Impact of Taxation on Economic Growth: Case study of sub-Saharan African Countries

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Abstract

This paper investigates the effects of taxes on economic growth by using a dynamic panel regression analysis on 35 countries in sub–Saharan Africa (SSA)[1] region over the 2009–2020 period. The analysis is executed using a dynamic panel regression model, System Generalized Methods of Moments (GMM). The findings of this paper suggest that different tax types have different effects on economic growth. Income taxes and corporate taxes have a statistically significant negative impact on economic growth. In contrast, value-added tax (VAT) exhibits a statistically significant positive relationship with economic growth. Therefore, according to these findings, policymakers in the SSA region should consider lowering income and corporate taxes while raising VAT because these policy combinations may increase long-term economic growth.

Keywords Taxation, Long Run Economic Growth, Sub-Saharan Africa

[1] Sub – Saharan Africa (SSA) includes 48 countries which include Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central Africa Republic, Chad, Comoros, Congo(Brazzaville), Congo(Democratic Republic), Cote d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea - Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome Principle, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Western Sahara, Zambia, and Zimbabwe.

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1. Introduction

This paper examines how different taxes affect Sub-Saharan Africa's (SSA) economic growth. In examining the growth effects of different taxes, this paper seeks to answer the research question, "how should a country's tax system be structured so that it spurs economic growth?". In addressing this question, this paper aims to provide policy recommendations on the tax structure that is effective for economic growth for countries in the SSA region. The importance of this analysis emanates from the essential role that taxation plays as a primary revenue source for Governments in the SSA region, making it crucial to examine the relationship between taxation and economic growth.

Revenue collection in most of the countries in the SSA region is constrained by the structure of their economies. Over half of the countries in the SSA region have an economic base on subsidence agriculture. Large informal sectors within their economies exclude most activities from the tax net. For these reasons, these countries have resorted to depending on trade taxes, which also, in recent years, have been constrained by trade openness and liberalization initiatives that have been propagated by the different regional economic communities in the SSA region. Consequently, most countries within the SSA region have a tax-to-GDP ratio of less than 15%, with a regional average of 14.7%. At this level, tax revenues are inadequate, and such low collections create a huge budget deficit, making it difficult for most countries within the region to carry out basic state functions and finance development expenditures. Therefore, enhancing revenue mobilization is critical for governments within the SSA region to better finance infrastructure, education, and health to eradicate poverty and boost their economies. Notably, there has been a decline in aid flows from the donor community to most low-income countries within the SSA region. This further necessitates enhanced tax revenue collection as these countries need to mobilize resources to finance their national budgets domestically.

The tenuous fiscal challenges that governments in the SSA region face require formulating a tax system that is both income-generating and growth-friendly. However, can taxation be used as a fiscal tool for solving some of the budget deficit problems common in the countries within the

SSA region and thus improve economic growth? If the answer is yes, which tax structure will generate adequate revenues, minimize the distortionary effects of taxation, reduces budget deficits, and fulfill the government's primary aim of achieving economic growth? Some empirical studies on the growth effects of taxation have attempted to answer this question for different countries, which have examined which taxes are income-generating and do matter for growth. Even though an extensive review of the literature suggests varied findings, much of the current literature postulates the following. A tax structure based on consumption taxes supports economic growth and switching from income taxes to consumption taxes produces positive growth effects (Stoilova, 2017; Bazgan, 2018). Therefore, if Governments employ base-broadening measures based on consumption taxes, such a policy prescription will eliminate the effect of tax rate cuts on budget deficits, generate income and reallocate resources across sectors toward their highest-value economic use, and consequently increase efficiency and potentially raise the overall size of the economy (Gale & Samwick,2014).

Considering this, a natural question is, should policymakers within the SSA region re-structure their tax system based on consumption taxes, and will such a reform increase tax collection required to better finance investments in human capital, health, and infrastructure to eradicate poverty and boost their economies.? This paper investigates this question by examining the relationship between individual taxes and economic growth to establish which taxes matter for economic growth in the SSA region. For my purposes, I use a dynamic panel data estimation technique to determine the effect of these taxes on economic growth. The system generalized method of moments (GMM) approach is applied to data for 35 countries in the SSA region and over the 2009-2020 period.

This paper finds that corporate tax income and personal income taxes both exert significant adverse growth effects, and in the case of VAT, positive significant growth effects are found. These results suggest that consumption taxes are effective tax instruments, and greater reliance on taxes on general goods and services for countries within the SSA region generates adequate revenues and minimizes the distortionary effects of taxation and budget deficits, ultimately yielding the desired growth effects.

Given the ongoing debate on the impact of taxation and economic growth, I contribute to the literature on taxation and economic growth from an empirical perspective. Firstly, I attempt to address some methodological challenges that most papers on taxation and growth grapple with in evaluating the relationship between taxation and economic growth. These challenges include small sample sizes, errors in measuring tax levels when using data from different countries, omitted variable bias, and simultaneity bias. Analyzing the impact of taxation on economic growth using the System Generalized Methods of Moment (GMM), developed by Arrellano and Bover (1995) and Blundell and Bond (1998), overcomes some of these methodological challenges. Secondly, the study considers 35 countries within the SSA region. Since there is not much literature investigating the linkage between taxation and economic growth for these countries, far less is known about this relationship. It is worth noting that as much as taxation exerts influence on other macroeconomic variables, such as wealth and income inequality, the primary focus of this paper is economic growth through the revenue generation aspect of taxation and other effects of taxation are left for further studies.

The remainder of this paper is organized as follows. Section 2 reviews the literature on taxation and growth to put the study in context. It also discusses the approximation of tax burden. Section 3 discusses data and explains the econometric methodology used to analyze the impact of taxation and economic growth and the empirical results. Finally, section 4 concludes the paper.

2. Taxation and Growth: Theoretical Foundation and approximation of tax burden

There is a vast range of channels through which taxation affects economic growth, encompassing endogenous growth theory or neoclassical growth theory. Both economists and policymakers have attempted to analyze how taxation affects economic growth by extensively exploring the impact of economic growth on taxation using various models. This has been chiefly achieved by modeling the growth generation process, which makes it possible to isolate possible effects of taxation on growth variables.

One simple informative model for illustrating how taxation can affect economic growth, which this study is based on, is a model developed by Mankiw et al. (1992), whose model captures several essential elements of Neoclassical growth theory. Mankiw et al. (1992) conceptualize their growth model by modifying the accounting framework first developed by Solow (1956) by augmenting the Solow Model with human capital. Their framework augments the Solow model by including human and physical capital accumulation. They argue that the omission of human-capital accumulation biases the estimated coefficients on other variables in the model that are also determinants of economic growth.

Their framework determines total output by human capital, physical capital, labor, and technology. Worker productivity depends on the level of technology, where technology augments labor productivity and increases total output through increased labor efficiency. Their model of the production function can be expressed as follows:

$$Y_t = K_t^{\alpha} H_t^{\beta} A L_t^{1-\alpha-\beta} \ . \tag{1}$$

Where α and β is the physical capital share and human capital share respectively.

Y_t is output and determined by a combination of the economy's resources; stock of physical capital K_t; stock of human capital H_t, size of labour force L_t and the level of technology A_t. The law of motion of physical capital per effective unit of labour and the law of motion of human capital per effective unit of labour is expressed as follows, respectively:

$$\dot{k}_t = s_k y_t - (n + g + \delta) k_t \tag{2}$$

$$\dot{h}_t = s_h y_t - (n + g + \delta) h_t \tag{3}$$

Where $y = \frac{Y}{AL}$, $k = \frac{K}{AL}$ and $h = \frac{H}{AL}$ are output, physical capital, and human per effective unit of labor, respectively. Where δ, n and g is depreciation rate, population growth and total factor productivity growth respectively.

