

Original Paper

Analysis of Value Added Tax Productivity in Kenya

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Abstract

One of the critical components of Sustainable Development Goals is to strengthen domestic resource mobilization. The target is to have domestic resources contributing at least 75 percent to 90 percent of the financing required to achieve Agenda 2063 (AU, 2015). In an effort to enhance domestic resource mobilization in Kenya, great emphasis has been placed on Value Added Tax whereby the tax authority endeavors to enhance the contribution of VAT collections to GDP from a mean of 6 per cent to 9 percent of GDP. The study sought to estimate the productivity of VAT over the period 1973-2016 using data collected from Kenya National Bureau of Statistics and Kenya Revenue Authority's database. OLS method was adopted to estimate buoyancy of VAT while Divisia index approach was adopted to estimate elasticity of VAT. The study found that, the VAT system was buoyant with a value greater than one while the elasticity was 0.79 which was less than one implying VAT system was inelastic. The study concluded that the tax reforms adopted during the study period had impacted positively on VAT performance hence the buoyancy value greater than one. Therefore, to mobilize more revenue from VAT, reforms focusing on enhancing VAT compliance and expanding tax base should be emphasised.

Keywords

Buoyancy, Elasticity, VAT

1. Introduction

1.1 Background

One of the critical components of Sustainable Development Goals (SDGs) is to strengthen domestic resource mobilization. The target is to have the domestic resource mobilization (DRM) contributing at least 75 percent to 90 percent of the financing of Agenda 2063 (AU, 2015). The principles of a good tax system necessitates that a tax system should yield adequate revenue to finance the public expenditure

and it should be elastic implying that the revenues should grow with GDP. The revenues should also be stable since fluctuating tax revenues tend to create uncertainty thus adversely affecting the running of government development programmes. Therefore, the tax structure should facilitate the use of fiscal policy for stabilization, achievement of growth objectives and distribution of the tax burden (Musgrave, R. & Musgrave, P., 1989; Glenn et al., 2000). To this end, estimation of a country's tax productivity is fundamental in determining to what extent the growth in GDP translates into growth in revenue through estimation of tax elasticity and buoyancy.

Tax Buoyancy measures how tax revenues vary with changes in GDP. A value of one implies that one percent growth in GDP would increase tax revenue by one percent. Tax buoyancy greater than one implies that a one percent growth in GDP would result in growth in tax revenue by more than one percent. If the short-term buoyancy exceeds one, the tax system is considered to be an automatic stabilizer while long-run buoyancy exceeding one holding other factors constant would imply that higher GDP growth would improve the fiscal balance through the revenue side of the budget (OECD, 2014). Tax elasticity measures the change in tax revenue due to a change in GDP after controlling for exogenous influences such as discretionary changes in tax policy. If a one percent increase in GDP results in greater than one percent increase in tax revenue holding discretionary tax changes constant the tax is said to be elastic. Elasticity assumes tax system remains unaltered with no change in the tax rates or bases. Therefore the two factors which can give rise to change in tax revenues are: discretionary changes in rules or rates of tax which can be changed to raise more revenue from the same base or the base on which the tax is imposed may grow in relation to GDP. The combined effect is known as the buoyancy of a tax (Osoro, 1993; Wawire, 2017, 2006).

Therefore, an elastic tax system is necessary in an economy since it implies that the revenues will grow automatically with growth in GDP without changes in tax rates. Such information is crucial to tax policy makers in guiding whether future tax revenues will be sufficient to meet the public expenditure needs of a country without changing the existing rates or bases of the tax. This also acts a guide in planning for tax changes and focusing more on buoyant sectors of the economy when expanding the tax base. This forms the basis of this study with focus on Value Added Tax.

1.2 Reforms Undertaken to Enhance Domestic Tax Revenue Mobilization

According to Besley and Persson (2013), in the process of development, countries tend to reduce dependence on trade taxes and therefore income tax and VAT become the main sources of tax revenue to finance the public expenditure. To this end, many developing countries have adopted VAT to mobilise more tax revenue. However, the potential of VAT to mobilize tax revenue depends on some of the following factors; tax base, exemptions, the rate, level of tax compliance, the simplicity of the tax regime and the efficiency level of the tax administration (Glenn et al., 2000; Wawire, 2003; Moyi & Ronge, 2006).

VAT was adopted in Kenya in 1990 as a strategy to expand the tax base thus increasing government revenue. The administration of VAT is governed by VAT Act, Cap. 476 of the Laws of Kenya. VAT

system contains the taxable goods and services, the exemptions and the zero-rated goods and services which include exports and the essential goods (Value Added Tax Act, Cap. 476). Other reforms undertaken to enhance revenue mobilization included; formation of KRA in July, 1995 under Cap. 469 of the laws of Kenya. During the Second Plan period from 2003 to 2006, the Authority focused on reforms and modernization programme (RARMP) to promote efficiency in revenue collection, integration of the revenue departments and efficiency in service delivery. Some of the specific reforms aimed at enhancing VAT performance included; introduction of Electronic Tax Registers (ETRs) in 2005 to ensure full remittance of VAT by retailers; introduction of Simba 2005 system a customs online platform to enable the importers declare their goods with ease, implementation of an Integrated Tax Management System (ITMS) and later the i-tax to provide various online tax services to taxpayers thus making compliance easier (KRA, 2012 ; Kanyi & Kalui, 2014). All these reforms were aimed at enhancing the tax revenue mobilisation.

1.2.1 Share of Value Added Tax Revenue Collections to Total Tax Revenue in Kenya

Total VAT revenue collection comprises of import VAT and domestic VAT revenue collected by the Authority in the respective financial years. Figure 1 provides the trend of the share of import, domestic and Total VAT to total tax revenue collection since the financial year 2001/2002 to 2016/2017.

