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Effect of Exchange Rate Volatility on Tax Revenue Performance in Sub-Saharan Africa

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Abstract

Efforts to spur growth in sub-Sahara Africa have been intensified amid structural and institutional constraints. Tax revenue, the chief source of funding for developmental purposes in SSA remains low and unstable. In fact, the SSA sub-region finds it difficult generating tax revenue up to 20 per cent of GDP. One factor that has not caught the attention of policymakers in terms of its impact on tax revenue performance is exchange rate volatility. Using macrodata spanning 1984 to 2017 for 21 countries, we provide empirical evidence from a panel autoregressive distributed lag technique to show that exchange rate volatility is directly harmful to tax revenue performance, and indirectly through trade openness.

Key Words: Cointegration, Exchange Rate Volatility, GARCH, Sub-Sahara Africa, Tax Revenue

1.0 Introduction

Sustained economic growth remains the main goal of policymakers in both emerging and advanced countries. This is linked to the relevance and achievement of the Sustainable Development Goals (SDGs), which requires that the global economy grows at a rate of at least 3 per cent per annum. To realize the SDGs, both developed and developing countries require concerted efforts to generate enough resources for development. In fact, the World Bank and the International Monetary Fund (IMF) recognize that mobilizing adequate resources remain the backbone of SDGs, which generally seek to end poverty, lessen inequality and injustice as well as combat climate change by 2030 (OECD 2018). To this end, the role of taxation in developing countries like those in sub-Sahara Africa (SSA) has been emphasized as an instrument for sustained economic growth and development (De Paepe and Dickinson 2014).

Generally, since tax revenues are usually low, policymakers in SSA rely on foreign aid (official development and concessional loans) as well as miscellaneous sources such as seigniorage to fund developmental projects. It is for this reason that the 2002 Monterrey Consensus stressed the need to mobilize adequate resources domestically and internationally for development. For developing economies, long-term problems of debt sustainability associated with concessional loans, macroeconomic instability associated with seigniorage, and unreliable inflow of official development assistance mean that these economies are left with the options of improving tax revenue collection, or slowing down capital expenditure – the latter obviously with its own deleterious growth implications. For SSA, mobilizing adequate resources in the form of taxes is, thus, crucial for state building, the provision of public services, infrastructure development as well as the creation and reinforcement of 'fiscal social contract' between policymakers and citizens. For instance, the IMF recommends that developing countries raise the level of tax to-GDP to at

least 20 per cent (IMF 2018). Unfortunately, most of the countries in SSA still fall short of this target (De Paepe and Dickinson 2014). Information gleaned from the 2019 edition of OECD tax revenue statistics indicates that tax revenue performance in SSA rose marginally from 15 per cent of GDP in 2015 to only 15.1 per cent in 2018. This, clearly, is one of the lowest in the world – falling short of Latin America and the Caribbean (22.8%), the OECD (34.1%), Asia and Pacific (24%), Europe (37.2%), and the world (26.2%). The low revenue performance means that aid from donor countries will have to rise significantly if SSA is to achieve the SDGs. It is in the light of this that donor countries committed to increasing their official development assistance up to 0.7 per cent of their GDP (OECD 2014).

While policymakers in SSA can do little to change the structural drivers of tax revenue in the short-run, they can influence long-run tax revenue performance by revising economic policies, fighting corruption, and improving the efficiency of tax systems. The bottom-line is that SSA countries can improve their tax efforts or reduce tax revenue instability by tackling structural and institutional bottlenecks (see, Ebeke and Ehrhart 2012). If concerted efforts are not made to improve the tax systems in SSA, the implications could be dire. It can further impoverish the masses, and above all, hamper inclusive growth efforts as it limits policymakers' ability to allocate or redistribute resources equitably. A poor tax system can thus fuel poverty and inequality which entrenches the power of a narrow elite and sustain them in patterns of public policy and administration. In Figure 1, we present tax revenue-to-GDP across regions, putting the tax revenue performance of SSA into perspective.

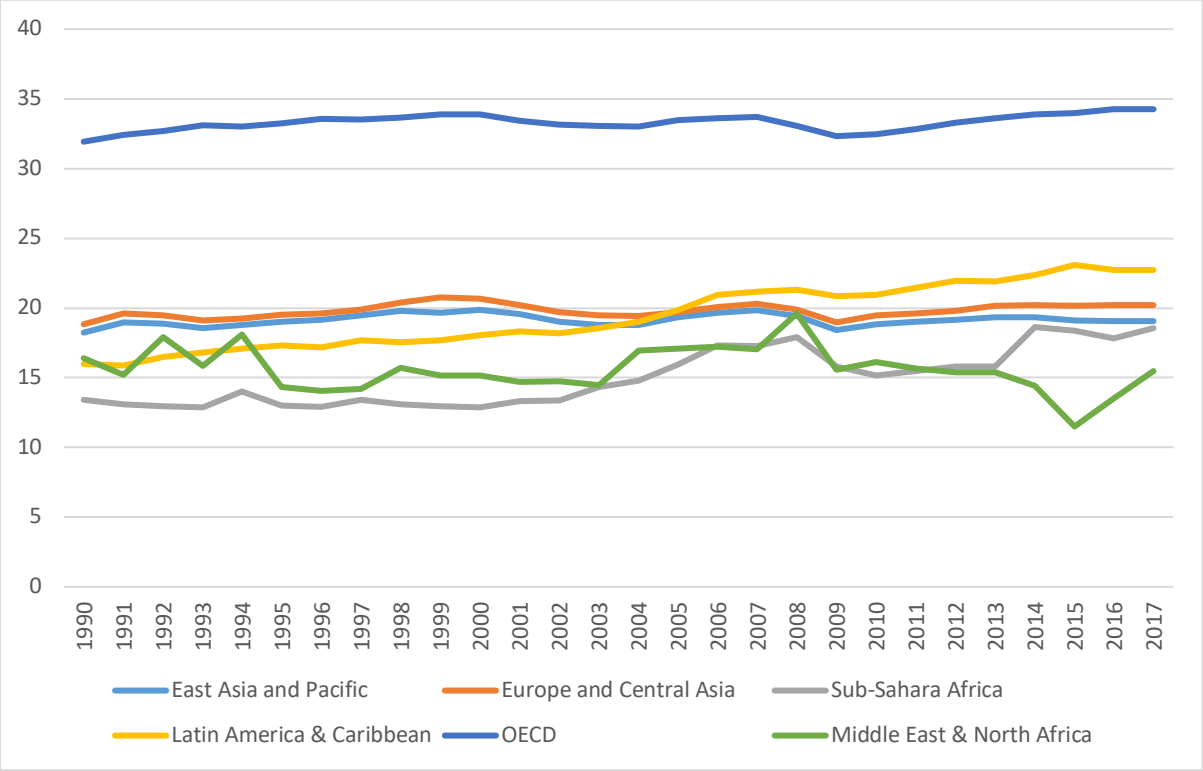

Figure 41.1: Trend of Tax Revenue (%GDP) by Region (1990 - 2017)