Eqn. (2) and (3) imply that the economy converges to a steady state which is defined as:

$$k^* = \left(\frac{s_k^{1-\beta}\, s_h^{\beta}}{n+g+\delta}\right)^{1/_{1-\alpha-\beta}} \tag{4}$$

$$h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n+g+\delta}\right)^{1/_{1-\alpha-\beta}} \tag{5}$$

Substituting the two steady-state equations into the production function and taking logs to give an expression of income per capita.

$$\ln\left[\frac{Y_t}{L_t}\right] = \ln\mathrm{A}(O) + g_t - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) \tag{6}$$

According to Mankiw et al. (1992), the equation above explains long-term per capita income level by human and physical accumulation rates and corresponding depreciation rates. Thus, income per capita depends on population growth, physical capital, and human capital accumulation.

In their model, income per capita is not constant and is subject to changes in human capital, physical capital, and technology. Therefore, in such a model, growth can be affected by taxation. The effects of taxation on growth variables can be traced by explicitly modeling the process through which growth is generated. Consequently, the tax burden can be understood, and predictions about growth effects can be made concurringly. Taxation will therefore affect the growth rate of income per capita by affecting these determinants of income per capita; human capital, physical capital, and technology advancement.

2.1 Literature on Taxation and Growth

An extensive review of the empirical literature on taxation and growth reveals that not all taxes will affect growth in the same way and suggests that the distortionary or non-distortionary effect of taxes will depend on the type of tax. Much of the debate on taxation and growth has evolved from considering whether taxation does indeed matter for growth to considering which taxes matter for growth.

Empirics based on endogenous growth models provide compelling evidence that suggests that the choice of indirect versus direct taxes matters for growth and switching from indirect to direct taxes will yield significant growth effects. Hakim (2020) states that a tax structure based on indirect taxes is more conducive to growth than direct taxes and recommends that governments focus on indirect taxes to maximize tax collection. He investigates the effects and consequences of both direct and indirect taxes on economic growth and total tax revenue in a panel of 51 countries over the period 1992 – 2016 using the dynamic panel generalized method of moments (GMM) estimation and finds that indirect taxes are significant and positively correlated with the economic growth. Korkmaz et al. (2019) and Nguyen (2019) also confirm that switching from income taxes to consumption taxes produces positive growth effects.

However, Simionescu and Albu (2016) suggest that the indirect tax associated with positive growth effects is the value-added tax (VAT). They analyze the impact of the standard VAT rate on economic growth in five Central and Eastern European countries using random effect, dynamic panel, and panel vector-autoregression models over the 1995–2015 period. They find a positive influence of VAT rate on economic growth and bilateral Granger causality between economic growth and VAT rate. Their findings are substantiated by Ayoub and Mukherjee (2019), Hassan (2015), Uritescu (2017), and Ngogu (2015), who confirm the existence of a positive relationship between VAT and economic growth.

Widmalm (2001) used pooled cross-sectional data from 23 OECD countries between 1965 and 1990 to provide evidence that tax structure based on income taxes negatively affects economic growth. Specifically, he finds that the proportion of tax revenue raised by taxing personal income negatively correlates with economic growth. This is supported by Dackehag and Hansson (2012).

They find a negative correlation between corporate and personal income tax and economic growth in their analysis of how statutory tax rates on corporate and personal income affect economic growth using panel data from 1975 to 2010 for 25 rich OECD countries.

While some studies have suggested that consumption taxes are growth-friendly because they are less distortionary than income taxes since they do not affect the incentive to save and invest, which is crucial for economic growth (Nguyen et al., 2021), Kolahi and Noor (2018) provide contrary evidence. They analyzed the effects of value-added tax on economic growth and capital accumulation of 19 developing countries for the period 1995 to 2010 using the GMM panel regression. They find that VAT has a positive effect on economic growth but a negative effect on capital accumulation. With these findings, they concluded that the positive impact of VAT on the level of economic growth is imposed through channels other than the increase of saving and its effect on capital accumulation.

According to Ormaechea and Morozumi (2019), the positive growth effect of the VAT will depend on whether it is raised through C-efficiency or the standard rate, where C-efficiency measures the departure of the VAT from a perfectly enforced tax levied at a single rate on all consumption, which in advanced economies is mainly due to the VAT that is not levied because of exemptions and reduced rates. Utilizing the pooled mean group (PMG) methodology in the context of OECD countries for the period 1970-2018, they examined whether a revenue-neutral increase in the value-added tax (VAT), offset by a fall in income taxes, may have different effects on long-run economic growth depending on how the VAT is raised. They find that an increase in VAT revenue, financed by a fall in income taxes, promotes growth only through a rise in C-efficiency, but not when this happens through an increase in the standard rate. Their result held even when they considered personal and corporate income taxes separately as a financing tax component. They also showed that, for a given VAT revenue, an increase in C-efficiency, offset by a decrease in the standard rate, fosters growth implying that the former is significantly more growth-friendly than the latter. Thus, their results suggest that an increase in C-efficiency, possibly reflecting the broadening of the VAT base through fewer exemptions and a more uniform rate structure with fewer reduced rates, promotes growth more than a rise in the standard rate.

Although there is overwhelming empirical evidence supporting the view that indirect taxes are more conducive to economic growth when compared to indirect taxes, nevertheless, there are other empirical findings that have supported the contrary about the relationship between taxation and economic growth.

Stoilova and Patonov (2013) provide evidence that a tax structure based on direct taxes is more efficient in terms of supporting economic growth in their analysis of the relationship between taxation and economic growth investigated using the ordinary least squares (OLS) method for the EU (27) member states during the period 1995-2010. Their comparative analysis is focused on the cross-country differences in the total tax burden, measured by the tax-to-GDP ratio and design of tax structure, presented by the breakdown of the total tax revenues into standard components such as direct taxes, indirect taxes, and social contributions. Their empirical results showed a clear and strongly expressed positive impact of the direct taxes on economic growth, which is expressed as being due to efficiency gains of revenue accumulation through taxation of wealth. Their comparison between the impacts of tax revenue accumulated by direct and indirect taxes confirmed the assumptions for a lower efficiency of the indirect taxes as a method of budgetary revenue accumulation due to the considerable extent of inequity of the indirect taxes and shrinking effects on production and sales.

This is supported by Korbi and Zani (2021). They also find that direct taxes are those that have a positive impact on economic growth in their analysis of the impact of direct and indirect taxes on the gross domestic product based on an econometric model of autoregressive vectors (VAR) model. According to their findings, an increase in direct taxes from the previous year simulates the current growth, while indirect taxes negatively affect economic growth.

However, Owen Zidar (2019) argues that income taxes will increase economic activity in short to medium run only if taxes are lowered for lower-income earners. He, therefore, emphasizes the importance of the distribution of tax changes for their overall impact on economic activity. He estimates the effects of income tax changes for different groups by using a data series of tax changes by income group and variation from the income distribution across states and federal tax shocks. He finds that the stimulative effects of income tax cuts are primarily driven by tax cuts for the bottom 90 percent and that the empirical link between growth and tax changes for the top 10 percent is weak to negligible. He concludes that tax cuts for top-income earners will be less effective than those for lower-income earners, even though tax cuts for top-income earners may have sizable long-run impacts through different channels such as human capital investment, firm creation, or innovation. This is supported by Mertens and Olea (2018), who also find that counterfactual tax cuts targeting the top 1% alone are estimated to have short-run positive effects on economic activity, while cuts for taxpayers outside of the top 1% also lead to increases in incomes and economic activity, but with a longer delay.