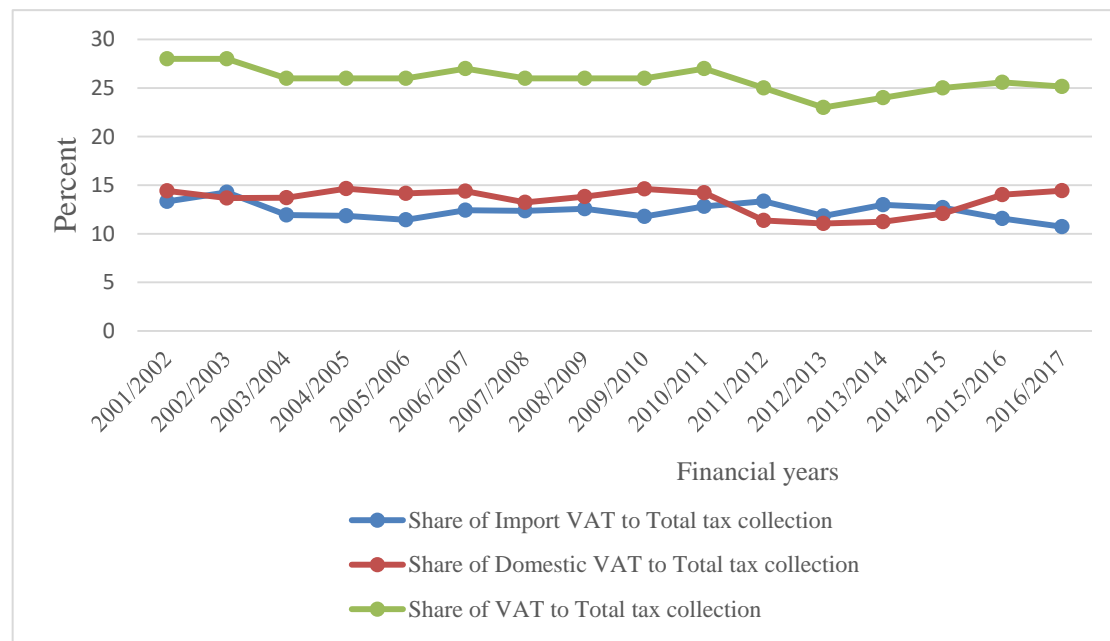


Figure 1. Share of Import VAT, Domestic VAT and Total VAT

Source: Authors, 2019

From the trend, though VAT collections have been increasing over the period, the share of total VAT to total tax revenue collections has been an average of 25 percent as shown in Figure 1.

1.2.2 Comparison of Tax Revenue Collected with Government Expenditure

When the government's expenditure is greater than the tax revenue collected, this creates a budget deficit. This calls for borrowing to meet the expenditure needs of a country. Figure 2 shows the trend in total tax revenue collected and government expenditure since the year 2002 to 2015.

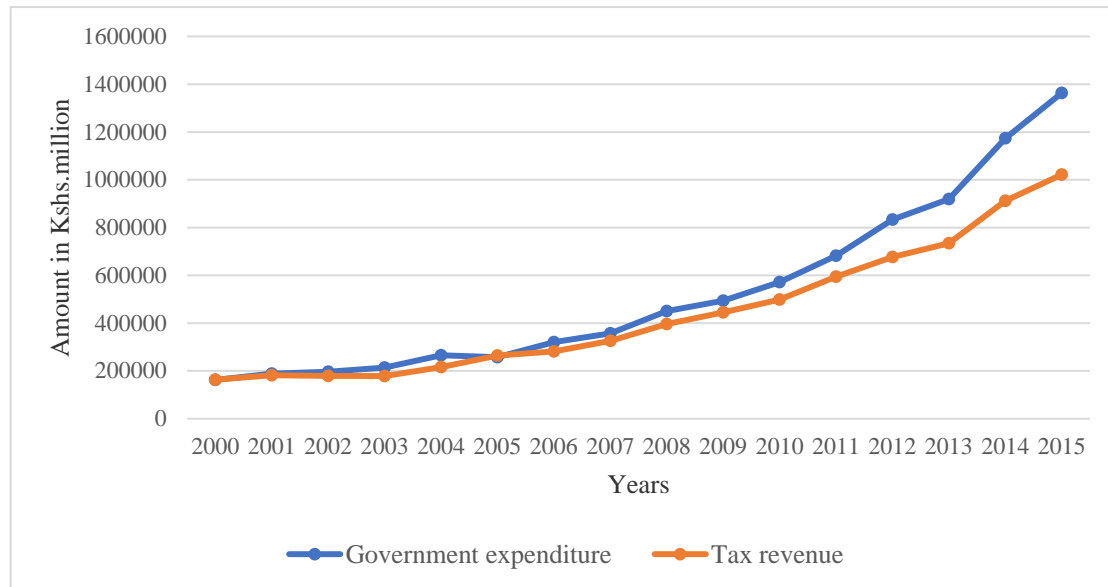


Figure 2. Comparison of Tax Revenue and Government Expenditure

Source: Authors, 2019

Figure 2 shows that, tax revenue collected plays a significant role in financing the public expenditure. The trend indicates that, tax revenue collected between the years 2000 and 2005 could finance the government expenditure with minimum budget deficit. However, since the year 2010 to 2015, the budget deficit widened especially between 2012 to 2015. With the public expenditure growing at a faster rate than the tax revenue collected, there is need to investigate all factors impacting on tax revenue performance to guide the policy makers on strategies which can enhance tax revenue mobilisation.

1.3 Contribution of Tax Revenue to GDP

Growth objectives underpinning the Vision 2030 requires a sustained economic growth of 10% and ensuring that the bulk of expenditures are met from tax revenue (Republic of Kenya, 2007). To achieve the objectives, the tax authority endeavours to achieve an average tax revenue growth of 24.3 percent. According to KRA's sixth Corporate Plan (KRA, 2015), the Authority will focus on key initiatives to enhance the attainment of sustainable tax revenue. This includes: attaining a share of Value added tax to GDP of 9 percent, achieving weighted taxpayer compliance of 65 percent and attaining a minimum active taxpayer base of 4 million. The Authority also endeavours to raise VAT contribution to total revenue from the current average of 25 percent to 35 percent. This clearly shows the Authority's

objective is to mobilize more revenue by concentrating on VAT and the significance of its performance in the attainment of the Authority's vision.

Table 1 shows the contribution of total VAT revenue and total revenue collection to GDP since the financial year 2005/2006 to 2015/2016.

