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# Does Tax Smoothing Exist in Africa? Evidence from a Panel of African Countries

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**Abstract**

We investigate evidence of tax smoothing in Africa using annual data from 1999 to 2021 for 31 African countries through two main approaches namely; 1) unit root testing, employing Augmented Dickey-Fuller (ADF), Phillips Perron (PP) and Im, Pesaran and Shin (IPS) tests for stationarity and 2) checking for the unpredictability of tax rates using the fixed and random effects models, and the two-step Generalized Method of Moments (GMM) to investigate the assumption of the unpredictability of changes in tax rates. Our findings reveal no evidence of tax smoothing in 7 out of 31 African countries namely Botswana, Democratic Republic of Congo, Cote D'Ivoire, Egypt, Equatorial Guinea, Lesotho and Mauritius while there is evidence in the remaining countries. Moreover, the IPS panel unit root test results showed evidence of tax smoothing in Africa. The study also finds that significant lag information about tax rates cannot predict changes in taxes in Africa. However, our analysis revealed that only last year's information about tax rates can predict changes in taxes and this is consistent in all the models. We therefore recommend that policymakers should improve institutional capacity for long-term fiscal planning and diversify revenue sources to mitigate reliance on unpredictable income streams.

**KEYWORDS**

Tax smoothing, Stationarity, Tax burden, Fiscal policy, System GMM, Fixed effects, Random effects

**JEL CLASSIFICATION**

E62, H20, H30, H60, O55, C23

## 1 INTRODUCTION

According to public finance theory, taxes create incentives for taxpayers to change their economic activities and lower their tax burden. If society values taxed activities more than non-taxed activities, the behavior change caused by taxation reduces society's welfare (Jayawickrama & Abeysinghe, 2013). The welfare cost of taxation is frequently known to increase more than proportionately with the tax rate. To reduce economic distortions and welfare losses, governments should maintain relatively steady tax rates over time, according to the fiscal policy idea known as "tax smoothing," which was first proposed by Barro (1979). While tax smoothing has been the subject of in-depth research in developed economies (Padda, 2009; Jayawickrama & Abeysinghe, 2013), there is scant and conflicting evidence of similar studies conducted in African nations

(Udoh, 2011; Bonzu, 2018; Belguith, Gabsi & Mtibaa, 2018; Karakas & Turan, 2020). The study aims to fill this gap by examining the presence and extent of tax smoothing practices across African nations and contribute to the growing body of literature on fiscal policy in developing economies. Understanding the tax smoothing behaviors of African countries is important for policymakers and researchers alike, as many African nations struggle to balance economic growth with fiscal sustainability. The distinct economic landscapes of African nations, characterized by resource dependence, informal economies, and developmental challenges, provide a compelling context for studying tax smoothing (Mayega et al., 2021). Additionally, recent economic challenges, such as the COVID-19 pandemic, global inflationary pressures, and commodity price volatility, have heightened the importance of effective fiscal management in Africa (Coulibaly, 2021).

Tax smoothing theory suggests that maintaining stable tax rates over time results in a nonstationary time series with a unit root, making future changes difficult to predict (Barro, 1981). This concept is particularly relevant for Africa, where income volatility, fragile institutions, a large informal sector, and reliance on external aid impact fiscal stability and economic development. Given the continent's efforts to enhance domestic resource mobilization and reduce dependence on foreign aid, tax smoothing could play a crucial role in achieving these goals. Many African nations fall below the recommended tax-to-GDP ratio of 15% needed for sustainable development (Gaspar et al., 2016), highlighting the importance of effective tax policies. The region's economic diversity, from resource-rich nations like Nigeria and Angola to more diversified economies like Kenya and South Africa, presents a unique setting to study tax smoothing mechanisms. Additionally, strong fiscal governance is essential for implementing such policies, as emphasized by Addison et al. (2018).

According to Gwaindepi (2021), the tax structure in African countries is marked by several distinct characteristics that differentiate it from other regions, particularly in its heavy reliance on indirect taxes such as value-added tax (VAT), excise duties, and trade-related taxes. These taxes often contribute between 50% and 70% of total government revenue in sub-Saharan Africa, while direct taxes, like personal and corporate income taxes, play a comparatively smaller role (Feger, 2014). This pattern is largely driven by the dominance of the informal sector, which constitutes over 80% of the labor force in many African economies, effectively narrowing the tax base for direct taxation (Makochekanwa, 2020). Additionally, African countries often face challenges such as weak tax administration, limited taxpayer compliance, and inadequate capacity to enforce tax policies. These dynamics result in volatile and unpredictable revenue streams, undermining fiscal stability and the ability of governments to plan and execute long-term development initiatives effectively.

The reliance on volatile revenue sources, particularly from natural resource exports and trade taxes, further complicates the tax landscape in Africa. Many countries in the region are heavily dependent on commodities, which are subject to frequent and unpredictable price fluctuations in global markets (Abaidoo & Agyapong, 2024). This dependence exposes fiscal budgets to external shocks, leading to significant revenue shortfalls during periods of declining commodity prices. Without sufficient fiscal buffers, such as sovereign wealth funds or robust counter-cyclical revenue management policies, governments often resort to reactionary measures such as increasing borrowing or adjusting tax rates to bridge revenue gaps (Saptono *et al*., 2024). These practices disrupt economic stability and create uncertainty for businesses and households, thereby eroding public trust in the fiscal system. Moreover, political and institutional factors, including corruption and weak governance structures, exacerbate these challenges by limiting the effectiveness and fairness of tax collection and allocation processes.

Given these structural and institutional constraints, achieving tax smoothing in African countries becomes a complex issue. Tax smoothing, which involves minimizing variations in tax rates over time to stabilize revenue and reduce economic distortions, requires a well-diversified tax base, effective revenue management mechanisms, and the political will to implement sustainable fiscal policies. However, the prevailing reliance on narrow and volatile revenue sources, coupled with weak fiscal institutions, makes the implementation of such strategies difficult. This situation raises critical questions about the extent to which African governments can adopt and sustain tax smoothing practices in their fiscal policies. This study intends to address this literature gap by examining the existence and effectiveness of tax smoothing in African countries by analyzing fiscal policy trends and revenue management practices across a panel of countries. The study aims to evaluate whether governments in Africa optimize tax policies to minimize economic distortions and stabilize public revenue over time.

### 1.1 Overview of Taxation in Africa

Tax regimes across African nations vary based on economic strategies and governance systems, encompassing corporate income tax (CIT), personal income tax (PIT), VAT, excise taxes, and trade levies (Caldeira, Geourjon & Rota-Graziosi, 2022). Southern African countries like South Africa, Namibia, and Botswana have well-established tax systems, with South Africa imposing a 27% CIT and 15% VAT (Erero, 2021, 2022), while Mauritius offers a flat 15% CIT and PIT to attract investment (PwC, n.d.). East African nations, including Kenya, Rwanda, and Uganda, employ progressive tax systems, with CIT rates around 30% and VAT between 15% and 18% (Akandwanaho, 2019). West African countries, such as Nigeria, Ghana,

and Senegal, shape their tax policies around commodity exports (Christensen, 2016), with Nigeria applying a 30% CIT and 7.5% VAT (Ezenwobi & John-Akamelu, 2024), while Ghana and Senegal maintain CIT rates of 25%-30% and VAT rates of 15%-18% (Bertinelli et al., 2024; Malik et al., 2021). North African nations, including Egypt, Morocco, and Tunisia, have structured tax systems with CIT rates ranging from 10% to 35% and VAT between 14% and 20% (Deloitte, 2024; PwC, n.d.). Additionally, small island economies like Seychelles, Mauritius, and Cabo Verde maintain competitive tax frameworks with incentives to attract foreign direct investment (Sharma, 2022).