Source: Authors' construct based on International Monetary Fund, Government Finance Statistics Yearbook, and World Bank and OECD GDP estimates, 2020

Figure 1 shows that over the past decade, the only region SSA outperforms in terms of tax revenue mobilization is the Middle East and North Africa. It is also clear from Figure 1 that, since 2003, the SSA continues to remain within a performance range of 15.1 per cent and 16.8 per cent. This clearly shows a region with slow growth in tax revenue performance. The trend for SSA over the last two decades has not only been slow but unstable if compared to that of Europe and Central Asia, and the Latin America and Caribbean. Also, Figure 1 shows that, from 2003 to 2017, SSA falls short of the performance by the Latin America and Caribbean (LAC) by 2 percentage points. More revealing is the fact that the LAC is a region with similar structural and institutional settings as that of the SSA suggesting that there are a number of structural and institutional impediments that need to be streamlined. But what could be accounting for this low tax revenue performance

in SSA? In addition to the traditional drivers of tax revenue such as the depth of the informal sector, economic growth, trade, foreign aid, among others, we identify one macroeconomic issue, exchange rate volatility, that affects tax revenue generation in SSA but remains unexplored.

1.1 Exchange Rate Volatility and Tax Revenue in Sub-Saharan Africa

In SSA, some amount of tax revenue come from inter- and intra-regional trade. Among the key components of tax revenue (as a share of gross domestic product) is international trade taxes, which include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes. Theoretically, all these components of trade tax revenue are affected by trade policies – tariff and non-tariff policies. Aside these traditional factors affecting the flow of goods and services across borders is trade uncertainties. One of such uncertainties that has gained attention in the trade and finance literature in recent times is exchange rate volatility. Exchange rate volatility is the tendency of the real exchange rate to rise or fall sharply within a short period of time. This implies that exchange rate volatility can create uncertainty in macroeconomic policy formulation, investment decisions, and international trade flows. Evidence shows that for small open economies like those of SSA, the effect of exchange rate risk on trade is high (Obeng 2018; Wang and Barrett 2007; De Vita and Abbott 2004; Tchokote, Uche, and Agboola 2015).

Further, the effect of exchange rate volatility on trade can be direct (through uncertainty and adjustment costs), and indirect (through its effect on the structure of output, investment, and government policy). The effect is however, dependent on the degree of risk aversion of trade players. De Grauwe (1988) argues that for risk neutral trade players, exchange rate uncertainty does not affect their decisions. Even in the case of risk-averse trade players, theory does not allow one to conclude that exchange rate volatility leads to a reduction in cross-border trade as it depends on the magnitudes of the substitution and income effects. The former compels trade players to

reduce trade participation while the latter lowers the expected total utility from trade compelling commodity arbitrageurs to devote more resources to trade in order to make up for revenue losses (Ofori et al. 2018). For import-dependent economies like those of SSA, exchange rate volatility can thus reduce the tempo of economic activities causing firms to raise their prices. The move, more often than not, results in drop in sales making it difficult for firms to meet their tax obligations. In fact, most businesses collapse in the process or layoff workers leaving to dire consequences for the economy. In Figure 2, we present the average exchange rate volatility and tax revenue performance in SSA.

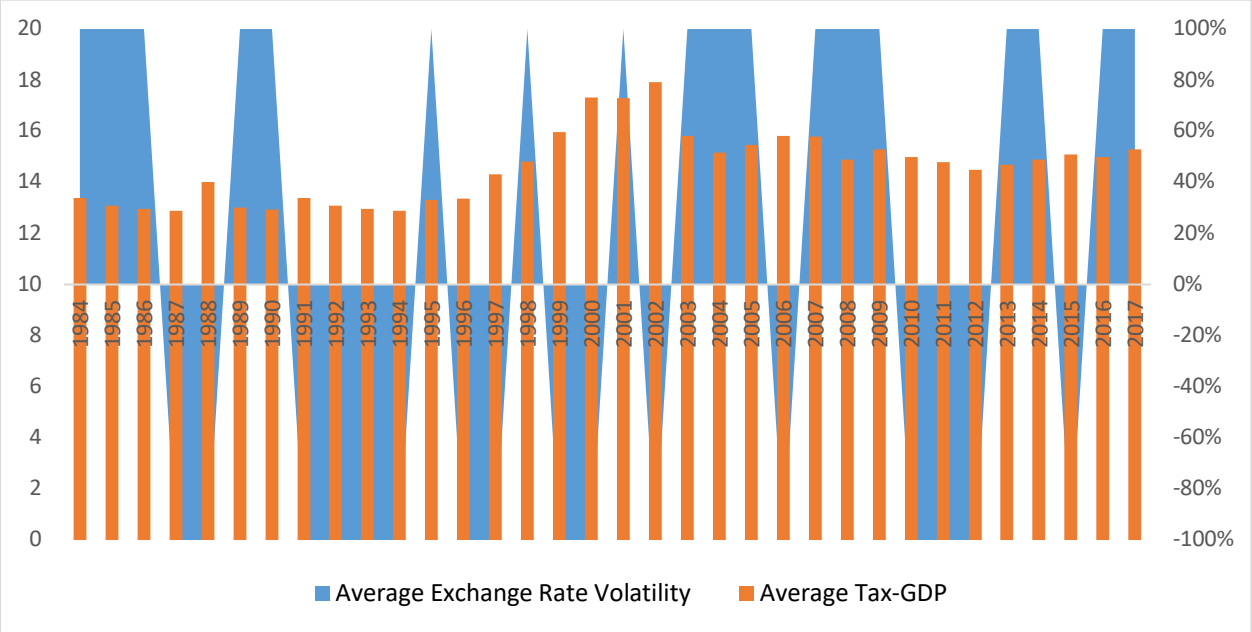

Figure 2: Trend of Average Exchange Rate Volatility and Tax Revenue (%GDP) in Sub-Saharan Africa (1984 – 2017)

Source: Authors' calculations based on International Financial Statistics database, 2020

It is evident from Figure 2 that from 1984 to 2002 where exchange rate volatility was downward –an indication of falling average risk, tax revenue rose steadily. Also, from 2003 to 2017 where

the average exchange rate volatility was largely high and persistent, tax revenue performance was generally low and unstable. This gives an indication of a possible drag effect from exchange rate volatility to tax revenue performance. This we reckon to be one of the ways in which SSA can raise tax revenue by 3-5 per cent of GDP (US$500 billion equivalent) as the IMF suggested in 2019.

