, though, staff of the property tax unit at the Liberia Revenue Authority should be properly trained in valuation, billing and collection;
- That Liberia over-reliance on direct tax (i.e., PIT and CIT) revenue be mitigated. This is because direct tax revenue is not always stable, as it is oftentimes easily avoided/evaded. Besides, it offers no incentives for investment and work, and given Liberia's low domestic investment levels and total factor productivity, over-reliance on direct taxation could be deleterious to tax revenue performance in the long run. To this end, we strongly recommend that revenue mobilization efforts be directed towards indirect taxation. In particular, we recommend the adoption of a VAT regime in the place of the current GST regime. GST is a single stage sales tax, which has low yields and is economically non-neutral – the higher the rate the higher the incentives to invade. The VAT is, on the other hand, levied on a broad base of producers and sellers and thus overcome most of the economic distortions associated with the GST. Besides, it leads to voluntary tax compliance;
- That the government, through the Liberia Revenue authority, launch a massive tax awareness campaign and community outreach programs, while at the same time instituting anti-corruption measures to ensure that government moneys do not end up in employees' pockets. On one hand, tax awareness comes with increased levels of tax compliance. On the other hand, massive tax awareness provides tax collectors with little or no incentives to be corrupt, because taxpayers tend to have all tax related information in their possession;

- That the Government of Liberia, through the state-owned enterprises (SOEs), enforce collection of revenue and provide budgetary support to the SOEs. In addition, to enhance efficiency and effectiveness, the weaknesses at these public institutions should be identified and addressed adequately. Our findings reveal that dividends from these institutions could increase revenue performance significantly;
- That the Liberia Revenue Authority, through its Customs Department, consider the use of excise stamp with strong security features to enhance excise tax compliance and to run an effective and efficient excise tax collection regime. In other words, all excisable products must be stamped at all ports of entry. However, the stamp should be extremely safeguarded, integrated and supported by examination procedures and systems. In addition, as our findings suggest, the LRA should consider the implementation of year three of the ECOWAS CET migration plan. However, to enhance efficient collection of import duties, ASYCUDA, an automated system that is presently being used by Customs mainly at the Freeport of Liberia and the Roberts International Airport, be rolled out to all ports of entry in the Republic.
- That the Government of Liberia, through the Liberia Electricity Corporation and the Ministry of Public Works, ensure the provision of stable electricity and construction of paved roads, which together serve as binding constraints to growth and economic transformation. In addition, the government should incentivize small and medium enterprises (SMEs) to enable them expand, create jobs for the unemployed youths and contribute significantly towards the revenue envelope;
- With loans and grants having a positive impact on tax revenue, we recommend that efforts to ensure that judicious use of external funds (i.e. loans and grants) be prioritized. If external funds are transparently and efficiently used, donors/lenders would be glad to give more; and these funds, in turn, positively impact revenue generation;
- That the Government of Liberia, through the Central Bank of Liberia, embark upon macroeconomic stabilization strategies. In particular, the CBL should pay special attention to the rate of exchange between the Liberia dollar and the US dollar. This is because our findings show that exchange rate volatility has severe negative consequences on tax revenue performance.

## References

- Abdixhiku, L., Krasniqi, B., Pugh, G., and Hashi, I. (2017). "Firm-level Determinants of Tax Evasion in Transition Economies". *Economic Systems*, 41 (3), 354-366
- Agbeyegbe, T.D., Stotsky, J., and WoldeMariam, A. (2006). "Trade Liberalization, Exchange Rate Changes, and Tax Revenue in Sub-Saharan Africa". *Journal of Asian Economics*, 17 : 261-284.
- Bahl, R.W. (1972). "Alternative Methods for Tax Revenue Forecasting in Developing Countries: A Conceptual Analysis". IMF Unpublished Paper.
- Batrancea, L., *et al.* (2019). "Trust and Power as Determinants of Tax Compliance Across 44 Nations". *Journal of Economic Psychology*, 74 , 1-15.
- Brautigam, D. (2000). "Aid Dependence and Governance". Almquist & Wiksell International, Stockholm.
- Bruckner, M. (2012). "An Instrumental Variables Approach to Estimating Tax Revenue Elasticities: Evidence from Sub-Saharan Africa". *Journal of Development Economics*, 98, 220-227.
- Bundgaard, T., and Keen, M. (2005). "Tax Revenue and (Or?) Trade Liberalization". IMF Working Paper. WP/05/112.
- Cage, J. and Gadenne, L. (2018). "Tax Revenues and the Fiscal Cost of Trade Liberalization, 1792-2006". *Explorations in Economic History*, 70, 1-24
- Castro, G.A., and Camarillo, D.B.R. (2014). "Determinants of Tax Revenue in OECD Countries over the Period 2001-2011". *Contaduría y Administración*, 59 (3):35-59.
- Chelliah, R.J., Baas, H.J. and Kelly, M.R. (1975). "Tax Ratios and Tax Effort in Developing Countries" 1969-71. IMF Staff Papers, 22, 187-205.
- Dewett, K.K. and Navalur, M.H.. (2010). "*Modern Economic Theory*". New Delhi: Shyam Lal Charitable Trust.
- Enders, W. (2014). *Applied Econometric Time Series* - 4th Edition. New York: John Wiley.
- Engle, F. and Granger, C. (1987). "Cointegration and Error Correction Representation: Estimation and Testing". *Econometrica*, Vol. 55.
- Friedman, M. (1942). "Discussing of Inflation Gap". *American Economic Review*, 32: 308-314.
- Gaalya, M. (2015). "Trade Liberalization and Tax Revenue Performance in Uganda". *Modern Economy*, 6, pp.228-244.
- Gaalya, M.S., Edward, B. and Hisali, E. (2017). "Trade Openness and Tax Revenue Performance in East African Countries". *Modern Economy*, 8, 690- 711.