Central African nations, including the Democratic Republic of Congo, Chad, and Cameroon, face challenges related to political instability and governance, leading to a heavy reliance on trade duties and resource taxation (Shulika & Shafiei, 2024; Wansi & Burrell, 2023; World Bank, 2024). Corporate income tax rates in the Democratic Republic of Congo and Cameroon range between 30%-33%, while VAT rates fall between 16%-19% (Rota-Graziosi & Sawadogo, 2022). Despite tax reforms across Africa, compliance issues, administrative inefficiencies, and informality persist (Gwaindepi, 2024). Digital tax systems and regional collaboration are crucial for improving revenue mobilization, as sub-Saharan Africa has shifted toward indirect taxes due to structural and institutional challenges in direct tax collection (Feger, 2014). VAT implementation has positively impacted overall tax revenue (Addison & Levin, 2012), though historical tax administrations prioritized revenue collection from international trade (Moore, 2021). While reforms have aligned tax systems with OECD standards, challenges remain in taxing transnational corporations and wealthy individuals (Moore, 2021). Factors such as economic openness, agricultural reliance, population size, and stability influence tax revenue, with less agrarian and more open economies showing higher tax-to-GDP ratios (Addison & Levin, 2012). Despite progress, tax-to-GDP ratios have remained relatively stable for decades (Moore, 2021), prompting recommendations to simplify tax structures, emphasize domestic consumption taxes, and reduce allowances in individual and corporate taxation (Shalizi, 1996).

### 1.2 Theoretical Framework

The Barro Model provides a theoretical framework for analyzing optimal government debt and tax strategies. At its foundation, the model contends that governments should try to reduce the distortionary impacts of taxes by keeping consistent tax rates over time, rather than modifying them to meet short-term swings in government spending or revenue (Barro, 1979). This idea contends that governments should strive for steady tax rates, even in the face of transient economic shocks or spending requirements. Tax smoothing could help African countries avoid economic inefficiencies caused by frequent policy changes and establish

a more predictable fiscal environment (Talvi & Végh, 2005). However, there are many barriers to applying the Barro Model in Africa because many African economies have inadequate institutional frameworks, restricted access to financial markets, and substantial economic volatility (Thornton, 2007). These characteristics can limit governments' ability to borrow and save effectively, which is critical for carrying out tax smoothing measures as envisioned by the model. Furthermore, African countries frequently experience severe revenue instability due to their reliance on commodity exports and foreign aid (Guillaumont & Guillaumont Jeanneney, 2009). This volatility can make it challenging to keep tax rates constant, as governments may need to modify fiscal policies quickly in response to external shocks. Despite these limitations, novel studies have discovered evidence of tax smoothing behavior in various African countries. Ebeke and Ölcer (2013) observed that some African countries with stronger institutions and more developed financial markets were better equipped to implement tax smoothing measures, suggesting that the Barro Model's principles may still be useful in specific African situations. Successful implementation could result in more stable economic conditions, attracting investment and promoting a sustainable future. However, it demands rigorous fiscal management, as well as institutional reforms, to improve the capacity of governments for long-term planning and budgetary discipline (Addison, 2017).

### 1.3 Empirical Literature

Most studies have been conducted on tax smoothing in both developed and developing countries. Bilgin and Bilgin (2014) researched the experience of the Turkish Economy on tax smoothing. The study revealed that the planned tax rate is as constant as the current tax rate. Also, the random walk test of the tax smoothing hypothesis showed that changes in tax rates are not predictable. The study employed a direct test of tax smoothing. With this model, it was easy for the researchers to differentiate between strong tax smoothing, weak tax smoothing, and no-tax smoothing. They showed that the Turkish economy supports the weak form of tax smoothing. Lopez-Velasco (2018) investigated tax smoothing with immigration in an overlapping generation economy. The author found that the immigration policies in overlapping generation economies are influenced by government expenditure shocks which have a strong impact on policy decisions. Additionally, the study also discovered that the equilibrium Markovial strategy permits immigration when government expenditure shocks surpass a specific threshold. This mostly leads to a form of tax smoothing. The study employed an overlapping generations economy model in which government expenditure was funded through a proportional income tax and follows a balanced budget. The approach involved examining

the impact that government expenditure shocks have on immigration policies and tax smoothing within such an economic framework.

Angyridis and Michelis (2019) researched structural breaks, debt limits, and the tax smoothing hypothesis in 22 OECD countries. The study made use of the general equilibrium model of optimal taxation. This showed that optimal tax rate does not necessarily imply tax smoothing, this is because it may depend on past government debt and news about future changes in fiscal policies of the country. After accounting for the structural break in data, the study found that tax smoothing hypothesis was rejected in favor of stationary tax rates in five countries. In contrast, Amaglobeli et al. (2019) examined the role of tax policy reforms in improving fiscal shock smoothing. They carried out a panel analysis with 13 OECD countries from the period 1980 to 2017. They found that tax reforms, especially those that broaden the tax base, have a strong impact on the strength of a fiscal policy to mitigate the impact of growth shocks on disposable income. Alekhin (2020) researched tax smoothing in Russia. The researcher used a sample of official data on tax and non-tax earnings and spending of the Russian government from 2000 to 2019 to test for the presence of tax smoothing. The study employed the Granger causality test, cointegration, unit root, and random walk in the analysis. The study found that the overall tax rate and permanent expenditures are cointegrated only if structural breaks in the data are accounted for, and permanent spending Granger-cause the overall tax rate. Further, the study also revealed that permanent expenditures of the government were followed by tax rate changes. This shows that government expenditures impact the tax rate in the Russian economy. Karakas and Turan (2020) studied the presence of tax smoothing in South Africa and Turkey. The study made use of the Vector Autoregression (VAR) model. They found that tax tilting is present in both economies, suggesting the absence of tax smoothing in South Africa and Turkey.

Kiarsi (2022) found that the widely accepted view that RBC models wedge smoothing implies tax smoothing is false. Additionally, it also revealed that the optimal inflation rate is much more persistent. The study examined the optimality of tax smoothing and optimal inflation persistence in the context of monetary models. Bonzu (2022) investigated whether the budget imbalances in Sierra Leone are consistent with optimal tax policy. The author carried out three major empirical analyses. First and foremost, the author assessed the random walk property of tax rate. The finding was that the null hypothesis of non-stationarity of tax rate failed to be rejected. This indicated that random walks exist. Furthermore, the researcher investigated to find out whether the tax rate is predictable. This was done by regressing changes in tax rate by its own lagged values. The analysis showed that tax rates cannot be predicted. Moreover, the study also employed the Vector

Autoregression (VAR) model to examine whether the tax rate is predictable by its own lagged values together with changes in government expenditures and the growth rate of real GDP. The finding indicated that all the variables used were insignificant in predicting tax rates. This signifies that there is the existence of tax smoothing over the sample period and is consistent with optimal tax policy.