1.2 Chapter Objectives

The implications of the substitution and income effects of exchange rate volatility on trade/investment means that exchange rate volatility can have both contemporaneous and long-term effects on tax revenue. We thus contribute to the literature on two counts: (1) by determining the direct effect of exchange rate volatility on tax revenue performance in SSA, and (2) by exploring the existence or otherwise of an indirect pathway through which exchange rate volatility affects tax revenue in SSA.

2.0 Literature Survey on Tax efforts and Tax Revenue Performance

The literature provides some important drivers of tax revenue in SSA. Among others, these drivers comprise structural factors (such as sectoral contribution to GDP, trade liberalization, inflation, foreign aid, government expenditure, foreign direct investment), and institutional factors (corruption, political instability/risk and democratic accountability) (see, Castaneda and Pardinas 2012). For instance, as Morrissey (2015) observes, a large proportion of aid to developing countries is given directly to the government either in the form of project-specific support or budgetary support. This underscores the direct impact of foreign aid on expenditure, taxation, and borrowing behavior of policymakers in SSA. The impact of aid on tax efforts is thus controversial

in that: (1) aid in the form development assistance/grants can reduce tax efforts as it is substituted for tax revenue generation (Thornton 2014); and (2) aid in the form of concessional loans induces greater tax efforts and fiscal management due to repayment conditions attached to it (see, Cordella and Ulku 2007; Benedek et al. 2014). On sectoral contribution to tax revenue performance in SSA, the literature shows that the agricultural sector hinders tax efforts as the sector is highly informal (Chaudhry and Munir 2010; Emran and Stiglitz 2005). However, the industrial and service sectors contribute favorably to tax efforts as companies usually keep records of their activities making it easier to tax. Furthermore, the level of economic development is often regarded as one of the main reasons SSA is unable to generate adequate revenues for development. There is empirical evidence that rising levels of per capita income – an indicator for economic development matters for tax revenue performance. Rising per capita income signifies improved capacity of the masses to spend which improves the capacity of the state to levy and collect taxes (Teera and Hudson 2004; Brafu-Insaidoo and Obeng 2008). Aside the traditional argument that foreign direct investment affects tax revenue efforts of developing economies, there is also the notion that trade liberalization depending on the form it takes can affect tax efforts (see, Zucman 2015). This stems from the argument that trade liberalization accelerates growth by enhancing productivity through the transfer of capital resulting in high employment and increased private spending (see, Ahmed and Muhammad 2010; Agbeyegbe et al. 2006). For instance, tax revenue may increase, provided that trade liberalization occurs through tariffication of quotas, eliminations of exemptions, reduction in tariff peaks, and improvement in customs procedure (Brafu-Insaidoo and Obeng 2008). Furthermore, liberalization in the form of tariff-cut can cause revenue losses on the one hand, but can also amount to an increase in the volume of imports and, hence, increased trade tax revenue on the other hand. A number of research has identified institutional factors such as corruption,

political risk, and democratic accountability as significant drivers of tax revenue generation (see, Bird et al. 2008; Garcia and von Haldenwang 2016). For instance, Garcia and von Haldenwang (2016) argue that political regimes matter for tax performance – with full autocracies and full democracies collecting significantly higher shares than political regimes located between both margins. Particularly, Baskaran and Bigsten (2013) provide evidence to show that, in SSA, democracy induces revenue generation efforts. One of the main impediments to tax efforts in SSA is widespread corruption which includes, but not limited to bribery, extortion, influence peddling, nepotism, fraud, and embezzlement (see, Klitgaard 1998; Chand and Moene 1997). There is a general consensus that a number of factors fuel fiscal corruption in SSA. These factors encompass complicated tax laws, undue discretionary power entrusted to tax administrators, the necessity for frequent contacts between taxpayers and tax officials, weak legal and judicial systems, lack of accountability and transparency in the tax administration, and low salaries in the public sector. This, in effect, incentivizes corrupt tax and custom officials who allocate a proportion of their working hours to: (1) collecting bribes in exchange for alleviating the tax burdens of taxpayers offering these bribes; and (2) complicating procedures for taxpayers who refuse to participate in the bribery scheme, thus, forcing them out of business, or into the informal sector. The end result is that investment is discouraged, economic growth is hampered while the tax base is weakened.

3.0 Methodology

3.1 Modeling Exchange Rate Volatility

Unlike some macroeconomic variables, exchange rate volatility is not directly observed over time. The literature offers techniques such as the moving average, the arithmetic deviation, the standard deviation, and the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) as ways of calculating exchange rate volatility. We opt for the GARCH (1,1) method put forward by

Bollerslev (1990) since it allows variances of errors in the real effective exchange rate to be time dependent. To do this, we model the GARCH (1,1) process with the mean equation allowing for changes in the real effective exchange rate to be dependent on its lagged value as seen in equation (1). The error term from the estimated mean equation is normally distributed with zero mean and variance, h_{it}. The GARCH (1,1) process is then specified with one ARCH term and one GARCH term (see, equation 2)

$$\Delta(ln\text{EXH})_{it} = c_1 + \beta\Delta(ln\text{EXH})_{i,t-1} + e_{it} \quad (1)$$

$e_{it} \approx N(0, h_{it})$

$$h_{it} = c_2 + \alpha_0 e_{i,t-1}^2 + \alpha_1 h_{i,t-1} \quad (2)$$

where: $\Delta(ln\text{EXH})$= log difference of the real effective exchange rate from period t to $t-1$

$h_{i,t}$ = variance of the error term, e_{it}, capturing volatility

$e_{i,t-1}^2$= the ARCH term.