Table 1. Total Tax Revenue and Total Value Added Tax Collection in (Kshs. Million) and Contribution of Revenue Collection to Gross Domestic Product

	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Import VAT	34,034	44,744	53,634	60,408	62,946	81,395	94,352	94,685	125,177	135,637	131,473
Domestic VAT	42,151	51,829	57,374	66,470	78,095	90,284	80,436	88,534	108,380	129,234	159,370
Total VAT	76,185	96,573	111,008	126,878	141,041	171,679	174,788	183,219	233,558	264,872	290,843
Total tax revenue	297,699	360,191	433,915	480,569	534,403	634,903	707,360	800,486	963,823	1,069,597	1,136,564
GDP	2,588,279	2,765,595	2,772,019	2,863,688	3,104,303	3,294,026	3,444,067	3,640,156	3,834,244	4,061,901	4,300,302
Total tax revenue as a percentage of GDP	12	13	16	17	17	19	21	22	25	26	26
Total VAT revenue as a percentage of GDP	2.9	3.5	4.0	4.4	4.5	5.2	5.1	5.0	6.1	6.5	6.8

Source: KRA and Republic of Kenya (2006, 2007, 2008, 2010, 2011, 2014, 2017).

Over the period, the share of total tax revenue to GDP was an average of 17 percent while the share of VAT to GDP was an average of 4.9 percent. The highest contribution was recorded in the financial year 2014/2015 and 2015/2016 whereby the total VAT revenue as a percent of GDP was 6.5 and 6.8 respectively while the total tax revenue contributed 26 percent of GDP. The statistics clearly indicates that VAT should grow by an additional average of 2 to 3 percentage points to achieve the target of 9 percent of GDP.

1.4 Statement of the Problem

In Kenya, tax revenue is the main source of revenue accounting for an average of 95 percent of ordinary revenue. Since inception of Kenya Revenue Authority in 1995, tax revenue collected has been on the rising trend. However, the country has been experiencing huge budget deficits thus prompting the government to focus more on strategies to enhance domestic tax revenue mobilization to finance the increasing public expenditures with minimal reliance on foreign aid. To achieve Vision 2030 development objectives, KRA is expected to collect revenue to GDP ratio of over 20.7 percent yearly and an annual growth of 10 percent over the plan period (Republic of Kenya, 2007). Considering the tax revenue administration's major role in the attainment of Vision 2030 objectives, the tax administration has adopted several strategies to enhance revenue mobilization with emphasis on ways of mobilising VAT revenue due to its high revenue raising potential, its vulnerability to evasion and poor enforcement

thus widening the VAT Gap. To this end, the tax administration endeavours to enhance contribution of VAT to GDP from 6 percent to 9 percent by the year 2018 as outlined in the Authority's sixth corporate plan. However the capability of VAT to mobilize more revenue depends on several factors some of which include the buoyancy and elasticity which guides in establishing the extent to which growth in GDP would translate to growth in VAT revenue collections. This called for the estimation of VAT productivity with the objective of establishing the extent to which VAT tax revenue could be relied on to mobilize more tax revenue to finance the government expenditures with the growth in GDP. This formed the basis of this study.

1.5 Objectives of the Study

The study sought to analyse the VAT productivity in Kenya and the specific objectives included;

- (i) Estimate the buoyancy of VAT in Kenya
- (ii) Estimate elasticity of VAT in Kenya

2. Literature Review

2.1 Introduction

The chapter presents the estimation techniques for buoyancy and elasticity of VAT and the empirical literature reviews various studies undertaken on VAT buoyancy and elasticity.

2.2 Estimation Techniques for Buoyancy of VAT

The Cobb Douglas functional form is commonly adopted in presenting a tax model equation for estimating buoyancy of tax (for example, Osoro, 1993 and 1995, Ariyo, 1997, Wawire, 2000, Muriithi & Moyi, 2003, and Wawire, 2003, 2006). In this case tax revenue is taken as a function of GDP holding other factors constant and tax buoyancy is estimated by regressing the log of tax revenue on the log of GDP. The model is presented as follows;

$$T = e^{\alpha} Y^{\beta} e^{\mu}$$

Where: T = tax revenue; Y = income (GDP); α = constant term; e = natural number; β = buoyancy coefficient; μ = error term

To capture the dynamic relationship between tax revenue and GDP, some studies (Beling et al., 2014; Bayu, 2015) adopted the error correction model to estimate the long run and the short run buoyancy and how fast the short run dynamics move towards the long run dynamics. The technique makes use of the autoregressive distributed lag model which allows for flexible dynamic relationship between tax revenue and GDP. The econometric specification of the autoregressive distributed lag model is as follows;

$$\ln T_t = \sum_{j=1}^p \phi_j \ln Tax_{t-j} + \sum_{j=0}^q GDP_{t-j} + \varepsilon_t$$

Where T_t is the tax revenue collected in year t, GDP_t is the country's level of GDP at period t, and ε_t is the error term. The equation suggests that changes in tax revenue can be explained by a distributed lag of order p of the dependent variable and a distributed lag of order q of GDP. To obtain a single error correction model of the form, the lagged tax variables are subtracted from both sides giving rise to the

following equation;

$$\Delta \ln Tax_t = \lambda_i (\ln Tax_{t-x} - \beta_i \ln GDP_t) + \theta_0 \Delta \ln GDP_t + \varepsilon_t$$

Whereby θ_0 measures the short-term buoyancy of the tax, which is the immediate effect of a change in GDP on tax revenue. The parameter β_i signifies the long-run buoyancy. The parameter λ_i measures how fast the short run values converge to its long-run equilibrium value.

2.3 Estimation Techniques for Elasticity of VAT

2.3.1 Proportional Adjustment (PA)

Developed by Prest (1962) the method entails first adjusting the historical time series data to a preceding year base. This is done by subtracting the budget estimates of the revenue impact of the discretionary tax measures implemented in a given year from the actual tax revenue collected in that year. The adjustment gives an estimate of the automatic growth in revenue between two successive years. Secondly, the actual tax collection is divided by the adjusted revenue collection to give the share of discretionary tax measure in revenue. The series are converted to the first year's basis by adjusting the year to year changes by the ratio of the tax yield based on the first-year rates to the actual tax yield (Wawire, 2006, 2003). The following were highlighted as the main constraints of the technique: the unavailability of data on discretionary changes in many countries which affects the reliability of the method; the method ignores the impact of changes in the degree of evasion or of administrative efficiency on tax revenues (Chelliah & Chand, 1974).