Neog and Gaur (2020) and Gashi et al. (2018) question the existence of a positive impact of either indirect or direct taxes on economic growth that previous studies have suggested. Neog and Gaur (2020) examined the long-run and short-run relationship between tax structure and state-level growth performance in India for the period 1991–2016. Using panel pool mean group estimation for 14 Indian states, they find that income tax and commodity–service tax have adverse effects on state economic growth. Gashi et al. (2018) also find that both income taxes and consumption have a negative impact on growth in their analysis of the tax structure's effect on Kosovo's economic growth in the period 2007-2015 conducted using the Ordinary Least Square method.

It is observed from the literature that even though there is no consensus on the relationship between taxation and growth, most studies advocate for consumption taxes as a stimulator for economic growth compared to income taxes. Therefore, the most popular policy recommendation is that policymakers should reduce personal and corporate income taxes offset by increasing sales tax/value-added tax to spur economic growth. However, it is observed that most of these policy recommendations are mainly based on empirical evidence obtained in the context of high-income countries. Not much work has been conducted for low to middle-income countries of the sub-Saharan region; therefore, they exist a gap in the literature. Most of the studies on taxation and growth have focused on OECD and EU countries due to the ease of data availability for these countries. By using panel regression specifically, the system GMM, which is tailored for a small sample size, this paper overcomes the data limitation that poses a challenge for examining the impact of taxation on growth for countries in the SSA region. In this respect, the primary purpose of this paper is to provide one more estimate and a few more suggestions for growth-conductive taxation in the context of the Sub-Saharan region's low to middle-income countries.

2.2 Approximation of tax burden

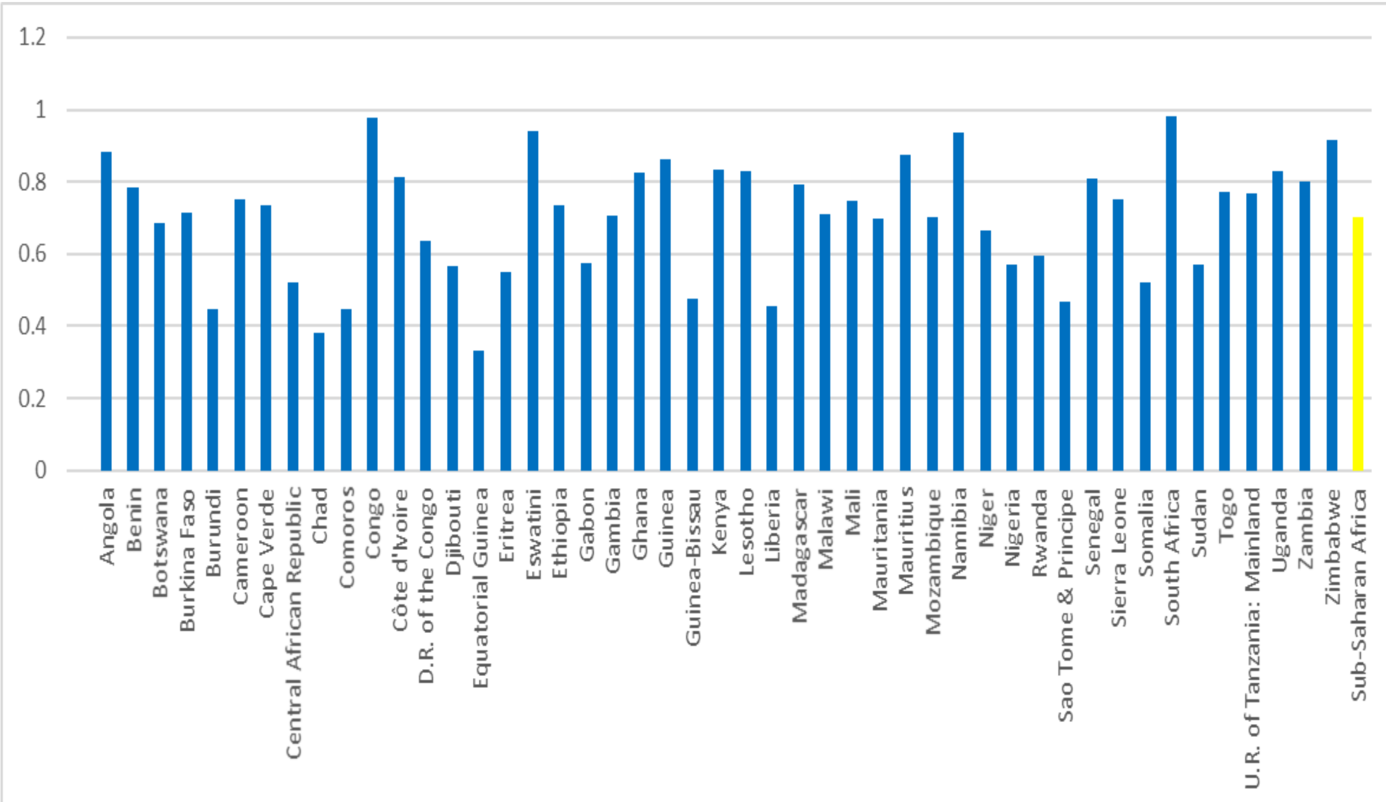
The SSA region is a group of heterogeneous countries comprising low-income and medium-income countries. The diversity of countries in this region is observed in both the structure of their economies and tax systems. Such heterogeneity raises the need to select tax burden indicators that allow for mutual comparison of tax burden across the region. Tax rates may not be the best approximation of tax burden for this analysis due to the differences in tax systems, making it difficult to achieve harmonization. The multiplicity of tax rates, tax bases, and tax brackets associated with different taxes makes it impossible to compute a comparable tax rate for the South Saharan African region. Comparison of the tax burden is best achieved by approximating the tax burden by the share of taxes in total government revenue and the share of taxes in GDP.

An alternative would be to use nominal tax revenue to measure the tax burden. However, using nominal tax revenue when conducting cross-country comparisons involves the tedious exercise of adjusting for different national currencies and for inflation to achieve standardization. Therefore, the simple, convenient, and comparable approximations of the tax burden that captures the effects of taxes on economic growth are the share of taxes to GDP and the share of taxes to total government revenue.

2.1.1 Approximation of tax burden by share of taxes in total government revenue

Tax as a share of total government revenue measures the relative importance of different taxes in total government revenue. This is a good approximation of tax burden measure when performing cross-country comparisons because it controls for the size of the economy, inflation, and other cross-country differences.