$h_{i,t-1}$= the GARCH term.

The dependent variable, h_{it}, represents the conditional variance (volatility) while α_0 and α_1 represent the lagged squared error term (ARCH effect) and conditional volatility (GARCH effect) respectively.

3.2 Empirical Strategy

The empirical thrust of the chapter stems from the behavioral approach to tax revenue mobilization. The approach requires a number of preliminary tests – stationarity test, cross-sectional dependence test, and cointegration test. The essence of the cross-sectional dependence test is to ascertain whether the variables share similar developments across panels, providing the impetus to adopt one stationarity test or the other. Whereas the stationarity test is worthwhile as it provides evidence of the statistical properties of the series, the cointegration test provides evidence as to whether there is a cointegration among the variables. Turning our attention to the main

empirical strategy, we follow the behavioral approaches advanced by Ofori et al. (2018) and Gaalya (2015). We specify two bivariate panel models to establish the link between exchange rate volatility and tax revenue; and exchange rate volatility and trade tax revenue as seen in equations (3) and (4) respectively.

$$lnTR_{it} = \delta_0 + \delta_1 EXV_{it} + \varepsilon_{It} \quad (3)$$

$$lnTT_{it} = \beta_0 + \beta_1 EXV_{it} + \varepsilon_{It} \quad (4)$$

Where TT denotes trade tax revenue, EXV is exchange rate volatility, ε_{It} captures country-specific effect and the error term. TR is tax-to-GDP ratio, δ_0 and δ_1 are the intercept and slope coefficient of the tax revenue – exchange rate volatility equation while β_0 and β_1 capture the intercept and slope coefficient of the trade tax revenue – exchange rate volatility equation.

Next, in determining the effect of exchange rate volatility on tax revenue, we find the panel autoregressive distributed lag (ARDL) estimation technique appropriate on three counts. First, the technique is able to capture both short-run and long-run effects. Second, the technique is efficient with large cross-sectional and short time periods, usually more than 20 years. Third, the technique is appropriate irrespective of whether the underlying regressors are purely integrated at order zero or one. Following Pesaran et al.(2001a), we specify a heterogenous panel ARDL $(\rho, q_1 \ldots . q_k)$ model as seen in equation 5.

$$Y_{it} = \gamma_i + \sum_{j=1}^{\rho} \emptyset_{ij} Y_{i,t-j} + \sum_{j=0}^{q} \beta'_{ij} \, X_{i,t-j} + \varepsilon_{it} \quad (5)$$

where 'ρ' is the lag of the outcome variable and 'q' is the lags of the regressors; i = 1, 2, …., N is the number of cross-sections; t = 1, 2,.....,T captures the time dimension; X_{it} is $k \times 1$ vector of regressors; β'_{ij} is $k \times 1$ coefficient vectors; $\emptyset_{ij}$ is scalars; γ_i is the country-specific effect and ε_{it} is error term. The next step is re-parameterizing equation (5) into an error-correction form in

order to capture short-run to long-run speed of adjustment following a shock to (5) as seen in equation (6).

$$Y_{it} = \gamma_i + \alpha_i\left(y_{i,t-1} - \delta_i' X_{it}\right) + \sum_{j=1}^{\rho-1} \emptyset_{ij}^{*} \Delta Y_{i,t-j} + \sum_{j=0}^{q-1} \beta_{ij}'^{*} \Delta X_{i,t-j} + \mu_{it} \quad (6)$$

Where $\delta_i = \frac{\sum_{j=0}^{q} \beta_{ij}'}{1-\sum_{j=1}^{p} \emptyset_{ij}}$ and $\alpha_i = -(1 - 1 - \sum_{j=1}^{\rho} \emptyset_{ij})$. The term $\left(y_{i,t-1} - \delta_i' X_{it}\right)$ captures the long-run cointegrating relationship among the outcome variable and the regressors while Δ is the first difference operator. Also, δ_i captures the long-run elasticities with $\emptyset_{ij}^{*}$ and $\beta_{ij}'^{*}$ denoting the short-run elasticities of the lagged values of the outcome variable and regressors. For the sake of efficiency checks, we estimate our models based on the mean group (MG) and pooled mean group (PMG). First, we specify a baseline model on the drivers of tax revenue in SSA (see, equation 7). Finally, we specify the panel ARDL model on the hypothesised tax revenue – exchange rate volatility relationship as seen in equation 8.

$$\Delta lnTR_{it} = \alpha_i\left(lnTR_{i,t-1} - \delta_{0i} - \delta_{1i} lnGPC_{it} + \delta_{2i} INF_{it} - \delta_{3i} OPEN_{it} - \delta_{4i} AGRIC_{it} - \delta_{5i} lnFDI_{it} - \delta_{6i} lnAID_{it}\right) + \beta_{1i} lnGPC_{it} + \beta_{2i} lnINF_{it} + \beta_{3i} lnOPEN_{it} + \beta_{4i} lnAGRIC_{it} + \beta_{5i} lnFDI_{it} + \beta_{6i} lnAID_{it} + \varepsilon_{it} \quad (7)$$

$$\Delta lnTR_{it} = \alpha_i\left(lnTR_{i,t-1} - \delta_{0i} - \delta_{1i} lnGPC_{it} + \delta_{2i} INF_{it} - \delta_{3i} OPEN_{it} - \delta_{4i} AGRIC_{it} - \delta_{5i} lnFDI_{it} - \delta_{6i} EXV_{it} - \delta_{7i} EXV * lnOPEN_{it}\right) + \beta_{1i} lnGPC_{it} + \beta_{2i} lnINF_{it} + \beta_{3i} lnOPEN_{it} + \beta_{4i} lnAGRIC_{it} + \beta_{5i} lnFDI_{it} + +\beta_{5i} lnAID_{it} + \beta_{6i} EXV_{it} + \beta_{7i} EXV_{it} * lnOPEN_{it} + \varepsilon_{it} \quad (8)$$

Where *TR* = Tax-to-GDP ratio; *GPC* = GDP per capita; *INF* = inflation; *AGRIC* = agricultural sector's contribution to GDP; *FDI* is foreign direct investment; *AID* is foreign aid; *EXV* is exchange rate volatility; *(EXV*lnOPEN)* is exchange rate volatility and trade openness interaction. Also, δ_{1i} , δ_{2i} , δ_{3i} , δ_{4i} ,δ_{5i} , δ_{6i} and δ_{7i} measure long-run elasticities; $\beta_{1i,}$ δ_{2i} , $\beta_{3i,}$ β_{4i} , $\beta_{5i,}$

β_{6i} and β_{7i} measure the contemporaneous elasticities; while δ_{0i} and ε_{it} capture country-specific intercepts and error term respectively.