In contrast, a recent study by Congregado et al. (2023) in Spain, revealed that there is the presence of tax tilting in the Spanish economy. Additionally, they discovered that there is evidence of tax smoothing over the period for their study, which was from 1850 to 2022. Rahman (2023) investigated the nexus between political stability and tax levels. The study revealed that political stability does not impact tax policy. This study was undertaken in 112 countries which includes some African countries such as Somalia, and Congo-Kinshasa.

The rest of this paper is structured as follows: the next section provides a detailed description of the methodology and data used for the analysis. This is followed by empirical findings and offers an in-depth discussion of the results. Finally, the last section concludes the study by summarizing the key insights, discussing policy implications, and offering recommendations for future research.

## 2 METHODS

### 2.1 Theoretical Model

According to the Barro Model, a government budget identity for country $i$, at a period $t$ can be expressed as follows:

$$GE_{it} + ir_{it} \equiv TR_{it} + (SD_{it} - SD_{it-1}) \quad (1)$$

where $GE_{it}$ denotes the real total government expenditure that excludes interest on the national debt, $TR_{it}$ denotes the real tax revenue, $SD_{it}$ denotes real stock of national debt outstanding at the end of period *t,* and $ir_{it}$ denotes the real rate of interest. To attain the intertemporal budget constraint, we divide equation 1 by $Q_{it}$ which denotes the real output of country $i$. Hence the intertemporal budget constraint can be expressed as:

$$ge_{it} + \sum_{j=1}^{\infty} E(ge_{it+j}(1+\gamma_i)^{-j}) + (1+\gamma_i)sd_{it-1}$$

$$= ב_{it} + \sum_{j=1}^{\infty} E(ב_{it+j}(1+\gamma_i)^{-j}) \quad (2)$$

where $E$ denotes the expectation operator,$ב_{it} \equiv TR_{it}/Q_{it},\ ge_{it} \equiv GE_{it}/Q_{it},\ sd_{it} \equiv SD_{it}/Q_{it}$ and $\gamma_i$ denotes the real rate of interest minus the growth rate of real output for country $i$, and it is assumed not to change with time.

After inserting $E(ב_{it+k}) = ב_{it}$ for all $j \neq 0$ in Equation 2, we can express equation 3 as follows:

$$ב_{it} = \gamma_i sd_{it-1} + ge_{it} \quad (3)$$

where $\gamma_i sd_{it-1}$ denotes the real interest rate minus real output growth multiplied by the ratio of real debt outstanding to real output for country *i*, at the end of the period $t-1$. $ge_{it}$ denotes the ratio of permanent government expenditures to the output for country $i$, at time $t$.

The random walk condition can be expressed as follows:

$$ב_{it} = \delta_i + ב_{it-1} + \epsilon_{it}, \qquad \epsilon_{it} \sim (0, \sigma^2) \text{ and } E(\epsilon_{it}\epsilon_{it-j}) = 0 \quad j \neq 0 \quad (4)$$

where $\delta_i$ denotes a country-specific constant term, and $\epsilon_{it}$ denotes the error term.

**2.2 Data and Variables**

The Barro model of tax smoothing asserts that governments reduce tax distortions by keeping tax rates stable over time, leading to unpredictable tax rate fluctuations and random walk behaviour (Strazicich, 1996; Strazicich, 2002). Testing this hypothesis generally requires unit root tests for nonstationary tax rates and an analysis of the predictability of tax rate changes (Strazicich, 2002). We test the random walk hypothesis as implied by the model in the African context. To do this, an initial sample of 31 African countries, as presented in Table 7, with annual data on average tax rates from 1999 to 2021 was used. We used this time frame because data for variables used to calculate the average tax rates were not readily available for periods beyond 2021. According to available data in the World Development Indicators database for instance, data for tax revenue as a percentage of GDP for periods beyond 2021 were available for only 4 countries as per the study's sample namely Kenya, Mauritius, Senegal and South Africa who only had data as far as 2023. These 4 countries were not enough to build our panel for analysis, hence the use of datasets up to 2021 for our study.

We test the effect of significant lags on changes in tax rates to confirm the hypothesis that changes in tax rates are unpredictable by its lagged information. We further examine the effect of relevant economic variables and their lagged information on changes in tax rates to see if these variables can predict changes in tax rates in Africa. We test the effect of government expenditure, economic growth, national debt levels, and political cycles on changes in tax rates to see if they can predict tax rate changes. For government

expenditure, we measure it as a ratio of total government spending to GDP as done by Strazicich, (2002) while for economic growth, we find changes in GDP (Strazicich, 2002) as a measure. For national debt levels, we used the total debt levels of each selected country as a percentage of their gross national product while for political cycles, we believe the political dynamics of each nation can have a significant impact on the budget-making process due to changes in government, hence we used dummy variables to represent it where years of presidential elections were represented by 1 while 0 represents non-election years. We estimate the fixed effect, random effect, and two-step Generalized Method of Moments (Two-Step GMM) models for this purpose.

Table 1: Variable Definitions and Data Sources

| Variables | Definition | Measurement | Source | Literature |
|---|---|---|---|---|
| GovExp | Government Expenditure | Government Spending/GDP | WDI | Strazicich, (2002); Bonzu, (2022) |
| GDP growth | Economic Growth | Percentage change in GDP | (stats.oecd.org) Own calculations | Bonzu, (2022) |
| Polit | Political Cycle | Dummy (Election year = 1, non-election year =0) | Wikipedia | Rose, (2006) |
| Taxrates | Tax Rates | Tax Revenues/GDP | stats.oecd.org | Strazicich, (2002); Angyridis and Michelis, (2021) |
| NatDebt | National Debt Level | Total Debt Level (% of GDP) | WDI | Angyridis and Michelis, (2021) |

Source: Authors' construct (2025)

Table 1 presents the definition for all variables used in the study. The table further presents how we measured the variables as well as the online and literature sources.

### 2.3 Empirical Strategies

We followed two stages in conducting our analysis. In the first stage, we estimated the individual equations for testing the random walk hypothesis as implied by the Barro model on each selected country for evidence of tax smoothing. In the second stage, we isolated the countries whose tax rates showed stationarity and reconstructed a panel of 24 countries to run the Im Pesarran and Shin (2003) test for panel unit root. As a measure of the average tax rates, we divided each country's tax revenue by GDP as done by Strazicich,

(2002). We estimated the following (5) and (6) Augmented Dickey-Fuller (ADF) and Phillips Perron tests respectively for stationarity in tax rates for each country.

$$\Delta Y_t = B_0 + B_1 t + \varphi Y_{t-1} + \sum_{i=1}^{p} \sigma_i \Delta Y_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta Y_t = B_0 + B_1 t + \varphi Y_{t-1} + \varepsilon_t \quad (6)$$

Where $Y_t$ represents tax rate at time t, $\Delta Y_t$ represents the first difference in the tax rates, $p$ denotes the number of lags, $\varepsilon_t$ is a parameter for white noise, $B_0$ and $B_1$ are the drift and trend components, $\varphi$ is the coefficient to test for a unit root. If $\varphi = 0$, then the series has a unit root indicating non-stationarity while if $\varphi < 0$, then the series is stationary. We conduct these tests to check for evidence of random-walk in tax rates in Africa.