2.3.2 Dummy Variable Approach

Developed by Singer (1968), the method involves use of dummy variable as proxy for each of the discretionary tax measure taken during the period. The resulting estimating model becomes:

$$\ln T_p = \alpha_p + \beta_p \ln Y + \sum \sigma_i D_i + \varepsilon_p$$

Whereby D_i ($i = 1, 2, \dots$) represents the dummy variable as proxy for the discretionary tax measure taken during the review period. The period when there is discretionary change takes the value of one (1) while the period without any discretionary tax change takes the value of zero (0). The coefficient β_p estimates the revenue elasticity. The limitation of this approach is that the elasticity obtained is not precise and reliable due to multicollinearity arising from including more than one dummy variable in the model. When tax policy changes are too frequent, it creates potential multicollinearity problem from the inclusion of more than one dummy variable into the tax function (Wawire, 2006, 2017).

2.3.3 Constant Rate Structure Method

The approach was used by Andersen (1973) for Denmark and Choudhry (1975) for West Malaysia. It involves applying the current year's rates to the previous year's tax bases and to construct the adjusted tax revenue series that would have been obtained had the same tax structure been applied consistently over time. The main limitation with this approach is that it requires a detailed tax-base series for all the individual taxes which can be difficult to obtain in most developing countries.

2.3.4 Divisia Index Method

According to Choudhry (1979) the Divisia index approach does not require the traditional adjustment

of historical revenue to eliminate effects of discretionary tax measures. The effects of discretionary tax measures on revenue are estimated by an index that isolates the automatic growth of revenue from the total growth. The characteristics of the effects of discretionary tax measures on tax yield are analogous to effects of technical change on productivity. The discretionary tax measures produce changes in tax yield over and above those caused by the automatic growth in tax bases just as technical change induces changes in total productivity. If there are no discretionary tax changes then the tax system remains unaltered. In case there is discretionary tax changes, the tax yield results from not only the growth in tax bases but also as a result of a discretionary tax change. The Divisia index is equal to the percentage increase in total tax yield divided by the percentage increase in total tax yield owing to automatic increase in the bases. A change in this index reflects the overall revenue effects of discretionary tax measures. In estimating elasticity using Divisia index approach, the buoyancy estimate is adjusted by a suitable transformation of the index of discretionary revenue.

2.4 Empirical Literature on Buoyancy and Elasticity

Osoro (1993) analysed Tanzania's revenue productivity with focus on the effects of tax reforms. The study found that the total tax system had a buoyancy coefficient greater than elasticity coefficient which implied that the discretionary changes were significant in raising tax revenues. The elasticity of the tax system was found to be 0.76. The elasticity of sales tax was below unity which was attributed to generous exemptions, tax evasion and weak tax administration. The elasticity of income taxes was less than one but company tax had an elasticity greater than one and higher than that of income tax, while PAYE showed a much lower elasticity.

Muriithi and Moyi (2003) using OLS estimated the buoyancy and elasticity of Kenya's tax structure with focus on the pre-reform and post reform period. Proportional adjustment method was used to isolate the discretionary effects from the revenue series. The estimated elasticity for Kenya's overall tax system during the pre-reform period was found to be inelastic with an elasticity coefficient of 0.276 for the period 1973-1985 while for post-reform period from 1986-1999, the overall tax system was elastic. Sales tax/VAT recorded less than unity buoyancy and tax-to-GDP elasticity coefficient of 0.547. The study found that the reforms improved the tax-to-income elasticity of direct taxes from 0.488 to 2.165, excise duties from 0.073 to 1.699, import duties from 0.380 to 1.661 and sales tax/VAT from 0.062 to 0.547. Therefore the reforms were found to have a positive impact on the overall tax structure and on the individual tax handles. However the reforms failed to make VAT responsive to changes in income.

Wawire (2006) estimated income elasticities of various taxes in Kenya. Using OLS method, the study found that, tax elasticities for total taxes, income taxes, and excise duties with respect to GDP were less than unity. Elasticities of excise duties in relation to volume of imports and trade were also less than unity as was the elasticity of import duty with respect to the volume of trade. On the other hand, growth elasticities for indirect taxes and sales taxes were all greater than one while elasticity of the direct tax revenue was found to be unitary.

Twerefou et al. (2010) estimated the elasticity of tax system in Ghana using the dummy variable

technique to control for effects of the discretionary tax measures on time series data for the period 1970-2007. The findings revealed that the overall tax system in Ghana was buoyant and elastic in the long run and buoyancy exceeded the elasticity. However, in the short run the reverse was the case. There was an improvement in both buoyancy and elasticity over the reform period (1985-2007). Overall tax elasticity estimate was 1.03, suggesting that the tax system was elastic with respect to GDP. Bettendorf and Limbergen (2013) estimated the elasticities of VAT and Personal Income Tax revenues for Netherlands for the period 1970-2011. The proportional adjustment method was used to correct the series on tax revenues for the impact of discretionary measures including legal changes in tax rates. Using OLS estimation technique, the study found that the long term elasticity for VAT was 0.97 whereas the short run elasticity was 1.02. The study further extended the regression with residential investment and the total of government consumption and investment as tax base. The results indicated that extending the base hardly affected these outcomes.

Dudine and Talles (2017) estimated short-run and long-run tax buoyancy estimates for 107 countries covering 31 Advanced Economies (AE), 38 Emerging Market Economies (EME) and 38 Low Income Countries (LIC) between 1980 and 2014. In estimating the coefficients, the study adopted fully modified ordinary least square (OLS) and (pooled) mean group estimators. The study found that the long-run buoyancy for advanced economies was 1.06 and 1.15 for both emerging markets and low-income countries. Long-run tax buoyancy was found to exceed one in the case of CIT for advanced economies, PIT and SSC in emerging markets, and TGS for low income countries. In regard to main determinants of tax buoyancy both trade openness and human capital were found to increase the buoyancy while inflation and output volatility decreased it.