3.3 Variable Description, Justification and Data Sources

Based on theoretical and empirical evidence, we use macrodata for the analyses. The chapter covers 21 SSA countries over a period spanning 33 years (1984 – 2017). The outcome variable, tax-to-GDP, is measured as the overall central government tax revenue as a ratio of GDP. The variable of interest, exchange rate volatility, is generated. With the control variables, we consider trade openness since substantial flow of goods and services across borders are taxed. Trade openness is captured as the ratio of the sum of export and import to GDP (Gupta 2007). Similarly, per capita income matters for tax revenue as it suggests rising economic wellbeing of the populace which improves the central government's capacity to levy and collect taxes (Chelliah 1971). Per capita income is measured as the ratio of national income to overall population at 2011 purchasing power parity. One of the controversial ways of generating revenue has to do with inflation tax. In low income countries, seigniorage is sometimes used to raise revenue for developmental purposes. This move puts the working class into an illusionary high-income group benefiting central governments of inflation tax (see, Alavirad 2004). We capture inflation as the end-of-period consumer price index. Further, we control for the real sector of the economies in question as the growth of the service and industrial sectors are favorable to tax efforts since by law, firms keep records of their activities as compared to the agricultural sector which is largely subsistence (Karagöz 2013; Baunsgaard and Keen 2010; Teera and Hudson 2004). We use the share of agricultural sector in GDP to control for the economic structure of the study area. Also, as Franco-Rodriguez et al. (1998) and Mahdavi (2008) argue, foreign aid can reduce tax efforts as it can be

substituted for tax revenue therefore its inclusion in the models. Foreign aid is captured as net official development assistance inflows ($ billions). Also, foreign direct investment can boost the productive capacity of recipient countries and consequently tax revenue efforts (see, Reynolds and Wier 2016; Zucman 2015). Foreign direct investment is measured as net inflow of direct investment as a ratio of GDP.

4.0 Results and Discussions

4.1 Summary Statistics

The presentation of the result starts with summary statistics, followed by the preliminary tests for stationarity, cointegration, and cross-sectional dependence. The summary statistics gives perspectives to the location and variability of the data (see, Table 1). For instance, the average tax-to-GDP ratio of SSA is a modest 16.9 per cent. Also, the average GDP per capita measured at 2011 purchasing power parity is US$2283.8. Further, the data shows that in SSA, the average net official development assistant amounts to $ 6.49 trillion while the sectoral contributions of agriculture to GDP stands at 25 per cent.

Table 1: Summary Statistics of Variables, 1984 - 2017

Variable	Obs	Mean	Std. Dev	Minimum	Maximum
Tax Revenue	693	16.942	8.567	0. 905	58.407
GDP Per Capita	693	2283.811	3297.985	193.861	20333.941
Agricultural Sector	693	25.003	16.412	0.891	79.042
Foreign Aid	693	6.490	8.400	-1.450	11.40
Inflation	693	46.333	920.367	-35.836	24411.037
Trade Openness	693	79.474	42.106	20.964	351.105
Trade Taxes	693	0.355	0.522	-0.943	3.569
Exchange Rate Volatility	693	-0.002	0.187	-1.372	1.922
Foreign Direct Investment	693	3.626	9.092	-28.624	161.821

Note: Std. Dev refers to Standard Deviation.
Source: Authors' Construct Based on Data from the International Financial Statistics and World Development Indicators, 2020.

4.2 Evidence of Real Exchange Rate Volatility in Sub-Sahara Africa

In Table 2, we provide evidence of the presence of exchange rate volatility in SSA via the GARCH (1, 1) technique. The magnitude of the ARCH and GARCH terms add up to 1 suggesting high levels of volatility in the sub-region. Finally, with ARCH LM test statistics of 0.189 and p-value of 0.671, we show the absence of serial correlation in the residuals of the real effective exchange rate series.

Table 2: Evidence of Exchange Rate Volatility in Sub-Sahara Africa (1984 – 2017)

	Coefficient	Standard Error	Z-score
ARCH (1)	0.701***	0.055	12.522
GARCH (1)	0 .355***	0.013	25.957
Constant	1.209***	0 .123	9.819
ARCH (1) + GARCH (1)	1.056		

Note: Three asterisks (***) denotes 1% significance level. ARCH refers to Autoregressive Conditional Heteroskedasticity while GARCH denotes Generalized Autoregressive Conditional Heteroskedasticity.

4.3 Cross-Sectional Dependence Test Results

As advised by Pesaran (2004), we first test for cross-sectional dependence among the variables to determine whether the variables share similar developments in the SSA. There is strong empirical evidence to show that on a whole, the variables exhibit similar developments (see, Table 3). This suggests that shocks to these variables, for instance, instability in aid, would possibly have similar impacts in all the economies in this chapter.

	CD-Test Statistics	Correlation	Abs (Correlation)
Tax Revenue	4.496***	0.053	0.363
Gross Domestic Product Per Capita	6.072***	0.072	0.175
Inflation	54.327***	0.644	0.750
Trade Openness	11.323***	0.134	0.380

Agriculture	27.625***	0.327	0.513
Exchange Rate volatility	13.728***	0.162	0.680

Table 3: Results for Cross-Sectional Dependence Test in Sub-Sahara Africa, 1984 – 2017

Note: A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. H_0: cross-sectional independence among panel units against H_1: cross-sectional dependence among panel units. CD is Cross-sectional Dependence; Abs which computes the average absolute value of the off-diagonal elements of the cross-sectional correlation matrix of the residuals

4.4 Panel Unit Root Test Results

Per the results of the cross-sectional dependence test, we rely on the second generational unit root tests such as Cross-Sectionally Augmented Dickey Fuller (CADF) and Cross-Sectionally Augmented Im Pesaran (CIPS) tests to ascertain: (1) the stationarity properties of the variables; and (2), establish the absence of I(2) variables. This is essential as it establishes whether the panel ARDL technique can be applied.