During the second stage, we sought to test the tax smoothing hypothesis in the African context using panel data to confirm or refute the claim of gaining better results with high statistical power using panel data and understand the situation of tax smoothing in Africa using panel data. we estimate the following IPS unit root test for a panel of 24 African countries.

$$\Delta Y_{i,t} = B_i + B_i t + \varphi_i Y_{i,t-1} + \sum_{i=1}^{pi} \sigma_{i,j} \Delta Y_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

Where $Y_{i,t}$ represents the tax rate for cross-section i at time t, $\Delta Y_{i,t}$ represents the first difference of the tax rate, $B_i$ denotes the intercept term (country-specific), $B_i t$ represents the time trend, $\varphi_i$ represents the coefficient to test for unit root, $\sigma_{i,j}$ represents the coefficients for lagged differences to account for serial correlation and $\varepsilon_{i,t}$ denotes the error term.

To test whether significant lag information of tax rates and relevant variables can predict changes in tax rates, we specify the following Generalized Method of Moments (GMM) as the baseline model.

$$\Delta Y_{i,t} = \emptyset_i + \sum_{j=1}^{p} \beta_j y_{i,t-j} + \sum_{k=1}^{q} \gamma_k X_{i,t-k1} + \sum_{k=1}^{q} \gamma_{k2} Z_{i,t-k2} + \ldots + \sum_{k=1}^{q} \gamma_{km} W_{i,t-km} + \varepsilon_{i,t} \quad (8)$$

$$\Delta Y_{i,t} = \alpha + \sum_{j=1}^{p} \beta_j y_{i,t-j} + \sum_{k=1}^{q} \gamma_k X_{i,t-k1} + \sum_{k=1}^{q} \gamma_{k2} Z_{i,t-k2} + \ldots + \sum_{k=1}^{q} \gamma_{km} W_{i,t-km} + \mu_i + \varepsilon_{i,t} \quad (9)$$

where $\Delta Y_{i,t}$ is the dependent variable for country $i$ at time $t$, $\emptyset_i$ is the country-specific fixed effect (captures the unobserved heterogeneity), $\alpha$ represents the constant term, $y_{i,t-j}$ is the lagged dependent variable for

$j$ lags, where $j$=1, 2, …, $p$. $X_{i,t-k1}$, $Z_{i,t-k2}$, … $W_{i,t-km}$ are the lagged independent variables for $k$ lags, where $k$=1,2,…,$q$, $\beta_j$ and $\gamma_k$ represent the coefficients for the lagged dependent and independent variables respectively, and $\varepsilon_{i,t}$ denotes the error term. We therefore estimate the following models.

$$\Delta Taxrates_{i,t} = \emptyset_i + \beta_1 Taxrates_{i,t-1} + \cdots + \beta_5 Taxrates_{i,t-5} + \gamma_1 GovExp_{i,t-1} + \cdots + \gamma_5 GovExp_{i,t-5} + \varphi_1 Polit_{i,t-1} + \cdots + \varphi_5 Polit_{i,t-5} + \omega_1 \text{GDP growth}_{i,t-1} + \cdots + \omega_5 \text{GDP growth}_{i,t-5} + \sigma_1 NatDebt_{i,t-1} + \cdots + \sigma_5 NatDebt_{i,t-5} + \varepsilon_{i,t} \quad (10)$$

$$\Delta Taxrates_{i,t} = \alpha + \beta_1 Taxrates_{i,t-1} + \cdots + \beta_5 Taxrates_{i,t-5} + \gamma_1 GovExp_{i,t-1} + \cdots + \gamma_5 GovExp_{i,t-5} + \varphi_1 Polit_{i,t-1} + \cdots + \varphi_5 Polit_{i,t-5} + \omega_1 \text{GDP growth}_{i,t-1} + \cdots + \omega_5 \text{GDP growth}_{i,t-5} + \sigma_1 NatDebt_{i,t-1} + \cdots + \sigma_5 NatDebt_{i,t-5} + \theta_1 \mu_i + \varepsilon_{i,t} \quad (11)$$

where $\Delta Taxrates_{i,t}$ represents changes in tax rates for country $i$ at time $t$, $GovExp_{i,t}$ represents government expenditure as a percentage of GDP for country $i$ at time $t$, $Polit_{i,t}$ represents the political cycle of country i at time t, $\text{GDP growth}_{i,t}$ represents the GDP growth of country $i$ at time $t$, $NatDebt_{i,t}$ represents nationa; debt level for country $i$ at time $t$, $\varepsilon_{i,t}$ represents the error term while $\beta_1$ $to$ $\beta_5$, $\gamma_1$ $to$ $\gamma_5$, $\varphi_1$ $to$ $\varphi_5$, $\omega_1$ $to$ $\omega_5$, $\sigma_1$ $to$ $\sigma_5$ represent the coefficient estimates for the lags of the respective variables.

Since GMM follows (9), we take the first differences of (11) to eliminate country-specific effects.

$$\Delta Taxrates_{i,t} - \Delta Taxrates_{i,t-1} = \alpha + \beta_1 (Taxrates_{i,t-1} - Taxrates_{i,t-2}) + \cdots + \beta_5 (Taxrates_{i,t-5} - Taxrates_{i,t-6}) + \gamma_1 (GovExp_{i,t-1} - GovExp_{i,t-2}) + \cdots + \gamma_5 (GovExp_{i,t-5} - GovExp_{i,t-6}) + \varphi_1 (Polit_{i,t-1} - Polit_{i,t-2}) + \cdots + \varphi_5 (Polit_{i,t-5} - Polit_{i,t-6}) + \omega_1 (\text{GDP growth}_{i,t-1} - \text{GDP growth}_{i,t-2}) + \cdots + \omega_5 (\text{GDP growth}_{i,t-5} - \text{GDP growth}_{i,t-6}) + \sigma_1 (NatDebt_{i,t-1} - NatDebt_{i,t-2}) + \cdots + \sigma_5 (NatDebt_{i,t-5} - NatDebt_{i,t-6}) + \theta_1 (\mu_i - \mu_i) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \quad (12)$$

Equation (12) therefore becomes;

$$\Delta Taxrates_{i,t} - \Delta Taxrates_{i,t-1} = \alpha + \beta_1 (Taxrates_{i,t-1} - Taxrates_{i,t-2}) + \cdots + \beta_5 (Taxrates_{i,t-5} - Taxrates_{i,t-6}) + \gamma_1 (GovExp_{i,t-1} - GovExp_{i,t-2}) + \cdots + \gamma_5 (GovExp_{i,t-5} - GovExp_{i,t-6}) + \varphi_1 (Polit_{i,t-1} - Polit_{i,t-2}) + \cdots + \varphi_5 (Polit_{i,t-5} -$$

$$Polit_{i,t-6}) + \omega_1(\text{GDP growth}_{i,t-1} - \text{GDP growth}_{i,t-2}) + \cdots + \omega_5(\text{GDP growth}_{i,t-5} - \text{GDP growth}_{i,t-6}) + \sigma_1(NatDebt_{i,t-1} - NatDebt_{i,t-2}) + \cdots + \sigma_5(NatDebt_{i,t-5} - NatDebt_{i,t-6}) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \quad (13)$$

The fixed effects panel estimation approach is used because it addresses unobserved heterogeneity by managing time-invariant features that differ among individual countries yet stay consistent over time (Hill et al., 2020). This enables the model to discern the impact of independent variables on the dependent variable to yield more precise estimates in the presence of omitted variable bias owing to unobserved country-specific features (Amir et al., 2016). This model mitigates the danger of endogeneity that may stem from these time-invariant factors by concentrating on within-individual variation (Brüderl & Ludwig, 2015). Nonetheless, a significant limitation of the fixed effects model is its inability to assess the impacts of time-invariant variables (Pesaran & Zhou, 2018), due to their perfect collinearity with individual-specific effects.