Figure 1. Average Tax burden Approximated by Share of Taxes in Total government revenue in SSA Countries (2009-2020)



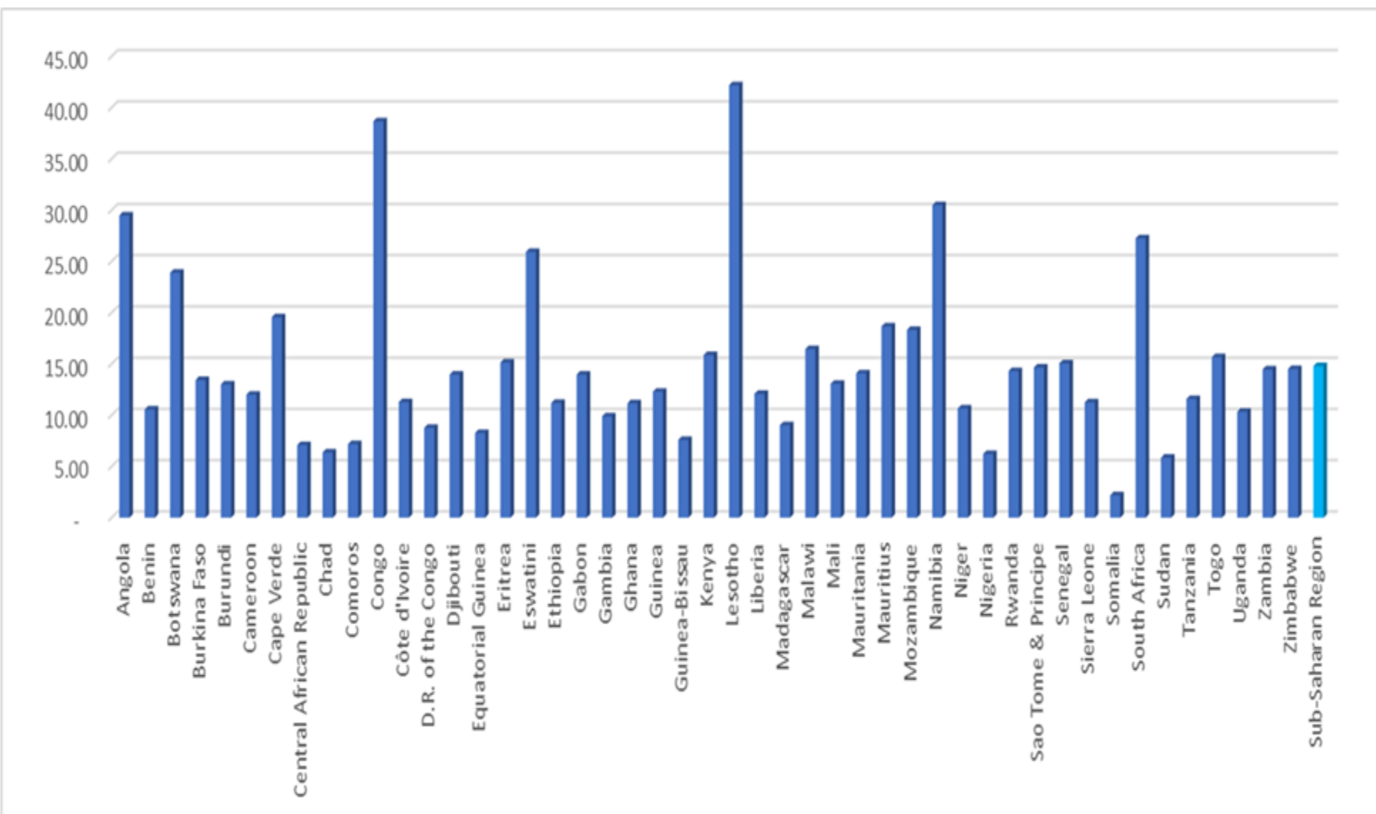
Source: Penn World Table 10.0(2009-2020)-http://www.ggdc.net/pwt

Figure 1 represents the average total tax burden approximated by the share of taxes in total government revenues for sub -Saharan African countries for the period 2009 -2020. The average tax burden for the region is 0.70, where the highest tax burden is estimated for South Africa at 0.98, and the lowest is estimated for Equatorial Guinea at 0.33. The difference between the lowest and the highest tax burden is 0.65. Fourteen countries register tax burden above 80%, including Angola, Congo, Cote d'Ivoire, Eswatini, Ghana, Guinea, Kenya, Lesotho, Mauritius, Namibia, South Africa, Senegal, Uganda, and Zimbabwe. The Majority of countries are found in the ranges between 0.5 to 0.8, namely Benin, Botswana, Burkina Faso, Cameroon, Cape Verde, Central African Republic, D.R. of the Congo, Djibouti, Eritrea, Ethiopia, Gabon, Gambia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Sierra Leone, Somalia, Sudan, Togo, Tanzania, and Zambia. Seven countries are found within 0.3 to 0.5: Burundi, Chad, Comoros, Equatorial Guinea, Guinea Bissau, Liberia, Sao Tome & Principle.

2.1.2 Approximation of tax burden by share of taxes in total government revenue

Tax as a percentage of GDP measures the performance of a country's taxes in relation to GDP. GDP provides an inherit yardstick against which the performance of taxes can be analyzed, considering that it does not consider changes in taxes associated with inflation and economic growth. This allows for cross-country comparisons by standardizing taxes to the size of the economy, eliminating the need for currency harmonization.

Figure 2. Average Tax burden Approximated by Share of taxes in GDP in SSA Countries (2009-2020)



Source: Penn World Table 10.0(2009-2020)-http://www.ggdc.net/pwt

Figure 2 depicts the size of the average tax burden in SSA countries approximated by the share of total taxes in GDP for the period 2009 to 2020. It can be observed from the figure that the total average tax burden for the region as a whole is 14.7%. The highest tax burden was computed for Lesotho, with a rate of 42.1%, positioning itself as the only country above the threshold level. There are only seven countries above a 20% tax burden: Angola, Congo, Botswana, Eswatini, Namibia, and South Africa. It is not a coincidence that all these countries mentioned above fall under the middle-income country category.

The masses are within the ranges from 0% to 20%. Kenya, Malawi, Mauritius, Mozambique, Cape Verde, Eritrea, and Tongo are within the range of 15% to 20%. The remaining 34 countries are under 15% in particular Benin, Burkina Faso, Burundi, Cameroon, Central Africa Republic, Comoros, Cote d'Ivoire, Chad, Democratic Republic of Congo, Djibouti, Ethiopia, Equatorial Guinea, Eritrea, Gambia, Ghana, Gabon, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania Niger, Nigeria, Rwanda, Senegal, Sao Tome & Principle, Somalia, Sudan, Sierra Leone, Tanzania, Uganda, Zambia, and Zimbabwe.

The lowest total tax burden under 20% is estimated for Somalia -2.2% followed by Sudan-5.8%. The difference between the lowest and highest tax burden is 39.9%. It is clear from these computations that the tax-to-GDP ratios for most countries within the sub-Saharan region fall below the minimum threshold of 15%. This implies that much work is needed for these countries to move from poverty to accelerated economic growth, considering that most of the countries in this category fall under the low-income category.

The low tax-to-GDP ratio of the region, estimated at 14.7%, can partly be attributed to the difficulties that governments within the region face in mobilizing revenues from taxation, such as:

i. Large informal sector:

   The informal sector in sub-Saharan Africa is amongst the largest in the world. According to Medina et al. (2017), the average share of informality in the SSA region is around 40% of the GDP. This poses a significant challenge for tax administrators to impose income taxes due to the nature of businesses within the sector. Such massive informality shares signify substantial revenue potential from the informal sector; consequently, vast sums of revenues are forgone.

ii. Political influence:
When taxpayers have political affiliations, they evade and avoid taxes, thereby frustrating the efforts made by revenue administrators to enforce tax remittance. This leads to a reduction in revenues collected from taxes.

iii. Manual systems in collecting revenue:
Most countries in the SSA region have not yet progressed to a digital collection of tax revenue. As a natural consequence, taxpayers still file returns and remit taxes manually. Such an ineffective mode of manual revenue collection leads to substantial revenue linkages and tax evasion.

iv. Exemptions and special waivers:
Substantial revenues are lost through exemptions and waivers by narrowing the tax base. Sometimes, politicians and bureaucrats use their office to grant targeted special waivers and exemptions for their gain.

3. Regression and Results

3.1 Model specification

This study aims to analyze the growth effects of different tax instruments. This paper applies the analytical framework as conceptualized by Mankiw et al. (1992), specified in the modified version of Macek (2014), where the growth effects of taxation are analyzed through the impact of growth variables such as investment, human capital, capital accumulation, and technological advancement.