Oketch and Mburu (2011) estimated buoyancy and elasticity in Kenya between 1986-2009. The study adopted a causal research design, a multiplicative model of estimating elasticity and buoyancy. In estimating the parameters, Ordinary Least Square (OLS) method was adopted using E-views package. The results suggested that the overall tax system had a buoyancy of 0.525 while the elasticity was 0.509 implying that growth in GDP over the study period spurred less than proportionate automatic increase in tax revenue. Import duty and Sales tax/VAT had a buoyancy of 1.572 and 0.879 respectively while excise tax had a buoyancy of 1.376 in real terms. The study concluded that a large percentage of tax revenue comes from discretionary tax policy and not from pure responsiveness of tax revenue to changes in national income.

Milwood (2012) sought to determine the relationship between GDP growth and the growth in tax revenue as well as the responsiveness of taxes to fiscal policy in Jamaica. This was done by estimating buoyancy and elasticity for the period March 1998 to December 2010. Divisia Index approach was adopted to separate the effect of the discretionary measures and the built-in response of tax revenues to the growth in GDP on total revenue. The results from OLS estimation indicated that the overall tax system was inelastic with a coefficient of 0.97 and a buoyancy of 1.11 implying that the discretionary measures had positive impact on revenues. Customs duty was positively impacted by discretionary

measures with buoyancy estimate of 0.91. Results from the VECM indicated that the total revenue had a buoyancy coefficient of 1.09 but was inelastic. Customs duty had a buoyancy estimate of 2.80 and an elasticity estimate of 2.31. DOLS estimates were in line with those from the VECM model and the results indicated a buoyancy coefficient of 1.09 for total tax revenue and an elasticity coefficient of 0.95. Customs duty recorded a lower buoyancy coefficient of 2.40 relative to an elasticity coefficient of 1.91. The results from all three tests indicated that in the case of total revenue and customs duty, discretionary tax measures led to an increase in revenues over the period. On the other hand, discretionary measures had little impact on GCT revenues as the elasticity coefficient was found to be greater than the buoyancy coefficient.

Cotton, (2012) estimated the buoyancy and elasticity of direct and indirect taxes in Trinidad and Tobago for the period 1990-2009. To estimate tax buoyancy, the study adopted the double logarithmic method. The study found that the buoyancy coefficient for the period under study was 0.99. This implied that the non-oil taxation system in Trinidad and Tobago is relatively responsive to changes in non-oil GDP. The Proportional adjustment method was adopted in estimating the elasticity and the results indicated that the overall non-oil tax elasticity was 0.81 thus inelastic. The elasticity coefficients for direct and indirect taxes were 1.21 and 0.99 respectively. The study concluded that, efforts to increase non-oil tax revenue in Trinidad and Tobago should focus on indirect taxes.

Desmond et al. (2013) estimated the buoyancy and elasticity of the Zimbabwean tax system over the period 1975-2008. The study adopted the OLS method and dummies were introduced for the years with major discretionary tax measures. The estimated overall buoyancy was 0.708 implying that 1 percent increase in real GDP per capita income led to a 0.708 percent average growth in total tax revenue hence not buoyant. The estimated elasticity was 0.664 implying that the tax system was inelastic. The estimated buoyancy for VAT/Sales tax was 0.815 while the elasticity was 0.735 implying that a one percent growth in GDP led to less than one percent growth in VAT revenue. The study attributed the non-productivity of VAT to numerous exemptions and tax evasion.

Belinga et al. (2014) estimated the long and short-run tax buoyancy for 34 OECD countries during the period 1965-2012. The study adopted an Error Correction Model (ECM) that simultaneously estimated short-run effects, a long-term relationship and a speed of adjustment. The results suggested an average long-run buoyancy of 1.03 and an average short-run buoyancy of 1.01. In 16 countries the long run buoyancy coefficient was not significantly different from one while in 14 countries the long run buoyancy significantly exceeded one. This implied that GDP growth helped improve fiscal performance through the revenue side of the budget. Using panel regressions, the study also assessed the buoyancy of the following tax heads; corporate income tax, personal income tax, social security contribution, goods and services taxes (GST) and excise taxes. The long-run buoyancy was found to exceed one for CIT, for the SSC and GST it was not significantly different from one, while the buoyancy for PIT, excises and property taxes was below one. CIT was found to be the best automatic stabilizer with a short-run buoyancy of 1.96. Short-run buoyancy for PIT and the GST was not

significantly different from one and the study concluded that PIT was a better automatic stabilizer than the GST.

Omondi et al. (2014) sought to establish the impact of tax reforms on tax buoyancy for the period 1963–2010 for Kenyan tax system. To adjust for discretionary changes, the study adopted the proportional adjustment method. Using Ordinary Least Square method, the study estimated the parameters of the model and found that the buoyancy coefficient for pre-reform period was 1.144 while for post reform period was 1.358. This implied that discretionary changes were important in raising revenue. However the estimated results indicated that the tax system was inelastic with an elasticity coefficient of 0.690 which implied that the increase in national income resulted in less than proportionate increase in tax revenue. The low elasticity was attributed to factors such as exemptions, tax incentives, duty waivers, low compliance and vibrant sectors of the economy which are not subject to taxation.

Olukuru and Mandela (2017) estimated the buoyancies of income tax, value added tax, import tax, excise tax and total tax revenues using annual data for the period covering 1972 to 2014 for South Africa and 1980-2014 for Kenya. The study applied the error correction model for estimating buoyancy coefficients and speed of adjustment. The results suggested a significant long run buoyancy coefficient for the total tax revenue of 1.77 for South Africa and 1.18 for Kenya. The short run buoyancy coefficients for South Africa and Kenya were 1.82 and 2.69 respectively. This implied that the tax systems for Kenya and South Africa were buoyant in the long run and short run. The long run buoyancies for income tax, VAT and excise duty were 2.69, 1.38 and 0.81 respectively for Kenya while the long run buoyancies for income tax, VAT and excise duty were 1.70, 1.61 and 1.16 respectively for South Africa. The study concluded that income tax was the best automatic stabilizer since it had the highest short run buoyancy coefficient.