The random effects model is advantageous for panel data analysis because it posits that individual-specific effects are uncorrelated with the independent variables (Schmidheiny & Basel, 2011). This facilitates the estimation of both within- and between-individual variations (Bell, Fairbrother & Jones, 2019). Nonetheless, the assumption of no association between individual-specific effects and independent variables might be problematic if violated, which could cause potential endogeneity problems (Baltagi & Baltagi, 2008). The GMM is appropriate in these instances, as it proposes a more robust solution by instrumenting endogenous variables and mitigating potential biases arising from the correlation between individual effects and regressors (Arellano & Bond, 1991; Blundell & Bond, 1998).

With the help of instrumental variables, the GMM is a flexible method used to reduce endogeneity in panel data models (Ullah, Akhtar & Zaefarian, 2018). System GMM improves GMM by combining difference and level equations to make it more efficient. This is especially true when there are unknown individual effects and endogenous regressors (Blundell, Bond & Windmeijer, 2001). When we use a set of valid instruments that get rid of possible biases from endogenous variables and serial correlation in the error terms, the two-step System GMM procedure makes things more efficient by giving you robust standard errors (Abdul Wahab et al., 2017; Boonyanet, Jangphanish & Tongkong, 2024). The Arellano-Bond test for autocorrelation is often used to make sure that instruments are valid and that they are stable. It expects there to be little to no second-order autocorrelation and some levels of first-order autocorrelation. The fact that there is no residual serial association in the differenced errors shows that the instruments are valid (Arellano & Bond, 1991).

## 3 RESULTS AND DISCUSSIONS

In this section, we present the results of our analysis and a discussion of findings with literature. We present the preliminary analysis followed by both single equation and panel unit root estimates. Furthermore, we present model estimates for the predictability of changes in tax rates in Africa and discuss the diagnostics associated with these models.

Table 2: Summary Statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Taxrates | 315 | 0.151 | 0.059 | 0.047 | 0.325 |
| GDP growth | 303 | 9.072 | 7.708 | -20.521 | 42.270 |
| Polit | 322 | 0.196 | 0.397 | 0 | 1 |
| GovExp | 320 | 13.809 | 4.18 | 3.588 | 26.588 |
| NatDebt | | 2.656 | 2.625 | 0.164 | 19.496 |
| | 322 | | | | |

Source: Authors' construct (2025)

Table 2 presents the summary statistics for all the variables we used in the study. The average tax rate is 0.151, with a standard deviation of 0.059, and it ranges from 0.047 to 0.325. This shows a substantial fluctuation. The GDP growth variable exhibits a mean of 9.072 and a substantial standard deviation of 7.708. This signifies considerable volatility, with values spanning from a negative growth of -20.521 to a growth of 42.270, reflecting notable fluctuations in economic performance among countries. The political cycle variable (Polit) is binary, with a mean of 0.196. This suggests that political events or conditions arise in roughly 20% of instances over the study period. Moreover, Government expenditure (GovExp) has an average of 13.81 and a standard deviation of 4.18, with a range from 3.59 to 26.59 portraying significant variability. The national debt (NatDebt) has a mean of 2.656 and a standard deviation of 2.625, with values spanning from 0.164 to 19.496, reflecting considerable variability in debt levels among observations.

Table 3: Pairwise correlations

| Same Variables | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| (1) Taxrates | 1.000 | | | | |
| (2) GDP growth | -0.304*** | 1.000 | | | |
| (3) Polit | 0.008 | -0.003 | 1.000 | | |

| | | | | | |
|---|---|---|---|---|---|
| (4) GovExp | 0.568*** | -0.310*** | 0.024 | 1.000 | |
| (5) NatDebt | 0.442*** | -0.232*** | 0.013 | 0.302 | 1.000 |

Source: Authors' construct (2025)

Table 3 illustrates the correlations among the variables. A notable negative correlation is shown between tax rates and GDP growth (-0.304). This implies that elevated tax rates correspond with diminished variations in GDP, likely reflecting the constraining impact of taxation on economic growth. Moreover, GovExp has a significant positive correlation with Taxrates (0.568), suggesting that increased government expenditures are typically linked to elevated tax rates, which may be essential for financing public spending. NatDebt exhibits a positive correlation with Taxrates (0.442). This suggests that rising national debt levels may lead to increases in tax rates. In contrast, GDP growth negatively correlates with GovExp (-0.310) and NatDebt (-0.232). The Polit variable has weak and statistically insignificant correlations with all other variables.

### 3.1 Trends in Tax Rates Over Time for Selected Countries

Figure 1, as shown in Appendix A, presents the trends and volatilities in tax rates for the selected countries. According to the plots, tax rates for each country exhibit significant fluctuations over the study period. Whiles countries such as Burkina Faso, Cabo Verde, Ghana, Mauritania, Rwanda, Senegal, Tunisia, South Africa, Sierra Leone and Cameroon saw a significant upward trend and highly volatile tax rates over the study period, others such as Morocco, Uganda, Kenya and Niger saw relatively stable tax rates over the years despite significant irregular spikes. For Chad, though tax rates were highly volatile, the country saw a significant downward trend over the study period until somewhere around 2016 when tax rates began to bounce back.