- Granger, C.W.J., and Newbold, P. (1974). "Spurious Regressions in Econometrics". *Journal of Econometrics*, 2: pp.111-120.
- Gupta, A. (2007). "Determinants of Revenue Efforts in Developing Countries". IMF Working Papers, 1-39.
- Hisali, E. (2012). "Trade Policy Reform and International Trade Revenue in Uganda". *Economic Modelling*, 29, 2144-2154.
- Johansen, S. (1988). "Statistical Analysis of Cointegrating Vectors". *Journal of Economic Dynamics and Control*, 12, 231-254.
- Karagoz, K. (2013). "Determinant of Tax Revenue: Does Sectoral Composition Matter?" *Journal of Finance and Accounting*, 4(2).
- Lotz, J.R. and Morss, E.R. (1970). "A Theory of Tax Level Determinants for Developing Countries". *Economic Development and Cultural Change*, 18, 328-341.
- Md Amin, M.A. (2010). "Measuring the Performance of Customs Information Systems (CIS) in Malaysia". *World Customs Journal*, 4 (2): 89-103.
- Miskam, M., Noor, R.M., Omar, N. and Aziz, R.A. (2013). "Determinants of Tax Evasion on Imported Vehicles". *Procedia Economic and Finance*, 7: 205-212.
- Prowd, R.S. (2020). "Determinants of Inflation in Liberia: An empirical investigation using ARDL Bounds Testing Approach". *Journal of Economics and Sustainable Development ISSN-2222-1700 (Paper) ISSN 2222-2855 (Online)*, 11(6).
- Thanasegaran, H. and Shanmugam, B. (2007). "International Trade-based Money Laundering: The Malaysian Perspective". *Journal of Money Laundering Control*, 10 (4): 429-437.
- World Bank. (2019). "Liberia Domestic Revenue Mobilization Policy Notes". Washington DC 20433: World Bank.

**Appendix: Impulse Response Function Table**

<b>Pd</b>	<b>Tax revenue</b>	<b>Property</b>	<b>Income_ profits</b>	<b>Goods_ Services</b>	<b>Property _income</b>	<b>Adm_ fees</b>	<b>Import_ duties</b>	<b>Excise</b>	<b>Other_ taxes</b>	<b>Grant</b>	<b>Loan</b>	<b>Gdp_ growth</b>	<b>Inflation</b>	<b>Reer</b>	<b>Population _growth</b>
1	4801.89	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	2038.37	2023.06	-1722.65	1354.37	210.27	-390.21	963.27	353.36	690.5	1228.38	676.96	1010.87	192.30	-826.52	-1943.50
3	1799.18	-1339.84	-132.12	331.03	559.62	2472.8	774.26	980.57	-1008.08	1291.79	-141.22	916.13	-604.97	-739.057	-403.91
4	2506.08	629.11	301.71	206.85	746.84	1.17	1511.3	-594	-1139.5	531.70	890.61	-266.80	1332.16	-1223.06	382.73
5	2381.70	467.18	-699.35	1111.46	735.92	840.22	954.83	613.58	-407.66	1512.57	370.99	285.94	228.56	-1096.17	-655.33
6	2025.76	55.38	374.35	461.31	627.69	981.25	1568.34	213.55	-732.53	1096.13	474.68	338.34	218.2	-1232.50	-228.11
7	2322.13	495.73	68.96	717.97	577.87	553.98	1249.48	92.75	-583.35	1097.98	525.14	82.2	554.96	-1285.14	-152.9
8	2228.47	483.88	-216.26	820.87	642.35	748.09	1278.84	344.19	-503.27	1182.02	465.57	286.91	182.13	-1278.29	-403.63
9	2149.62	256.06	89.519	668.67	599.75	854.72	1395.7	223.36	-723.42	1120.02	432.54	254.89	296.64	-1246.31	-213.02
10	2220.55	480.62	30.45	757.91	639.05	630.74	1321.51	151.52	-677.13	1094.26	525.28	201.3	433.91	-1250.79	-195.19

**Source:** Authors' Computations based on dataset