The analysis is executed using a dynamic panel regression model, which allows the inclusion of dependent variables as explanatory variables. As such, this model enables extensive exploitation of the dynamics of the effects of different tax instruments on economic growth. Therefore, this study estimates the following standard growth regression, which takes the form of a dynamic panel regression that includes time and country effects.

$$GDP_{it} = \hat{\beta}_1 GDP_{it-1} + \hat{\beta}_2 RINV_{it} + \hat{\beta}_3 HUM_{it} + \hat{\beta}_4 GOV_{it} + \hat{\beta}_5 TAX^*_{it} + \hat{u}_{it} \quad (8)$$

$i = 1 \ldots\ldots\ldots 35;\ t = 2009 - 2020,$

Where *i* corresponds to each country *i,* for which 35 are in the sample. Furthermore, *t* corresponds to the period from 2009 -2020. In the specification of the model above, the dependent variable is real GDP per capita expressed as the amount of GDP per capita in purchasing power parity, GDP_{it}, in country i in year t, regressed on its own lagged value, GDP_{it-1} and a set of other regressors. The set of regressors includes the determinants of economic growth such as capital accumulation approximated by investment share in GDP expressed in purchasing power parity per capita, $RINV_{it}$, the share of taxes in GDP or total revenues, TAX^*_{it}, and growth rate of the human capital index, HUM_{it}. Share of government spending in GDP, GOV_{it}, is also added to the regression. In analyzing tax policy implications including the expenditure financed by taxation is crucial in understanding the growth effects of taxation. Tax increases enacted to finance productive expenditures such as investment are associated with economic growth, while unproductive spending funded through taxation has adverse growth effects. Concurrently, Bleanary et al. (2001) emphasize the importance of evaluating the growth effects of taxation and spending together. He argues that analyzing tax effects in isolation weakens economic growth while examining these effects in collaboration offsets the negative impact of taxation on economic growth.

The variables entering the model are transformed into logarithms so that the coefficients of the independent variables can be interpreted as the amount by which the GDP growth rate increases or decreases when the independent variable changes by 1%. Therefore, this involves estimating model (8) as follows:

$$lnGDP_{it} = \hat{\beta}_1 lnGDP_{it-1} + \hat{\beta}_2 lnRINV_{it} + \hat{\beta}_3 lnHUM_{it} + \hat{\beta}_4 lnGOV_{it} + \hat{\beta}_5 lnTAX^*_{it} + \hat{u}_{it} \quad (9)$$

$i = 1 \ldots\ldots\ldots 35;\ t = 2009 - 2020$

The estimation of Eqn. (9) poses significant econometric problems which may lead to spurious results. Firstly, countries in the SSA region are divergent countries with significant differences in their tax systems, production functions, institution parameters, etc. Therefore, with such differences across panels, unobserved panel heterogeneity is likely. Secondly, the likelihood of encountering omitted variable bias is high considering that when policymakers formulate a new policy or revise an existing one to achieve specific objectives, such as to stimulate a weak economy, offset changes in government spending, or a reduce budget deficits, such policy changes are often implemented alongside other policies which affect economic growth.

Thirdly, while tax changes may affect economic growth, economic growth may also influence taxation. This may happen when changes in economic growth prompt policymakers to revise taxes or restructure the tax system when economic growth changes affect productivity and, consequently, the tax base. In such cases, this may lead to simultaneity bias, where GDP becomes a predictor of taxation and not simply a response to taxation. The omitted variable and simultaneity bias may cause endogeneity problems in the model, which may cause spurious results. Lastly, another problem likely to be encountered is small sample bias due to this study's small sample size originating from data availability issues.

The use of system generalized methods of moments, developed by Arellano and Bover (1995) and Blundell and Bond (1998), to estimate equation (9) helps to address all the estimation problems outlined above. The system generalized methods of moments are specially designed for dynamic panel models with short time, t, for independent variables that are not strictly endogenous and correlated with past and possibly current realization of the error terms, and for panels with arbitrary distributed fixed effects, heteroscedasticity and that are autocorrelated.

Using fixed effects to estimate equation (9) violates the assumption of strict exogeneity due to the possibility of correlation amongst the explanatory variables. According to Nickell (1981), fixed effects estimates for dynamic panel models are biased and inconsistent. Such endogeneity and inconsistent estimation call for using instrumental variables where the instrumental variable is not correlated with the error term but with the regressor. Anderson and Hsia (1982) state that earlier lag periods can be used as instrumental variables where either the first difference or level of the second difference of the dependent variable can be used as an instrument. When the level of the second difference is used as an instrumental variable, the correlation between the second difference and the difference of error terms is not found. However, the second difference is correlated with the first difference. Hence the instrumental variables cannot exploit all the available moment conditions; therefore, such instruments are consistent but ineffective. However, Arrelano and Bond (1991) postulate that for such instruments to be both consistent and efficient, they must exploit all available moment conditions. The system generalized method of moments satisfies such unconditional population moment conditions.

System generalized methods of moments build a system of two equations. The first equation is expressed in levels using the first differences as instruments, and the second is expressed in differences using levels as instruments. This approach involves the use of a greater number of moment conditions. Thus, it corrects for endogeneity by introducing many instruments to drastically improve efficiency and transform the instruments to make them uncorrelated (exogenous) with fixed effects.

System GMM is best suited for dynamic panels with large panel units with short time periods(N>t). The estimator minimizes data loss by applying forward orthogonal deviations rather than first differences. Instead of subtracting the previous observations from contemporaneous ones, the estimator subtracts the average of all future available observations of a variable. No matter how many gaps exist, it is computable for all observations except the last for each to minimize data loss. Henceforth Monte Carlo evidence suggests that when time, t, is short and the dependent variable is persistent, there are gains in precision. The small sample bias is reduced when the system generalized methods of moments is used. Additionally, the two-step system generalized methods of moments estimator corrects for the presence of heteroscedasticity by exploiting a weighting matrix using residuals from the first step.

The appropriateness of utilizing system GMM is tested using Bond (2001) rule of thumb, which estimates equation (9) using pooled OLS, fixed effects estimator, and difference generalized methods of moments[2]. The value of the $\hat{\beta}_1$ coefficient for the pooled OLS is computed as an upper bound, while the value of $\hat{\beta}_1$ coefficient for the fixed effects estimator is computed as a lower bound. When the difference GMM estimate of $\hat{\beta}_1$ is close to or below the fixed effect estimate of $\hat{\beta}_1$,it implies that the difference GMM is downward bias of weak instrumentation, and the system GMM estimator should be used instead. When difference GMM is not a suitable estimator for any model, it yields a biased and inefficient estimate of $\hat{\beta}_1$ in finite samples, which is potentially acute when the time, t, is short, as is the case with panel data in this analysis. Blundell and Bond (1998) assert that such poor performance of the difference GMM estimator in such a scenario is attributed to poor instruments. They argue that the instruments used in the first differences become less informative where the autoregressive parameter increases towards unity and the variance of the specific effects increases relative to the variance of the error term.

Several pre-estimation tests are carried out to test the adequacy of model[3]. Firstly, the stability of the variables was checked by the tests of Lm, Pesaran, and Shin (2003), Madalla and Wu (1999), and Levin, Lin, and Chu (2002). These tests examine whether the inverse of all unit roots are inside the unit circle. Secondly, Hansen (1982) and Sargan (1958) tests are carried out to test the instruments' validity. They test the over-identifying restriction where the null hypothesis is the overall validity of the instruments used, and failure to reject the null hypothesis supports the choice of instruments. Thirdly, tests for autocorrelation and serial correlation of the error term are conducted to test the null hypothesis that the differenced error terms in both the first and second orders are not serially correlated. Failure to reject the null hypothesis of no second-order serial correlation implies that the original error term is serially uncorrelated, and the moment conditions are correctly specified.