Wawire (2017) investigated the determinants of Value Added Tax revenue and further assessed the response of VAT structure to changes in tax bases and tax reforms for the period 1963/64 to 2008/09. Using OLS regression, the study found that the coefficient of log monetary had a positive sign and was statistically significant. The previous levels of GDP, the log of volume of trade, its lagged values and the lagged value of log sales taxes/VAT revenue had statistically significant effects on log sales taxes/VAT revenue. The coefficient of log population was positive indicating that an increase in population would increase VAT revenues which could be attributed to high demand for taxable goods and services associated with population increase. Sales taxes/VAT structure was found to be elastic with respect to total GDP indicating that a one percent increase in GDP led to more than one percentage change in VAT revenue. The elasticities of sales taxes/VAT with respect to log volume of imports and log per capita volume of imports were positive and statistically significant implying that an increase in the volume of imports increased revenue collected from sales taxes/VAT.

Gupta and Liu (2020) estimated tax buoyancy for 44 sub-Saharan African (SSA) countries covering the period 1980-2017 using time series and panel techniques. The focus was on aggregate tax revenues,

personal income tax (PIT), corporate income tax (CIT), tax on goods and services (TGS) and trade taxes. The estimated results suggested an average long-term buoyancy of 1.088 and an average short-term buoyancy of 1.004. The study further investigated whether tax buoyancies had changed over time following introduction of tax reforms by many countries since the late 1990s. The study found that for overall taxes and most tax components, there was an increase in long-term buoyancy during 1999-2017 period, except for trade taxes owing to declining reliance on trade taxes in SSA countries. Short term buoyancy of personal income tax was found to be significantly less than one. The study also found that, central government debt and shadow economy exerted a downward pressure on tax buoyancy. This implied that the current tax systems in SSA would not be able generate domestic revenues to the extent needed for financing the Sustainable Development Goals (SDGs).

3. Methodology

This chapter presents the empirical framework, model specification, data type and data analysis techniques adopted in the study.

3.1 Empirical Framework

The study's objective was to assess productivity of VAT. Divisia index approach was adopted to estimate the elasticity of VAT. The approach avoids the multicollinearity problem inherent in the dummy variable approach which arises from including many dummy variables in the equation.

In assessing tax buoyancy, the study followed the work of various authors such as Omondi et al. (2014), Wawire (2003, 2006, 2017), Muriithi and Moyi (2003), Osoro (1993), Ariyo (1997). These studies adopted the Cobb Douglas functional form to represent the relationship between tax revenue and GDP. The dependent variable was tax revenue while GDP was the independent variable.

To capture the dynamic relationship between VAT and GDP, the study adopted the ARDL model. This is due to the recognition that tax revenue performance may be affected by the current values of the independent variables and the lagged values of the independent and dependent variables. The study followed the work of Belinga et al. (2014).

In estimating VAT elasticity, the study adopted the divisia index technique following the empirical work of Choudhry (1979).

3.2 Model Specification for Estimating Buoyancy

In the assessment of tax revenue productivity, there are two measures which are normally utilized which are buoyancy and elasticity of tax. The estimation equation for tax buoyancy is specified in the Cobb-Douglas functional form as shown in equation 3.1.

$$T = e^{\alpha} Y^{\beta} e^{\mu} \quad 3.1$$

Whereby; T is tax revenue, Y is income (GDP), α is the constant term, e is the natural number, β is the buoyancy coefficient and μ is the error term.

The equation was linearized by taking the logarithms of the variables in the model and introducing an error term μ . Therefore, in estimating the buoyancy, the following equation was estimated:

$$\ln T_t = \alpha_0 + \beta_1 \ln Y_t + \mu \quad 3.2$$

Where, T_t = revenue from VAT α_0 = constant term β_1 = buoyancy coefficient Y = Tax base μ = error term
Ordinary least squares was used to estimate the parameters whereby β is an estimate of the tax buoyancy which measures the change in tax revenue due to change in GDP.

To capture the dynamic relationship between VAT and GDP, the study adopted the ARDL cointegration technique used in determining the relationship between variables with different order of integration (Beling et al., 2014; Pesaran et al., 2001).

The econometric specification of the autoregressive distributed lag model (ARDL) is as follows;

$$\ln T_t = \gamma_0 + \sum_{j=1}^p \delta_j \ln Tax_{t-j} + \sum_{j=0}^q \beta_j \ln GDP_{t-j} + \varepsilon_t \quad 3.3$$

Where T_t is tax revenue in year t , GDP_t is the GDP in period t , γ is the constant, δ_j and β_j are the coefficients ε_t is the error term. The equation can be interpreted as follows; tax revenue can be explained by a distributed lag of order p of the dependent variable, and a distributed lag of order q of GDP.

To obtain a single Error Correction Model of the form, the lagged tax variables are subtracted from both sides giving rise to the following equation;

$$\Delta \ln Tax_t = \lambda_i (\ln Tax_{t-x} - \beta_i \ln GDP_t) + \theta_0 \Delta \ln GDP_t + \varepsilon_t \quad 3.4$$

Whereby θ_0 measured the short-term buoyancy of the tax, which is the immediate effect of a change in GDP on tax revenue. The parameter β_i signified the long-run buoyancy. The parameter λ_i measured how fast the short run values converge to its long-run equilibrium value.

3.3 Estimating Elasticity Using Divisia Index Method

Divisia index approach entails estimating tax elasticity in three steps. The effects of discretionary tax measures on revenue are estimated by an index that isolates the automatic growth. Second the buoyancy of tax revenue is estimated with respect to gross domestic product by a regression technique. The buoyancy estimate obtained is adjusted by a suitable transformation of the index obtained in the first stage to obtain the elasticity of the tax yield. The main advantage of Divisia index approach compared with the other methods is that it uses only historical data and requires no specific information on the revenue effects; does not require information on past frequency of discretionary tax changes (Choudhry, 1979).

3.4 Conceptual Framework for the Divisia Index Method

The effect of discretionary tax measures on tax yield is analogue to the effects of technical change on total productivity. The discretionary tax measures cause changes in tax yield over and above those caused by automatic growth in tax base just as technical change causes changes in total productivity. Hence in case of a discretionary tax change, the change in tax yield results from both growth in the tax base and the discretionary change. The Divisia index of discretionary tax change is equal to the percentage increase in total tax yield divided by the percent increase in the total tax yield owing to the automatic increase in the bases. The index should possess the invariance property such that if there are no discretionary tax measures, then there is no discretionary revenue change and the growth in tax

revenue in this case is due to the growth in tax bases.