Table 4: Unit Root Test Results for the Variables at Levels

Variables	Constant		Constant and Trend	
	CADF (Z-t-bar)	CIPS	CADF (Z-t-bar)	CIPS
Tax Revenue	-0.179	-2.293**	0.508	-2.526
GDP Per Capita	-7.432***	-4.280***	-6.141***	-4.524***
Inflation	6.084	-1.310	3.508	-2.211
Trade Openness	1.087	-1.667	0.414	-2.271
Agriculture	-2.453***	-2.363**	-1.747**	-2.771**
Foreign Direct Investment	-2.721***	-3.243***	-3.044***	-4.065***
Foreign Aid	-5.003***	-3.359***	-4.190***	-3.626***
Exchange Rate Volatility	3.233	-0.843	4.390	-1.313

A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. Both CADF & CIPS test the H_0: All panels contain unit root against H_1: Some panels are stationary. CADF means Cross-sectionally Augmented Dickey–Fuller while CIPS refers to Cross-sectionally Augmented Im Pesaran Shin.

Table 5: Unit Root Test Results for the Variables at First Difference

Variables	Constant	Constant and Trend

	CADF (Z-t-bar)	CIPS	CADF (Z-t-bar)	CIPS
Tax-to- Gross Domestic Product	-10.443***	-5.517***	-7.814***	-5.543***
Gross Domestic Product Per Capita	-17.859***	-6.146***	-16.600	-6.358***
Inflation	-5.500***	-4.311***	-4.154***	-4.564***
Trade Openness	-11.314***	-5.756***	-9.505***	-5.883***
Agriculture	-13.511***	-5.463***	-12.026***	-5.535***
Foreign Direct Investment	-14.846***	-5.985***	-12.982***	-6.145***
Foreign Aid	-12.519***	-5.958***	-10.200***	-6.078***
Exchange Rate Volatility	-2.413***	-2.847***	-1.194	-3.124***

A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. Both CADF & CIPS test the H_0: all panels contain unit root against H_1: Some panels are stationary. CADF means Cross-sectionally Augmented Dickey–Fuller while CIPS refers to Cross-sectionally Augmented Im Pesaran Shin.

The results from the stationarity tests at levels and first difference are reported in Tables 5 and 6 respectively. But for inflation, trade openness, and exchange rate volatility, all the variables are stationary at levels. However, after first difference, all the variables containing unit root become stationary. This suggests that the variables are only integrated at levels or first difference. The absence of I(2) variables means that the Panel ARDL technique can be applied.

4.5 Panel Cointegration Test Results

To establish whether there is cointegration among the variables, we apply the Westerlund (2007) cointegration test. The strength of this test is that, it allows for heterogeneous vectors and hence, do not impose a common-restriction factor. More importantly, the test is normally distributed and accommodative of unit specific short-run dynamics, trend, slope parameters and cross-sectional dependence. The Westerlund (2007) test of cointegration relies on the group mean and panel statistics from the cross-section. The group mean statistics ($G\tau$ and Gα) test the alternative hypothesis of cointegration for at least one cross-sectional unit in the panel whereas the panel

statistics ($P\tau$ and Pα) tests the alternative hypothesis of cointegration for the whole cross-section. Table 6 reports the results of the panel cointegration test.

Table 6: Westerlund Cointegration Test Results for Cointegration in the Series

Cointegration Statistics	Values	Z-value
$G\tau$	-2.633*	-1.505
Gα	-7.735	2.882
$P\tau$	-12.740***	-3.499
Pα	-11.220**	-1.710

Note: A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. $G\tau$ and Gα are group mean statistics while $P\tau$ and Pα refer to panel

Results from Table 6 is premised on the null hypotheses of no cointegration among the variables from both the group mean and panel statistics. However, it is evident from the level of significance that there is strong cointegration among the variables.

4.6 Baseline Results on Drivers of Tax Revenue in Sub-Sahara Africa

The interpretation of the baseline results in Table 7 is based on the Hausman (1978) test on the efficiency of the MG and PMG estimates.

Table 7: Baseline Results on Drivers of Tax Revenue in Sub-Saharan Africa (1984 – 2017). [Dependent Variable: ln (Tax-to- Gross Domestic Product)]

Variables	*MG* *Tax-to-GDP* (SR)	*MG* *Tax-to-GDP* (LR)	*PMG* *Tax-to-GDP* (SR)	*PMG* *Tax-to-GDP* (LR)
Gross Domestic Product Per Capita	0.094	0.201	0.048	0.106***
	(0 .061)	(0.130)	(0.054)	(0.035)
Trade Openness	0 .046*	–0.053	–0.487	0.034***
	(0 .023)	(0.087)	(0.502)	(0.008)
Foreign Aid	–0.662	–1.427	0. 046***	–1.080***
	(0.785)	(2.137)	(0.016)	(0.351)
Inflation	0.048	0.052	–0.032	–0.023***
	(0.041)	(0.055)	(0.042)	(0.007)
Agricultural Sector	–0.035	–0.298	–0.009	–0.213***
	(0.078)	(0.258)	(0.081)	(0.065)
Foreign Direct Investment	–0.283	0.210	–0.312*	–0.085***
	(0.219)	(0. .292)	(0.156)	(0.032)
Exchange Rate Volatility	–	–	–	–
*Exchange Rate Volatility*Trade Openness*	–	–	–	–
Error Correction Term	–0.523***	–	–0.210***	–
	(0.061)		(0.039)	
Constant	8.449	–	8.336***	–
	(9.587)		(1.747)	
Number of Panels	20	20	20	20
Hausman X^2statistic			1.161	
[P-value]			0.884	

Note: All variables with the exception of exchange rate volatility are measured in natural logs. Values in parenthesis are standard errors. A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. MG is Mean Group; PMG is Panel Mean Group; SR is Short-run, and LR is Long-Run