3.2 Data and Findings

[2] The results justifying the appropriateness of using the system GMM to estimate this paper's model are presented in section D of the Appendix.
[3] Stationarity test results, tests for the validity of instruments used, and tests for autocorrelation and serial correlation are presented in section C of the Appendix.

In this analysis, panel data for the period 2009 – 2020 is used to examine the growth effects of tax instruments on a sample of 35 countries. The sample size comprises selected low- and middle-income countries within the SSA region. Given the unavailability of data on tax revenue disaggregated by tax type for most of the countries in the SSA region, the analysis is conducted using data for 12 years. The system GMM approach developed by Arellano and Bond (1991) that is used in this paper's analysis controls for small sample bias. As such, it provides consistent and effective estimates of the growth effects of taxation in our small sample size.

The tax data was extracted from the IMF's World Revenue Longitudinal data[4] and the IMF's Government Finance Statistics at a glance[5]. The data on the human capital index, the ratio of investment in GDP, real GDP, and the ratio of government spending in GDP are obtained from the Penn World Table database (Penn World Table 10.1)[6].

Two different approximations of tax burden have been used to capture the effects of taxes on economic growth. The share of taxes to GDP and the share of taxes to total government revenue is used as tax burden measures. These two tax burden measures are compiled and computed for all 35 countries in the data sample.

The estimation results when employing the system GMM estimator are given in Tables (1) and (2). According to the diagnostic test results in column 1 of both tables (1) and (2), the autocorrelation of the differenced error term is present in the second order (AR-2) and absent in the first order (AR-1). The Sagan Test supports the validity of the choice of instruments. The presence of autocorrelation in the second order compromises the consistency of the system GMM approach. Therefore, to improve the model's consistency, the system GMM estimator was conducted with robust standard errors in columns 2 of tables (1) and (2). Respective diagnostics checks support the robustness and consistency of these results.

3.3 Analysis of Results

[4] IMF's World Revenue Longitudinal data available from: https://data.world/imf/world-revenue-longitudinal-dat
[5] Government Finance Statistics at a glance-available from: https://data.imf.org/?sk=a0867067-d23c-4ebc-ad23-d3b015045405
[6] Penn World Table database (Penn World Table 10.1)- available from: http://www.ggdc.net/pwt

Table 1 System GMM estimation results where taxation is approximated by share of taxes in total government revenue

	(1)	(2)	(3)	
No. of countries	35	35	Economic verification	
No. of observations	578	578		
Within R-squared	0.87	0.86		
Sargan Test	0.17	0.130		
Arellano-Bond AR (1)	0.002	0.013	Empiric	Result
Arellano-Bond AR (2)	0.281	0.017		
Lagged GDP	0.87(0.01) **	0.86(0.00) ***	+	+
Investment share	0.03(0.042) *	0.04(0.00) ***	+	+
Human Capital	0.01(0.31)	0.027(0.14)	+	+
Government spending	-0.03(0.06)	0.02(0.04) *	+	+
Corporate income tax	-0.02(0.15)	-0.015(0.05) *	-	-
Personal income tax	-0.04(0.022) *	-0.03(0.01) **	-	-
VAT	0.05(0.03) *	0.06(0.00) ***	+	+

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level respectively

Table 1 provides the model results in which the share of taxes in total government revenue is used as an approximation of the tax burden. The estimated coefficient in the lagged dependent variable is positive and significant at a 1% significance level, which suggests that GDP follows a significant AR (1) process. The estimated coefficient on the investment growth is positive and significant at a 1% significance level. The acquisition of capital adds up to the existing capital stock level, thus increasing the quantity of capital available in an economy. Increased capital translates to increased productivity, ultimately contributing to economic growth. The estimated coefficients on the growth in human capital is positive and insignificant.

The estimated coefficient on government spending is positive and significant at 10%. Government spending associated with increased productivity enables and promotes income generation through increased tax revenues conducive to economic growth. Such expenditure includes infrastructure development, health, education, and transport. This significant positive effect of government spending on growth implies the prevalence of productive governmThesent spending.

The estimated coefficient on VAT is positive and significant at a 1% significance level, registering a positive growth effect. The estimated coefficient on PIT is negative and significant at a 5% significant level, while the estimated coefficient on CIT is negative and significant at 10% significant level.

The negative coefficient on CIT and PIT are consistent with the theory that postulates a negative growth effect of both PIT and CIT as these taxes reduce discretionary income for individuals and businesses. Every currency unit government consumes one less currency unit available for the private sector to engage in productivity and investment. As such, income taxes exert significant adverse effects and little or no positive substitution effects that incentivize individuals to work, save and invest. However, VAT does not play any significant role in distorting the allocation of resources since it is a tax on consumption where the type of good or service is irrelevant in its computation. Consumption taxes favor productivity and investment by not disincentivizing individuals to work, save, and invest. Unlike income taxes, consumption taxes exert significant positive substitution effects that incentivize individuals to work, save and invest, exert minor adverse income effects, and minimize economic distortions.

The positive relationship between VAT and economic growth can further be explained by the fact that VAT is easy to administer, and that revenue leakages and low compliance is minimal compared to income taxes. VAT collection is not constrained by valuation or assessment issues/disputes common in calculating other taxes, such as income and wealth taxes. Furthermore, most countries in the SSA region have employed administrative, and tax measures that have succeeded in enhancing compliance of the VAT. Such measures include block management systems, withholding VAT, and electronic tax registers. For example, Kenya, Tanzania, Rwanda, and Malawi, have enforced Electronic Tax Registers through the mandatory use of Electric fiscal devices (EFDs) for every VAT taxpayer. These EFDs monitor taxpayers' sales transactions through a GPRS modern to the Revenue Authority's central server. As such, this curbs tax evasion and compliance.

The Negative relationship between PIT, CIT, and economic growth can be attributed firstly to the prevalence of a substantial informal sector in the SAA region. About 40% of the working population is in the agriculture sector, and the scope of taxing individuals in this sector is limited. As a result, most of the activities in the informal sector are excluded from the tax net. Secondly, the widespread practice of granting tax concessions to attract new investors that is common in the SSA region has the natural consequence of limiting the scope of corporate income tax. These tax concessions are granted through tax holidays, capital allowances, industrial rebates, etc. In Malawi, for example, mining companies are exempt from taxes for the first ten years. In Kenya, investors investing in Export Processing Zones are granted a 10-year CIT tax holiday. In Tanzania, Investors that invest in Free economic zones are given a 10-year CIT tax holiday, while those that invest in free zones are given a 20-year CIT tax holiday.

Estimating equation (2) using the share of taxes to GDP yields slightly different results from the first model, which are more consistent with economic theory. The estimated investment coefficient is also positive and statistically significant, with a 5% significance level. Unlike the previous model, the estimated coefficient on human capital is positive and statistically significant at a 10% significance level. Growth in human capital embodies the growth in knowledge and skills that individuals attain and develop, which empower them to reach their potential as productive economic actors. Investment in individuals through quality education and skillful training leads to the expansion of human capital, which leads to increased productivity. Therefore, efforts made by the public and private sectors to develop the knowledge and skill of the workforce through the provision of quality education promotes economic growth. Like the first model, the estimated coefficient in the lagged dependent variable is positive and significant at a 1% significance level, confirming that GDP follows a significant AR (1) process.

Table 2 System GMM estimation results where taxation is approximated by share of taxes in GDP.