3.5 Model Specification for the Divisia Index Method

Considering a continuously differentiable aggregate tax function at each time as shown in equation 3.5

$$T(t) = f(x_1(t), \dots, x_k(t); t) \quad 3.5$$

Where T denotes the aggregate tax yield, x_i represents the tax base for the tax, and the t variable is a proxy for discretionary tax measures, by taking the logarithm of the of the tax function, differentiating with respect to time and rearranging the equation, yields the following equation;

$$\frac{\dot{f}_t(t)}{f(t)} = \frac{\dot{T}(t)}{T(t)} - \sum_1^k \frac{f_i(t)x_i(t)}{f(t)} \frac{\dot{x}_i(t)}{x_i} \quad 3.6$$

Setting $\frac{f_i(t)x_i(t)}{f(t)} = \beta_i(t)$ and $\frac{\dot{f}_t(t)}{f(t)} = \frac{\dot{D}(t)}{D(t)}$ where $D(t)$ is the divisia index of discretionary tax change, equation 3.6 is rewritten as

$$\frac{\dot{D}(t)}{D(t)} = \frac{\dot{T}(t)}{T(t)} - \sum_1^k \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)} \quad 3.7$$

The shift of the tax function f over time, $\frac{\dot{D}(t)}{D(t)}$ is the growth of tax revenues owing to discretionary tax measures. Equation 3.7 can be integrated to get the index of discretionary tax ss over the time interval $(0, n)$.

$$\frac{D(n)}{D(0)} = \left[\frac{T(n)}{T(0)} \right] \exp \left(- \sum_1^k \int_0^n \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)} dt \right) \quad 3.8$$

Normalizing by setting $D(0)=1$, $D(n)$ is viewed as the index of revenue growth due to discretionary tax measures at time n .

The fluctuating $\beta_i(t)$ is replaced by a constant $\tilde{\beta}_i$, which is some form of weighted average of the fluctuating $\beta_i(t)$. This yields the following equation,

$$\int_0^n \tilde{\beta}_i \frac{\dot{x}_i(t)}{x_i(t)} dt = \int_0^n \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)} dt \quad 3.9$$

Integrating the left-hand side of equation 3.9 yields the following equation;

$$\tilde{\beta}_i \log \left(\frac{x_i(n)}{x_i(0)} \right) = \int_0^n \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)} dt \quad 3.10$$

Whereby;

$$\tilde{\beta}_i = \frac{1}{n} \int_0^n \beta_i(t) \frac{p_i(t)}{\bar{p}_i} \text{ where by } p_i(t) = \frac{\dot{x}_i(t)}{x_i(t)} \text{ and } n\bar{p}_i = \int_0^n \frac{\dot{x}_i(t)}{x_i(t)} dt = \log \left(\frac{x_i(n)}{x_i(0)} \right)$$

$$\tilde{\beta}_i = \frac{1}{n} \sum_{t=1}^n \beta_i(t) \frac{p_i(t)}{\bar{p}_i} \text{ while } \beta_i(t) = \frac{T_i(t) - T_i(t-1)}{x_i(t) - x_i(t-1)} \frac{x_i(t)}{T_i(t)}$$

Putting the left-hand side of equation 3.10 into the right-hand side of equation 3.8, yields the following equation in logarithmic form which is the divisia index of discretionary tax revenue.

$$\log D(n) = \log \left(\frac{T(n)}{T(0)} \right) - \sum_1^k \tilde{\beta}_i \log \frac{x_i(n)}{x_i(0)} \quad 3.11$$

According to equation 3.11, the growth rate of the discretionary tax revenues is equal to the difference between the growth rates of total tax revenues and automatic tax revenues. To compute the elasticity of tax revenue, the buoyancy of tax revenue is adjusted by a suitable transformation of the index which gives rise to the following equation;

$$\hat{\tau} = \mu - \frac{\log D(n)}{\log[x(n)/x(0)]} \quad 3.12$$

Equation 3.12 therefore provides the estimate of elasticity of the tax revenue.

3.6 Data Source and Type

The study used secondary data on tax revenue which was collected from Kenya Revenue Authority Statistics department, Kenya National Bureau of Statistics' Economic Surveys. The study used time series yearly data from 1973-2016 in estimating the buoyancy and elasticity. The tax revenue data was transformed into real tax revenues by dividing the nominal values by the consumer price index (CPI). This was necessary to avoid biased results due to inflation. The data was analyzed using EViews a statistical software for social sciences.

3.7 Time Series Properties of the Variables

The study made use of time series data and therefore the first step involved subjecting the data to unit root test to make sure that the results obtained were not spurious. In this regard Augmented Dickey Fuller (ADF) test was used to test for unit roots. ARDL Bounds was used to test for cointegration while LM was used to detect the presence of serial correlation in the data set.

4. Empirical Results and Discussion

4.1 Stationarity Tests Results

Testing for stationarity of variables is essential to avoid running a spurious regression. Augmented Dickey Fuller (1979) test was used in establishing the order of integration of the variables. The unit root tests results indicated that log VAT was stationary at levels I(0) while log GDP was non-stationary at level. This necessitated testing log GDP for unit root in first difference and the variable was found to be stationary hence integrated of order one I(1).

4.2 ARDL Bounds Cointegration Test

To determine if there was long run relationship between log VAT and log GDP, cointegration test was conducted. Since the variables were not integrated of the same order, cointegration test was conducted using ARDL bounds cointegration test developed by Pesaran et al. (2001). To determine the appropriate lag structure, the study made use of Akaike's information criterion (AIC) and found that the appropriate lag length for log VAT was one while that of log GDP was two years. The null hypothesis stated that there is no long-run equilibrium relationship between the variables. That is, $H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$ while the alternative hypothesis states that $H_0: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$. The computed F-statistic was compared

with the critical values at ten percent level of significance to determine if there was cointegration and the results are provided in Table 2.