Table 4: Unit Root Test Results for Individual Countries (Mackinnon Approx) (1999-2021)

| Country | ADF statistic | PP statistic | Result |
|---|---|---|---|
| Botswana | -4.454** | -4.452** | Stationary |
| Burkina Faso | -1.404 | -1.388 | Not stationary |
| Cameroon | -1.857 | -1.855 | Not stationary |
| Cabo Verde | -2.642 | -2.616 | Not stationary |
| Chad | -1.474 | -1.48 | Not stationary |
| Congo | -1.735 | -1.818 | Not stationary |
| Democratic Rep. of Congo | -27.360 *** | -18.329*** | Stationary |
| Cote D'Ivoire | -4.513*** | -4.528*** | Stationary |
| Egypt | -4.488*** | -4.410*** | Stationary |
| Equatorial Guinea | -3.809** | -3.831** | Stationary |

| | | | |
|---|---|---|---|
| Ghana | -1.121 | -1.102 | Not stationary |
| Kenya | -1.865 | -1.873 | Not stationary |
| Lesotho | -3.709** | -3.736** | Stationary |
| Madagascar | -2.138 | -2.159 | Not stationary |
| Malawi | -2.024 | -2.022 | Not stationary |
| Mali | -1.271 | -0.95 | Not stationary |
| Mauritania | -1.531 | -1.521 | Not stationary |
| Mauritius | -3.548** | -3.521** | Stationary |
| Morocco | -1.741 | -1.739 | Not stationary |
| Namibia | -2.244 | -2.259 | Not stationary |
| Niger | -1.894 | -1.842 | Not stationary |
| Nigeria | -1.162 | -1.272 | Not stationary |
| Rwanda | -0.597 | -0.579 | Not stationary |
| Senegal | -0.833 | -0.731 | Not stationary |
| Seychelles | -2.014 | -2.129 | Not stationary |
| Sierra Leone | -0.331 | -0.176 | Not stationary |
| South Africa | -0.928 | -0.877 | Not stationary |
| Eswatini | 0.315 | 0.546 | Not stationary |
| Togo | -0.858 | -0.872 | Not stationary |
| Tunisia | 0.425 | 0.511 | Not stationary |
| Uganda | 0.15 | -0.031 | Not stationary |

Source: Authors' construct (2025)

Table 4 presents the unit root tests for stationarity in the tax rates of 31 African countries from 1999 to 2021. We test the necessary conditions of tax smoothing where tax rates need to exhibit non-stationarity and significant lag information should not be able to predict changes in tax rates. We estimate the individual equations specifically for each country using Augmented Dickey-Fuller (ADF) and Phillips Perron. The results indicate that most selected countries' tax rates (24 out of 31) did not exhibit stationarity over the study period. We do not reject the null hypothesis of no stationarity, meaning tax rates follow a random walk. The result is consistent in both ADF and PP tests. Holding all other factors constant, the results imply that, there is no evidence of tax smoothing in only 7 African countries namely, Botswana, Democratic Republic of Congo, Cote D'Ivoire, Egypt, Equatorial Guinea, Lesotho and Mauritius as their tax rates do not follow random walk. However, we saw evidence of tax smoothing in the remaining 24 countries. This agrees with the extant literature in which evidence of tax smoothing was assessed in individual specific countries. In Sierra Leone for instance, the current study supports the findings of Bonzu, (2022) as the study fails to reject the null hypothesis of non-stationarity in Sierra Leone's tax rates. Furthermore, this finding corresponds with Kurniawan, (2011) in Indonesia and Karakas, Taner and Yanikkaya, (2014); Bilgin and Bilgin (2014) in

Turkey. Moreover, Adler (2006) indicated that tax smoothing might account for approximately 60% of the fluctuations in Sweden's central government budget surplus from 1952 to 1999. More recently, Congregado, Esteve García and Prats, (2023) show evidence of tax smoothing in the Spanish economy. This corroborates our findings for the 24 African countries. However, Angyridis and Michelis, (2021) find that in the presence of breaks, there is inference shifts from unit root to stationarity for Canada, Finland, Ireland, Spain, and Sweden, whereas the tax rates for the US and Iceland remain constant irrespective of breaks.

On the other hand, we find that tax rates in Botswana, the Democratic Republic of Congo, Cote D'Ivoire, Egypt, Equatorial Guinea, Lesotho and Mauritius are stationary implying evidence against the tax smoothing theory in these countries. Although this does not conform with Bonzu, (2022) in Sierra Leone, it agrees with several other studies in the literature. Moreover, our findings slightly disagree with Padda, (2009) who notes that Pakistan and Sri Lanka have endeavored to reduce the welfare costs associated with taxation; nonetheless, their efforts have not aligned perfectly with optimal tax smoothing practices. They further find that India has not endeavored to harmonize its tax rates to reduce welfare costs. In line with our findings for these countries, Karakas and Turan, (2020) find evidence against tax smoothing in Turkey and South Africa. However, we find evidence for South Africa which partially contradicts with Karakas and Turan, (2020). Several studies suggest that although tax smoothing may be feasible in certain settings, other issues can hinder its execution and efficacy. Sheikh et al. (2021) demonstrate that tobacco companies utilize several pricing tactics to circumvent tax regulations, especially in low and middle-income nations. Shimeles et al. (2017) established that audit threats and appeals to tax morale can significantly diminish tax evasion in Ethiopia, with audit threats exhibiting marginally greater efficacy. Flores et al. (2023) analyzed tax buoyancy in 185 nations, revealing long-term buoyancy estimates aligned with other research, although lower short-term estimates, indicating restricted automatic stabilization from taxes. They also observed that economic cycles do not inevitably affect tax reforms.

Table 5: IPS Panel Unit Root Test Results (1999-2021)

| Sample | IPS T-Statistic |
|---|---|
| 24 African Countries | 0.8321 |

Source: Authors' estimates (2025)

To enhance the power of our estimates, we constructed a panel of 24 African countries comprising of those whose tax rates did not show stationarity and run the Im Pesarran and Shin (2003) test for panel unit root.

Table 5 presents the results of the panel unit root test. The findings indicate that by combining all 24 African countries in a panel, the results still fail to reject the null hypothesis of no stationarity. This indicates that there is evidence of tax smoothing in Africa in terms of these countries since non-stationarity is a necessary condition for tax smoothing (Bonzu, 2022). This finding confirms the conclusions made in Strazicich, (2002) as they find a strong support for tax smoothing by national governments in a panel of 18 industrial countries. Our finding confirms that of Angyridis and Michelis, (2021) who recorded that out of 22 OECD countries, they only reject the null hypothesis of tax smoothing for only 5 countries. Furthermore, the findings agree with Jayawickrama and Abeysinghe, (2013) as they show evidence of tax smoothing in Canada, Italy, Australia, Japan, the Netherlands, the UK and New Zealand the US.