	(1)	(2)	(3)	
No. of Countries	35	35		
No. of Observations	578	578	Economic verification	
Within R-squared	0.83	0.82		
Sargan Test	0.172	0.141		
Arellano-Bond AR (1)	0.017	0.015	Empiric	Result
Arellano-Bond AR (2)	0.253	0.016		
Lagged GDP	0.83(0.01) **	0.82(0.00) ***	+	+
Investment share	0.02(0.03) *	0.05(0.01) **	+	+
Human Capital	0.03(0.18)	0.03(0.04) *	+	+
Government spending	0.04(0.01) **	-0.01(0.00) ***	+	-
Corporate income tax	0.03(0.04) *	-0.02(0.01) **	-	-
Personal income tax	-0.06(0.02) **	-0.02(0.01) **	-	-
VAT	0.01(0.03) **	0.01(0.00) ***	+	+

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level respectively

Unlike in the previous model, the coefficient on government spending is negative and significant at 1%. These results can be explained by the low ratio of recurrent expenditure to total expenditure for the countries within the SSA region. For some of the countries in the sample, development expenditure is not prioritized, and no funds are disbursed for capital expenditure. For the countries with budget allocations towards capital expenditure, the proportion of capital expenditure to total Government expenditure is less than 10%. Hence such low capital investment will have a minimal impact on productivity and bring little returns to the government.

Additionally, most countries within the SSA region operate on deficit budgets where the deficits are financed mainly through domestic borrowing. Government expenditure financed through domestic borrowing depletes the accessible lending volume in an economy. This implies raising interest rates making credit expensive. Consequently, individuals and firms shy away from obtaining loans to finance investments and increase productivity. This fosters an economic decline lowering revenues obtained from taxation because of a reduction in productivity. As a result, these further necessities more government borrowing, further exhausting the credit volume in the economy.

Furthermore, corruption in rampage within countries in the SSA region where it is common practice for political authorities to dictate budget allocations for their gains. Some politicians and bureaucrats sometimes use their influence to extract economic gains from others by involving in transactions that benefit a few targeted individuals at the expense of taxpayers' money. Therefore, the negative coefficient on government spending indicates the possible prevalence of unproductive government spending, rent-seeking, and crowding-out effects in total government spending.

Theoretical assumptions on the negative growth effect of taxes are confirmed with a realization of significant negative estimated coefficients on PIT and CIT at 5% significance levels. As explained earlier, income taxes exert significant adverse income effects by negatively impacting productivity and investment. Like the previous model, VAT registers a positive significant estimated coefficient at a 1% significance level. As eluded before, VAT has minimal distortion effects because it does not significantly affect the allocation of resources.

4. Conclusion

This paper investigates which tax instruments are effective tax measures that satisfy government expenditure needs while resolving existing budget problems in a panel of 35 countries in the SSA region where the tax burden is approximated as the share of taxes in total government revenue and the share of taxes in GDP. The analysis is conducted using the system GMM estimator technique developed by Arellano and Bond (1991) and Blundell and Bond (1998).

By empirics, for most of the analysis, I find that greater reliance on income taxes hurts economic growth. I find a negative relationship between income tax and personal income with economic growth in both the separate regressions where the tax burden is measured as a share of taxes to total government revenues and where it is measured as a share of tax instruments to GDP. The results confirmed the findings from most studies where a significant positive relationship with economic growth is obtained using both approximations of the tax burden.

A mutual comparison of the growth effects of the different tax instruments suggests that by registering a positive growth effect, VAT is an effective tax policy that generates adequate tax revenue while exerting minimal distortions to the economy. On the other hand, both income taxes are less effective tax instruments which are evident by their negative impact on growth through their effect on investment, human capital, and capital accumulation.

Governments in the SSA region must strengthen and restructure their fiscal frameworks to mobilize tax revenues and make budget allocations efficiently and productively to address their existing budget problems. Thus, tax structure based on consumption taxes coupled with productive expenditure will play a vital role in achieving a growth-induced budget consolidation process that can reduce budget deficits by facilitating the generation of adequate tax revenue while exerting minimal economic distortions. Therefore, based on the results of this paper, to address the existing budget issues, countries within the sub-Saharan region should lower their income tax rates, which should correspond with an increase in rates of consumption taxes.

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Appendix

Section A: List of Countries in the sample

The sample consists of the following 35 countries.

Angola, Burundi, Benin, Botswana, Burkina Faso, Central African Republic, Cote d'Ivoire, Cameroon, D.R of the Congo, Congo, Ethiopia, Ghana, Gambia, Kenya, Liberia, Lesotho, Madagascar, Mali, Mozambique, Mauritania, Mauritius, Malawi, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Eswatini, Togo, Tanzania, Uganda, South Africa, Zambia, Zimbabwe.

Section B: Data Description and sources

This section describes all variables employed in the study. It explains how each variable is computed and includes information on all the data sources. A summary of the main descriptive statistics for the variables in the study is provided in table 3.

GDP per capita is obtained by dividing real GDP in constant 2011 national prices (rgdpna) with population figures to obtain per capita values given by the formula below

$$GDP_C = \frac{rgdpna}{population}$$

The real GDP and population figures were taken from the Penn World Table version 10.0 database.

Human capital measure is approximated as the growth rate of the human capital index obtained from Penn World Table version 10.0. This index measures the stock of human capital in each country. It is calculated by combining information on average years of schooling for the working-age population of 15 to 65 years with return rates to education. The following formula gives the growth rate of the human capital index

$$g^{hc} = \frac{human\ capital_t}{human\ capital_{t-1}} - 1$$

Investment share is the ratio of gross fixed capital formulation to GDP in current prices and is obtained directly from the Penn World Table, version 10.0.

The share of total taxes in GDP is obtained directly from the IMF's World Revenue Longitudinal data set and the IMF's Government Financial Statistics at a glance. These data comprise corporate income taxes, personal income taxes, and Value added taxes (VAT) estimated as shares in GDP.

The share of taxes in total government revenue is commuted by dividing each of the taxes on corporate income, personal income, and value addition by total tax given as follows

$$t_1^{CIT} = \frac{Corporate\ income\ tax}{Total\ government\ revenue}$$

$$t_2^{PIT} = \frac{Personal\ Income\ tax}{total\ government\ revenue}$$

$$t_3^{VAT} = \frac{Value\ added\ tax}{total\ government\ revenue}$$

Tax data is obtained from the IMF's World Revenue Longitudinal data set.

Section C: Pre-estimation tests

Stationarity test

Three different stationarity tests were conducted to examine the stability of all the variables used in this paper's analysis, namely, Lm, Pesaran, and Shin (2003), Maddala and Wu (1999), and Levin, Lin, and Chu (2002). The stationarity of variables needed to be assessed before running any regressions, particularly using the above panel data unit root tests. Instead of conducting stationarity tests on time series that make up the panel, stationarity tests were conducted collectively to exploit the advantages of testing the panel collectively. Such benefits include desirable standard asymptotic distributions of panel unit root tests, greater power associated with panel unit root tests, and a large quantity of information and variation possessed by panel data compared to time series unit root tests and time series data.