Table 2. ARDL Bounds Cointegration Test Results

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	5.588436	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78

Source: Authors, 2019

The results indicated that the F-statistic is greater than the lower and upper Bound of the Pesaran's critical values at 10 percent level of significance, thus the null hypothesis of no cointegration was rejected. This implies that the variables have a long run relationship. This necessitated estimation of a long-run model as well as an Error Correction Model (ECM) to measure the long-run relationship and the short-run relationship.

4.3 Serial Correlation Test Results

Presence of autocorrelation leads to underestimation of the error variances thus making the significance test invalid. This necessitated the testing for serial correlation to establish if the variables were serially correlated. The null hypothesis stated that there was no serial correlation in the residual while the alternative hypothesis stated that there was serial correlation in the residual. Breusch-Godfrey serial correlation LM Test was used and the results indicated that the P-value was 0.1055 which was greater than 5 percent. Hence the null hypothesis could not be rejected and the conclusion was that there was no serial correlation between tax revenue and GDP.

4.4 Buoyancy Estimates

To obtain the buoyancy estimates for VAT, the study established the optimal lag length using the Akaike Information Criteria (AIC) to avoid too many lags which lead to loss of degrees of freedom. The optimal lag length for VAT was one year while the optimal lag length for GDP was two years. To this end, the log of VAT was regressed against lagged values of GDP and a one-year lag of the dependent variable. The essence of including the lagged GDP was to take care of the lagged effect of GDP on tax revenue performance whereby the previous year's GDP may have an impact on current year's tax revenue.

4.4.1 Estimated Long Run Buoyancy Coefficients for VAT

The Table 3 provides the long run buoyancy estimates for VAT

Table 3. Regression Results for Buoyancy Estimate for the VAT

Dependent variables	Explanatory variables	Coefficient	t-statistic	Prob
LOGVAT	CONSTANT	-0.002044	-0.017850	0.9859
	LOGGDP(-1)	1.480970	10.34350	0.0000
	LOGGDP(-2)	-0.472807	-3.292423	0.0022
	LOGVAT(-1)	-0.013408	-0.814483	0.0000
	ADJ. R-squared	0.760321	F-statistic	44.35399
	Durbin Watson Statistic	2.363383	Prob(F-statistic)	0.000000

Source: Authors, 2019

The results indicated that, the coefficient of a one and two years' lag in GDP were significant in explaining the variation in VAT performance. The coefficient of one-year lag in VAT was also found to be significant in explaining VAT performance in the current year. A one per cent increase in GDP in the previous year, led to a 1.48 percent increase in VAT in the current period implying that the positive effect of GDP growth on VAT performance is realized with a lag of one year while a one percent increase in GDP in the previous two years had a negative effect. The negative effect of a one-year lag in VAT revenue on the VAT collected in the current period could be explained by the credit incurred in the previous year being recovered in the present period thus having a negative effect on VAT performance after a period of one year. This is because, when a Vatable transaction takes place, the input tax incurred by the traders in the purchase of the Vatable goods or manufacturing of Vatable goods and services, may take longer period to be fully claimed or recovered. Hence according to the results, part of the input VAT incurred in the previous year will be recovered in the current year.

4.4.2 Estimated Short Run Buoyancy Coefficients

The study adopted an Error Correction Model to assess the short run effects and the speed of adjustment of the disequilibrium in the system. The estimated results are provided in Table 4.

Table 4. Estimated Short Run Buoyancy Results

Dependent variables	Explanatory variables	Coefficient	t-statistic	Prob
DLOGVAT	CONSTANT	-0.046227	-1.200330	0.2374
	DLOGGDP(-1)	1.845755	2.183798	0.0352
	ECT(-1)	-0.479377	-2.864377	0.0068

Source: Authors, 2019

According to the results, a one percent increase in one-year lag of differenced GDP led to a 1.8 percent increase in VAT. The error correction term coefficient indicates that, 47 percent of disequilibrium in the system is restored in the current period while the remaining disequilibrium is restored in the subsequent

periods. VAT is therefore more buoyant in the short run whereby one percent growth in GDP leads to more than one percent growth in VAT.

4.5 Estimated Elasticity Output Using the Divisia Index Approach

The divisia index approach outlined in the model specification was adopted to obtain the elasticity estimates and the procedure entailed three steps. First, the buoyancy of VAT was estimated using OLS as outlined in the methodology. Second, the divisia index approach was used to separate the effects of discretionary tax measures on revenue. The Buoyancy estimate was then adjusted by transformation of the index to obtain the elasticity of the tax yield. The elasticity results obtained are as provided in Table 5.

Table 5. Estimated VAT Elasticity Results Using Divisia Index Technique

PERIOD UNDER STUDY	1974-2016
ELASTICITY OF VAT	0.79

Source: Authors, 2019

The estimated results indicated that the automatic growth of VAT resulting from the growth in GDP over the study period was 0.79 implying it was inelastic. Thus in enhancing VAT revenue mobilization discretionary tax measures are significant.

4.6 Conclusion and Policy Implication

The study sought to estimate the productivity of VAT with the objective of establishing how VAT responds to the growth in GDP and whether the various administrative, policy and tax modernization reforms had a positive influence on revenue performance.

From the analysis of VAT productivity, the empirical results indicated that the buoyancy estimate was greater than one and the elasticity was 0.79. Therefore a buoyancy coefficient greater than one implied that the tax modernization programmes and the administrative reforms adopted during the period impacted positively on VAT performance. An elasticity coefficient with a value less than one implied that a one percent increase in GDP resulted in less than one percent increase in revenue holding discretionary tax changes constant. Hence the VAT system was found to be inelastic. Thus, to enhance the VAT performance which is considered important in mobilizing more revenue, focus should be on measures towards enhancing voluntary compliance, close monitoring of non-compliant taxpayers, use of third party data to check compliance levels, improved customer service and education to facilitate taxpayers' compliance and increasing the administration's efficiency. The policy makers should also focus on those taxes which are more elastic to increase the overall tax revenue performance. Another strategy is to widen the tax base by targeting the unexploited sources of revenue such as property taxes and capital gains taxes which would help mobilize more revenue and reduce the tax burden for the taxpayers.

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