Table 6: Tests for Effects of Significant Lag Information

| Variables | FE | | RE | | Two-Step System GMM | |
|---|---|---|---|---|---|---|
| ∆Taxrates | Coef. | SE | Coeff | SE | Coeff | SE |
| L | 0.656*** | 0.083 | 0.978*** | 0.077 | 0.779*** | 0.257 |
| L2 | -0.033 | 0.11 | 0.017 | 0.12 | 0.188 | 0.267 |
| L3 | -0.097 | 0.108 | 0.031 | 0.115 | -0.091 | 0.209 |
| L4 | -0.091 | 0.107 | -0.128 | 0.118 | | |
| L5 | -0.005 | 0.085 | 0.097 | 0.083 | | |
| GovExp | | | | | | |
| L | -0.0004 | 0.001 | -0.001 | 0.001 | 7.94E-05 | 0.001 |
| L2 | -0.0004 | 0.001 | -0.0001 | 0.001 | -0.001 | 0.001 |
| L3 | -0.0002 | 0.001 | -5.89E-05 | 0.001 | 0.001 | 0.002 |
| L4 | 0.001 | 0.001 | 0.001 | 0.001 | | |
| L5 | -0.0003 | 0.001 | 0.0002 | 0.001 | | |
| Polit | | | | | | |
| L | -0.001 | 0.003 | -0.001 | 0.003 | -0.002 | 0.004 |
| L2 | -0.001 | 0.003 | 0.001 | 0.004 | 0.002 | 0.004 |
| L3 | -0.001 | 0.003 | -0.0002 | 0.003 | -0.0002 | 0.005 |
| L4 | -0.0003 | 0.003 | 0.0003 | 0.004 | | |
| L5 | -0.002 | 0.003 | -0.003 | 0.003 | | |
| GDP growth | | | | | | |
| L | -2.89E-10 | 1.15E-09 | -9.65E-10 | 9.72E-10 | -5.84E-10 | 9.36E-10 |
| L2 | 1.47E-09 | 1.40E-09 | -1.53E-10 | 1.48E-09 | -9.29E-10 | 1.39E-09 |
| L3 | 4.57E-10 | 1.71E-09 | 1.36E-09 | 1.82E-09 | 1.71E-09 | 1.41E-09 |
| L4 | -2.66E-10 | 1.54E-09 | -1.31E-09 | 1.67E-09 | | |
| L5 | 2.02E-09 | 1.37E-09 | 1.24E-09 | 1.25E-09 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| NatDebt | | | | | | |
| L | 0.0003 | 0.001 | -0.001 | 0.001 | 0.001 | 0.005 |
| L2 | 0.001 | 0.001 | -0.0005 | 0.001 | 0.002 | 0.006 |
| L3 | 0.001 | 0.001 | 0.001 | 0.001 | 0.0005 | 0.009 |
| L4 | -0.0002 | 0.001 | 0.001 | 0.001 | | |
| L5 | -0.001 | 0.001 | 0.0005 | 0.001 | | |
| Constant | 0.088*** | 0.016 | 0.005 | 0.005 | 0.061 | 0.135 |
| Diagnostics | | | | | | |
| Number of obs | 202 | | 202 | | 240 | |
| AR (1) | | | | | 0.167 | |
| AR (2) | | | | | 0.532 | |
| Sargan | | | | | 0.135 | |
| Hansen | | | | | 1.000 | |
| R-squared | 0.482 | | 0.431 | | | |
| Prob > F (chi2) | 0.000 | | 0.000 | | | |

Source: Authors' construct (2025)

As a condition for tax smoothing, significant previous information about tax rates should not be able to predict current and future tax rates. To test this, we estimate three main econometric models namely the Fixed Effects (FE), Random Effects (RE) and the Two-Step System GMM on the tax rates of a panel of 19 African countries for a period covering from 2005 to 2021. This is because data for relevant variables whose effects on changes in tax rates we wanted to test were not available. Table 6 presents the regression results of the fixed and random effects and the two-step system GMM models. We tested for the predictability of 5 lags of all the variables on changes in tax rates in Africa. The results show that across all three models, only the previous year's information about tax rates can predict changes in tax rates. For all other variables such as Government Expenditure (GovExp), Political Cycle (Polit), Economic growth (GDP growth) and National Debt Levels (NatDebt), we find no evidence of their ability to predict current and future tax rates. This provides strong evidence of tax smoothing in Africa using the selected countries. We confirm the findings of Angyridis and Michelis, (2021) as they find that relevant variables such as the debt-to-GDP ratio do not help to predict expected future tax rates of countries whose tax rates are non-stationary. Moreover, our findings still corroborate Bonzu, (2022) in Sierra Leone as they used VAR models. Their findings show that their own lagged information about tax rates and relevant variables such as government expenditure and growth in real GDP are unable to predict changes in tax rates. In our study, all the variables are not statistically significant implying that tax rates are not predictable which confirms the results of Kurniawan (2011) and Karakas, Taner and Yanikkaya (2014).

Studies on tax smoothing and the predictability of tax rates have produced inconclusive findings. Barro (1981) and Strazicich (2002) provided evidence corroborating the tax smoothing theory, indicating that alterations in tax rates are predominantly unpredictable when assessed through historical data and lagged variables. Their research revealed minimal variation in tax rates and negligible correlations between alterations in tax rates and other economic variables which our study confirms in the context of Africa. Nonetheless, Sahasakul (1986) contested this perspective, demonstrating that U.S. tax rates were influenced by both enduring government spending and transient defense acquisitions, price levels, and temporal trends. Leeper et al. (2008) established the notion of fiscal foresight, emphasizing that legislative and implementation delays can offer distinct indications regarding future tax rates.

The results of the diagnostic tests show that the models are robust and well-defined. The AR (1) test for the Two-Step System GMM model shows that there is no significant first-order autocorrelation ($p = 0.167$), and the AR (2) test confirms that there is no second-order autocorrelation ($p = 0.532$), which satisfies the GMM assumptions. It is clear from the Sargan test ($p = 0.135$) and the Hansen test ($p = 1.000$) that the instruments used are valid and not over-identified. Also, the R-squared for the fixed effects model (0.482) and the random effects model (0.431) show that they have moderate explanatory power.

## 4 CONCLUSIONS

As Barro (1979) implies, we examine tax smoothing in Africa to add to the literature. We study this phenomenon in Africa because income volatility, fragile institutions, a large informal sector, and dependence on external assistance affect fiscal stability and economic development. We built a panel of 24 African countries for strong statistical power to inform fiscal policy formulations and reforms. We experimentally examine tax rate randomness and tax rate unpredictability by lags and pertinent variables in Africa. We test unit root using ADF and PP tests and use three primary econometric models: fixed, random, and two-step system GMM to evaluate how substantial lag information affects tax rates. Our study found stationarity in tax rates for 7 African countries and non-stationarity in 24. Most African countries follow the tax smoothing theory by keeping their tax rates non-stationary to distribute the tax burden over time, however seven countries keep their tax rates stable. Although revenue fluctuations make it difficult, most African governments aim to maintain tax rates throughout an economic cycle. Other governments may utilize reactive tax policies that reduce efficiency and increase welfare costs. Our findings are intriguing as we find that only the most recent preceding year's tax rate data can predict African tax rate changes. This means that African countries base their tax policy decisions on the latest tax rates and are reactive and short-term. This lack of long-term fiscal

planning and strategy could weaken continent economies, waste money, and make tax smoothing difficult to achieve.

Policymakers should increase institutional capacity for long-term fiscal planning, diversify revenue sources to reduce reliance on unpredictable income streams, and formalize the informal sector to extend the tax base to improve tax smoothing and fiscal stability in Africa. Governments could also use data analytics to estimate income needs beyond current cycles and reduce reliance on reactive tax policy. Our study has significant drawbacks. First, we could not individually evaluate tax rate prediction by lags and important variables in each selected country. Future studies could estimate country-specific equations to explain country dynamics. Future study may also examine how external shocks like global commodity price fluctuations or foreign aid affect tax smoothing in African nations.