We find that the growth of SSA economies proxied by per capita income induces tax revenue performance both in the short-run and long-run. The result is however, only significant in the long-run. The result shows that a 1 per cent increase in per capita income improves tax revenue performance by 0.1 per cent. The finding supports the argument by Gupta (2007) and Brafu-Insaidoo and Obeng (2008) that economic growth improves the capacity of the populace to spend

and thus the capacity of policymakers to levy and collect taxes. Further, there is evidence that in SSA, trade openness reduces tax revenue performance in the short-run while it improves tax revenue mobilization in the long-run. Intuitively, tax revenue performance falls in the short-run following the removal of tariffs however, in the long-run, tax revenue performance increases due to improved tax revenue receipts from indirect taxes (see, Gupta 2007). In addition, we show that foreign aid is harmful to tax revenue generation in SSA in both the short-run and long-run implying that development assistance is used as a substitute for tax revenue in SSA (see, Bird et al. 2008; Gupta 2007). As expected, inflation proved favorable to tax revenue performance in SSA. There is empirical evidence that in the long-run, a 1 per cent increase in inflation levels improves revenue generation by 0.02 per cent. Raising tax revenue through seigniorage is not surprising in developing economies where fiscal authorities exercise domineering powers over monetary authorities. However, the macroeconomic instability associated with this approach makes it an uneconomical way of generating revenue. Also, in conformity with our apriori expectation, we find that the agricultural sector supresses tax revenue generation both in the short-run and long-run. The predominant informal agricultural sector of SSA is difficult to tax as records of activities are not usually kept (Chaudhry and Munir 2010; Gupta 2007). Moreover, there is empirical evidence to show that the short-run and long-run effects of foreign direct investment on tax revenue mobilization in SSA is negative. The effect is however pronounced in the short-run relative to the long-run. Overall, there is a 20 per cent adjustment speed towards long-run equilibrium following a shock to the model.

4.7 Bivariate Results

The essence of the bivariate estimation is to show if there is empirical evidence that exchange rate volatility is deleterious to tax revenue performance.

Table 8: Bivariate Results on Effect of Exchange Rate Volatility on Tax (%GDP), and Trade Taxes

[Dependent Variable in (1) & (2): ln (Trade Tax-to-Gross Domestic Product)]

[Dependent Variable in (3) & (4): ln (Tax-to-Gross Domestic Product)]

Variables	*Trade Taxes* SR	*Trade Taxes* LR	*Tax-to-GDP* SR	*Tax-to-GDP* LR
Exchange Rate Volatility	-0.163***	-0.168***	-0.382***	-0.351***
	(0.047)	(0.047)	(0.089)	(0.089)
Constant	3.325***	3.350***	4.432***	4.278***
	(0.227)	(0.238)	(0.424)	(0.436)
Observations	693	693	693	693
Hausman	25.73		25.20	
Prob > F	0.000		0.000	
Number of Panel	*20*	*20*	*20*	*20*

Note: A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. SR is Short-run while LR is Long-Run

The results show a strong negative effect of exchange rate volatility on both trade tax revenue and overall tax revenue in SSA. The effect is however pronounced on overall tax revenue than it is on trade tax revenue.

4.7.1 Contemporaneous Effect of Exchange Rate Volatility on Tax Revenue in SSA

The short-run results show that exchange rate volatility is detrimental to tax revenue performance (see, Table 9). The result has both theoretical and empirical justification. Theoretically, exchange rate volatility can cause risk-averse international trade players to reduce the volume of transaction thereby causing revenue shortfalls.

Table 9: Main Results on Effect of Exchange Rate Volatility on Tax Revenue in Sub-Saharan Africa. [Dependent Variable: ln (Tax-to- Gross Domestic Product)]

Variables	*MG* *Tax-to-GDP* (SR)	*MG* *Tax-to-GDP* (LR)	*PMG* *Tax-to-GDP* (SR)	*PMG* *Tax-to-GDP* (LR)
Gross Domestic Product Per Capita	0.076	0.761	0.048	0.043***
	(0.080)	(0 .582)	(0.054)	(0.014)
Trade Openness	0 .069*	–0. 027	–0.487	–0.138**
	(0.041)	(0. 094)	(0.502)	(0.067)
Foreign Aid	–1.059	1.898	–0.369	–0. 108
	(1.059)	(24.897)	(0.489)	(0. 086)
Inflation	0.163*	0.113*	0.032	0.085***
	(0.066)	(0.066)	(0.042)	(0.012)
Agricultural Sector	–0.073	0.366	–0.009	–0.098***
	(0.075)	(1.249)	(0.081)	(0.0461)
Foreign Direct Investment	–0.364*	–0.164	–0.313*	–0.049***
	(0.205)	(0.364)	(0.156)	(0.013)
Exchange Rate Volatility	–1.823	–1.516	–2.114**	–6.498*
	(6.873)	(1.136)	(4.641)	(0.486)
*Exchange Rate Volatility*Trade Openness*	–0.060	2.229	0.111	0.038***
	(0.142)	(1.448)	(0.106)	(0.016)
Error Correction Term	–0.194	–0.194	–0.107**	–
	(0.155)	(0.155)	(0.046)	–
Constant	20.923		4.204**	
	(13.153)	–	(2.009)	–
		–		–
Number of Panels	20	20	20	20
Hausman X^2 statistic	–	–	8.551	–
[P-value]	–	–	0.382	–

Note: All variables with the exception of exchange rate volatility are measured in natural logs. Values in the parenthesis are standard errors. A single asterisk (*) denotes significance at 10% level, two asterisks (**) at 5% level, and three asterisks (***) at 1% level. MG is Mean Group; PMG is Panel Mean Group; SR is Short-run, and LR is Long-Run

Further, we provide empirical evidence to show that, in the short-term, foreign direct investment is harmful to revenue generation in SSA. The result indicates that a 1 per cent increase in inflows of direct investment results in a 0.3 per cent shortfall in tax revenue generation though there is no empirical support for it. Plausibly, this is due to tax holidays these firms enjoy or transfer pricing

strategies these firms adopt (see, Reynolds and Wier, 2016). The economic structure of SSA has often been considered as one of the main reasons behind the sub-region's low revenue generation efforts. Though there is no empirical evidence for this result, the sign indicates that the growth of the agricultural sector is harmful to tax revenue generation. One variable that has generated debate in terms of its effect on tax revenue performance has been trade openness. Though there is no empirical support, we find a negative effect of trade openness on tax revenue generation. This is plausibly due to the gradual reduction in tariffs, weak border controls or corruption at the borders. In addition, we show that economic growth is tax revenue inducing. Generally, an expansion of the economy creates additional employment and expenditure which further fuel both direct and indirect revenue generations (Brafu-Insaidoo and Obeng 2008).