Table 3. Descriptive statistics and sources

	Obs	Mean	Std. dev	Min	Max	Cor.	Source
Tax share in revenue							
Corporate income tax	420	-1.908	0.516	-3.590	-0.360	0.1152	IMF World Revenue Longitudinal data
Personal Income tax	420	-2.006	0.649	-5.865	-0.482	0.0788	IMF World Revenue Longitudinal data
VAT	420	-1.503	0.906	-8.409	-0.387	-0.2415	IMF World Revenue Longitudinal data
Tax share in GDP							
Corporate income tax	420	0.756	0.629	-1.393	2.997	0.4834	IMF GFS at a glance
Personal Income tax	420	0.658	0.818	-3.685	2.358	0.3618	IMF GFS at a glance
VAT	420	1.161	1.011	-7.044	2.160	0.2078	IMF GFS at a glance
Other variables							
GDP	420	7.931	0.819	6.676	10.079	1	Penn World Table
Investment Share	420	-1.693	0.443	-3.167	-0.544	0.2273	Penn World Table
Human Capital	408	-4.752	0.724	-6.775	-3.456	0.0903	Penn World Table
Government spending	420	-1.901	0.350	-2.787	-1.075	0.3069	Penn World Table

lm, Pesaran and Shin (2003), Maddala and Wu (1999) and Levin, Lin, and Chu (2002) test the null hypothesis that a unit root is present in the panel data sample. The null hypothesis is that the panel data does not have a unit root. Thus, they test the null hypothesis that the data is non-stationary against the alternative hypothesis that it is stationarity.

According to the panel unit root tests results depicted in table 4, we are able to reject the null hypothesis of the existence of unit root in our panel data for all the variables employed. These results are agreeable for all the three tests. The significance of all the test results falls within 1% and 5% level. Thus, all our variables are stationarity and pass the stability test.

Table 4. Stationarity test results

Variable	Levin, Lin & Chu (2002)	Lm, Pesaran & Shin (2003)	Maddala & wu (1999)	Status
Tax share in total government revenue				
Corporate income tax	-16.165*** (<2.2e-16)	-13.843*** (<2.2e-16)	709.73*** (<2.2e-16)	I (0)
Personal Income tax	-7.8521*** (2.045e-15)	-6.462*** (5.167e-11)	244.87*** (< 2.2e-16)	I (0)
VAT	-26.18*** (< 2.2e-16)	9.6806*** (< 2.2e-16)	-402.34*** (< 2.2e-16)	I (0)
Tax share in GDP				
Corporate income tax	7.9109*** (1.277e-15)	8.2053*** (< 2.2e-16)	350.7*** (< 2.2e-16)	I (0)
Personal Income tax	-5.6027*** (1.055e-08)	-5.982*** (1.102e-09)	263.11*** (< 2.2e-16)	I (0)
VAT	-2.7088*** (0.003376)	-3.669*** (0.0001217)	159.32*** (6.468e-09)	I (0)
Other variables				
GDP	-2.2849** (0.01116)	-2.4073** (0.008035)	209.93*** (6.711e-16)	I (0)
Investment Share	-6.5397*** (3.08e-11)	-6.3333*** (1.2e-10)	323.58*** (<2.2e-16)	I (0)
Human Capital	-3.211*** (<2.2e-16)	1.18406*** (<2.2e-16)	488.79*** (<2.2e-16)	I (0)
Government spending	-6.3866*** (8.47e-11)	-4.107*** (2.004e-05)	186.7*** (1.461e-12)	I (0)

Notes: *** and *** indicates significance at the 1%, 5% level respectively

A combination of different stationarity tests was employed to exploit strengths and counteract the limitation of each panel unit root test. The Levin-Lin-Chu unit root test is famous for its ability to control heteroscedasticity and autocorrelation, allowing for effects, time, and trend effects. However, this test does not perform well with panel data with large panels and relatively short time periods, as it requires that the ratio of the number of panels to time periods should tend toward zero. Furthermore, the critical values for this test are primarily influenced by the choice of lag lengths in ADF regression. The Lm Pesaran and Shin unit root tests are considered a relatively flexible and simple panel unit root test to the Levin-Lin-Chu unit root test. The significant advantage of this test is that it allows for serial correlation and heterogeneity across panels. Even so, this test is only limited to balanced panel data, and the results of the panel unit need to be interpreted with care, as rejecting the null hypothesis does not mean that the unit null is rejected for all observations. Some of the shortcomings of the Levin-Lin-Chu unit root test and the lm Pesaran and Shin unit root test are overcome by Madda and Wu (1999), which use a non-parametric fisher-type test.

Section D: Additional regression results

To assess the appropriateness of employing the system GMM, documentation is given on how the choice of the model's estimator was arrived at utilizing the Bond (2001) rule of thumb. To carry out this exercise, equation (9) is estimated using three estimators: pooled OLS, fixed effects, and difference GMM. According to Bond (2001), the pooled OLS estimator is the upper bound estimate, and the fixed effect estimator is the lower bound estimate.

Columns (1), (2), and (3) of tables (5) provide regression estimates of the three estimators using the share of taxes in total government revenue as an approximation of tax burden. According to these results, the estimated coefficient in the lagged dependent variable for the difference GMM estimator is below the lower bound coefficient estimate of the fixed effects estimator. This suggests that the system GMM estimator is the best suitable estimator for equation (9). Hence the Bond (2001) rule of thumb postulates that if the coefficient estimates of the lagged dependent estimated with difference GMM is below or close to the coefficient estimate of the lagged dependent variable estimated with fixed effects estimator. The equation should be calculated using the system GMM estimator.

Table 5. estimation results where taxation is approximated by share of tax revenues in total government revenue

	Pooled OLS (1)	Fixed effects (2)	Difference GMM (3)
Lagged GDP	0.87(0.00) ***	0.86(0.00) ***	0.79(0.00) ***
Investment share	0.02(0.00) ***	0.06(0.00) ***	0.02(0.72)
Human Capital	0.01(0.13)	0.02(0.11)	0.01(0.59)
Government spending	0.06(0.01) **	-0.32(0.28)	-0.08(0.03) *
Corporate income tax	-0.09(0.02) *	-0.08(0.00) ***	-0.03(0.61)
Personal income tax	-0.06(0.00) ***	-0.07(0.01) **	-0.02(0.01) **
VAT	0.04(0.01) **	-0.03(0.04) *	-0.15(0.00) ***
Countries	34	34	35
Observations	306	306	272
R-squared	0.8755	0.855	-
Adjusted R-squared	0.8734	0.847	-
Sargan Test	-	-	0.2341
Arellano-Bond AR (2)	-	-	0.0047

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level respectively

Columns (1), (2), and (3) of tables (6) provide regression estimates of the three estimators using the share of taxes in total GDP as an approximation of tax burden. The results of the estimated coefficient in the lagged dependent variable for the difference GMM estimator are also below the lower bound coefficient estimate of the fixed effects estimator. Hence these results are similar to those obtained where the tax burden is approximated by the share of taxes in total government revenue. They also suggest that the system GMM estimator is the best suitable estimator for equation (9).

Table 6. estimation results where taxation is approximated by share of taxes in GDP.

	Pooled OLS (1)	Fixed effects (2)	Difference GMM (3)
Lagged GDP	0.89(0.00) ***	0.85(0.00) ***	0.77(0.00) ***
Investment share	0.018(0.000) ***	0.05(0.01) **	0.03(0.67)
Human Capital	0.01(0.15)	0.03(0.16)	0.02(0.49)
Government spending	-0.03(0.12)	-0.30(0.30)	0.07(0.86)
Corporate income tax	-0.08(0.01) **	-0.07(0.01) **	-0.01(0.76)
Personal income tax	-0.04(0.00) ***	-0.06(0.00) ***	-0.04(0.02) *
VAT	0.03(0.01) **	0.02(0.00) ***	-0.16(0.00) **
Countries	34	34	35
Observations	306	306	272
R-squared	0.8514	0.847	-
Adjusted R-squared	0.8562	0.852	-
Sargan Test	-	-	0.2240
Arellano-Bond AR (2)	-	-	0.0045

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level respectively