**Authors' contributions**

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**STATEMENTS AND DECLARATIONS**

**Data Availability Statement:**

The data used in this study is publicly available online; however, it may also be provided by the authors upon reasonable request to the corresponding author

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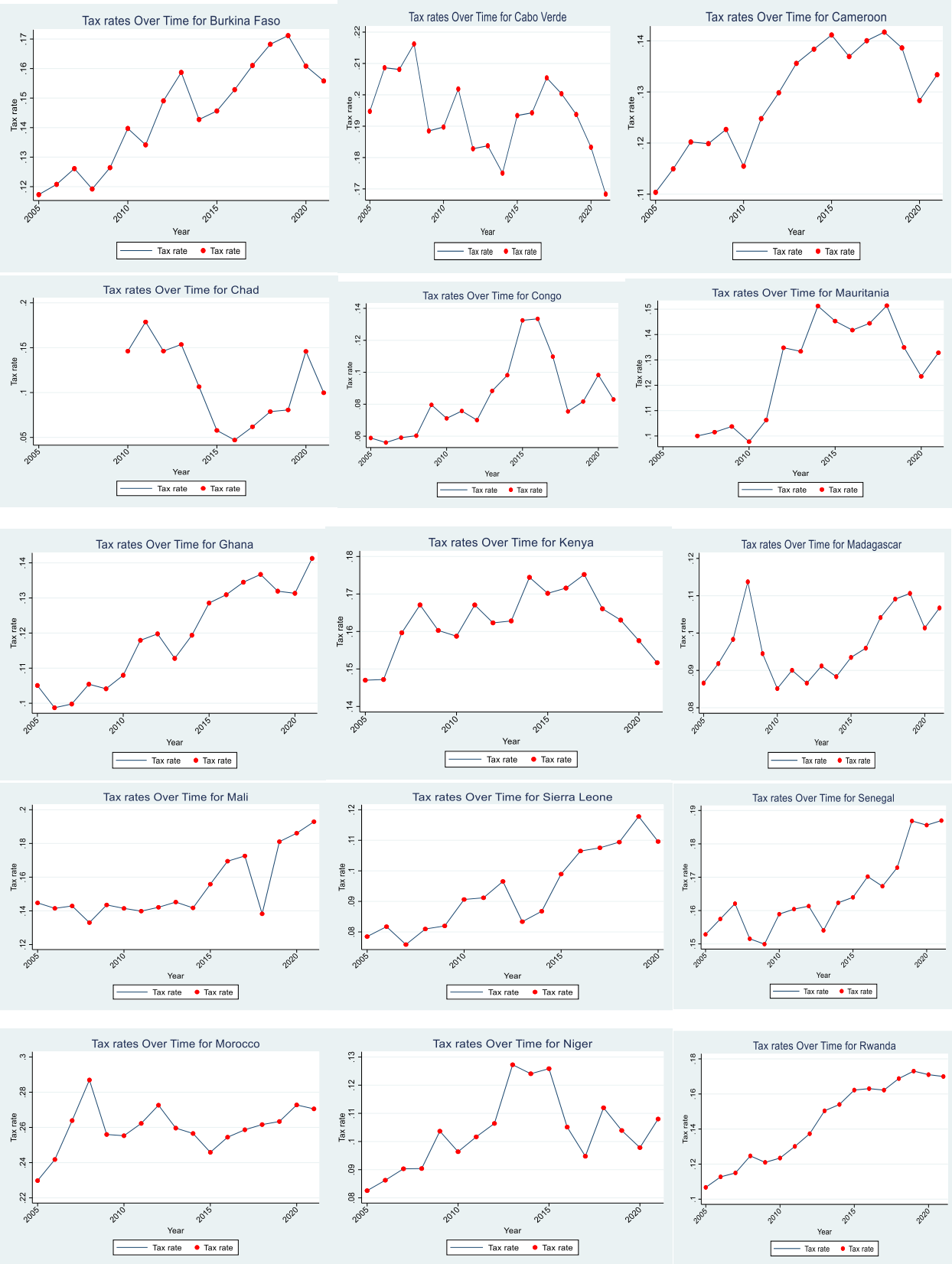
# APPENDIX A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Tax rates Over Time for Cabo Verde
Tax rates Over Time for Cameroon
Tax rates Over Time for Chad
Tax rates Over Time for Congo
Tax rates Over Time for Mauritania
Tax rates Over Time for Ghana
Tax rates Over Time for Kenya
Tax rates Over Time for Madagascar
Tax rates Over Time for Mali
Tax rates Over Time for Sierra Leone
Tax rates Over Time for Senegal
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Tax rates Over Time for Niger
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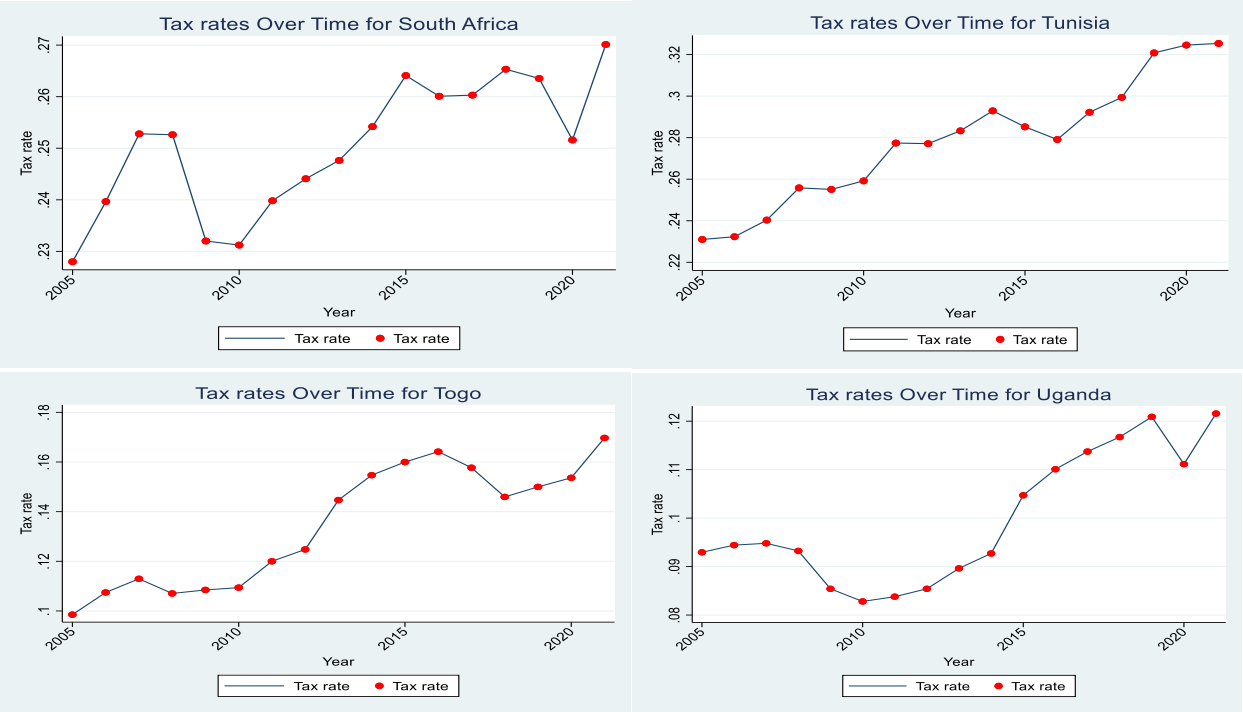


Figure 1: Trends in Tax Rates Over Time for Selected Countries

Source: Authors' construct (2025)