4.7.2 Long-Run Effect of Exchange Rate Volatility on Tax Revenue in SSA

In line with our short-run results, exchange rate volatility hinders tax revenue performance also in the long-run (see, Table 9). The result is statistically significant at 10 per cent suggesting that a 1 per cent increase in exchange rate volatility results in 0.06 per cent shortfall in tax revenue. The theoretical underpinning of the result is that, in small open economies like those of SSA, short-term trade risk posed by exchange rate volatility causes trade players or investors to substitute domestic markets for foreign markets. The end result is the direct loss of trade tax revenue as prolonged planning and adjustment cost results in the folding up or floundering of businesses. Further, we find that, there is an indirect pathway from exchange rate volatility to tax revenue performance through trade openness. We provide strong empirical support to show that given exchange rate volatility, the more SSA liberalizes trade, the more the region loses tax revenue.

$$lnTR = 0.0435lnGPC + 0.0848lnINF - 0.1383lnOPEN - 0.0979lnAGRIC -$$

$$0.0494lnFDI - 0.1082lnAID - 6.4984EXV + 0.0379(EXV * lnOPEN)$$

$\frac{\partial(lnTR)}{\partial(lnOPEN)} = -0.1383 + 0.0379\overline{EXV}$, from the descriptive statistics, $\overline{EXV}$ = -0.0023

$$\frac{\partial(lnTR)}{\partial(lnOPEN)} = -0.1383 + 0.0379(-0.0023)$$

$$\frac{\partial(lnTR)}{\partial(lnOPEN)} = -0.1383$$

Thus, in the presence of exchange rate volatility, policies aimed at opening up SSA economies to trade by 1 per cent lead to a decline in tax revenue performance by approximately 0.14 per cent. We test for and find statistical evidence for this interaction term at 1 per cent (F-statistics is 32.727; p-value is 0.000). The result is not farfetched per the structure of the economies of SSA as trade in SSA revolve around commodity arbitrage in which trade players hardly make use of hedging facilities or forward contracts. The long-term effect of persistent exchange rate risk is high planning and adjustment cost which have dampen effect on trade and indirect taxes. This, in effect, hinders tax revenue mobilization in SSA.

Again, we sought to determine the extent to which exchange rate volatility affect tax revenue given the current state of openness to trade in SSA.

$$lnTR = 0.0435lnGPC + 0.0848lnINF - 0.1383lnOPEN - 0.0979lnAGRIC -$$
$$0.0494lnFDI - 0.1082lnAID - 6.4984EXV + 0.0379(EXV * lnOPEN)$$

$\frac{\partial(lnTR)}{\partial(EXV)} = -6.4984 + 0.0132\overline{lnOPEN}$, from the data, $\overline{lnOPEN}$ = 2.2729

$$\frac{\partial(lnTR)}{\partial(EXV)} = -6.4984 + 0.0379(2.2729)$$

$$\frac{\partial(lnTR)}{\partial(EXV)} = -6.4122$$

From the net effect, we show that, given the current state of trade openness in SSA, a 1 per cent increase in exchange rate volatility results in a 0.064 per cent decline in tax revenue mobilization. The evidence for this interaction term is an F-statistics of 32.727 and a p-value of 0.000. Also, there is empirical evidence to show that trade openness has a harmful effect on tax revenue mobilization in SSA. The result suggests that a 1 per cent increase in trade openness results in approximately 0.14 per cent reduction in tax revenue generation. Plausibly, the regional integration laws of free movement of goods and services, and corruption at the various ports and custom units in SSA account for this. The finding corroborates that of Gupta (2007). The results suggest that given that the economies of SSA adhere to regional trade laws, then fiscal authorities of the various countries must brace themselves for tax revenue shortfalls. To address this, policymakers can adopt a gradual approach to the implementation of free trade; discourage border corruption through provision of better conditions of service; and ensure the prosecution of corrupt officials. Also, we provide strong empirical support for the argument that the growth of the agricultural sector has a suppressing effect on tax revenue mobilization. This partly explains the resolve on the part of policymakers in SSA to industrialize their economies since manufacturing enterprises/companies are easier to tax (see, Agbeyegbe et al. 2006; Ahmed and Muhammad 2010). The implication of this is that the establishment of new enterprises, sustainability of existing firms, and support for manufacturing industries has the potency of improving tax revenue performance. Moreover, there is evidence that foreign direct investment has a harmful effect on tax revenue generation in the long-run. In conformity to the finding of Beck and Chaves (2011), we show that a 1 per cent increase in inflow of direct investment reduces tax revenue performance by 0.1 per cent. Also, we find that the growth of SSA economies is tax revenue inducing. We show that for every 1 per cent improvement in the economic performance of SSA, tax revenue rises by approximately 0.04 per

cent. The result leans itself to the argument that rising levels of economic growth is associated with higher levels of private spending (Teera and Hudson 2004; Brafu-Insaidoo and Obeng 2008). This shows the need for policymakers in SSA to strive to expand their economies. Also, inflation proved to be tax revenue inducing suggesting that printing of monies, a common means of raising revenue fuels inflation tax in SSA (see, Alavirad 2003).

5.0 Conclusion

In this chapter, we looked at tax revenue performance of 21 SSA countries[i] from 1984 to 2017. Like other developing regions of the world, the SSA faces a number of structural and institutional constraints in its tax mobilization efforts. In this chapter, we contribute to knowledge by looking at how a major risk factor to trade and investment – exchange rate volatility – affects tax revenue generation in a region where forward contracts and hedging facilities are rarely used. Recognizing the fact that theory posits both short-run and long-run effects of exchange rate volatility on trade and tax revenue, we rely on a heterogenous panel ARDL estimation technique to estimate the pathways through which exchange rate volatility affect tax revenue. First, we find that exchange rate volatility has a direct deleterious effect on tax revenue performance in SSA. Second, we establish the presence of an indirect pathway of exchange rate volatility to tax revenue performance through trade openness. Therefore, stabilizing the real effective exchange rate is crucial to improving revenue generation in SSA. We therefore recommend that monetary authorities in SSA intensify efforts to reduce exchange rate volatility. Further, we recommend that monetary authorities (Central Banks) in SSA collaborate with financial institutions to provide trade players affordable forward contracts or hedging facilities. Lastly, we recommend that policymakers in SSA adopt a gradual approach when signing on to trade liberalization agreements.

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[i] Botswana, Burundi, Cape Verde, Cameroon, Comoros, Congo, Congo DR, Cote d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, The Gambia, Guinea Bissau, Ghana, Kenya, Lesotho, Mozambique, Sierra Leone, Tanzania, Uganda, Zambia.