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Effect of the Shadow Economy on Tax Revenue in Sub-Saharan African Countries: A Dynamic Panel Data Analysis[1]

Abstract. The shadow economy in Sub-Saharan African (SSA) countries has become a persistent challenge that undermines government tax revenues. This study investigates the shadow economy's adverse effect on tax revenue in SSA, addressing a critical gap in the region's fiscal research. The analysis covers 15 SSA countries over the period of 15 years, using the Arellano-Bover/Blundell-Bond GMM estimation method. Model validity was confirmed through Arellano-Bond autocorrelation tests and a significant Wald chi-squared statistic, ensuring robust results. Descriptive analysis reveals that SSA countries exhibit relatively low tax revenue (15.7 % of GDP, on average) alongside a sizable shadow economy (36.2 % of GDP). The shadow economy was found to exert a significant negative effect on tax revenue ($\beta = -0.249$, $p = 0.010$). Tax revenues also display persistence, with prior tax revenue significantly influencing current levels. Among the control variables, unemployment ($\beta = 0.315$, $p = 0.002$) and trade openness ($\beta = 0.057$, $p = 0.006$) positively affect tax revenue. Conversely, foreign direct investment ($\beta = -0.022$, $p = 0.071$) and oil revenue ($\beta = -0.087$, $p = 0.002$) have negative impacts, reflecting tax incentives and resource dependency. Control of corruption exerts a marginally positive influence ($\beta = 2.950$, $p = 0.096$). GDP per capita, inflation, the role of agriculture, the number of taxes paid by businesses, and regulatory quality show no significant effects. This study highlights the shadow economy's detrimental impact on tax revenue in SSA and underscores the need for policies aimed at formalizing informal activities and strengthening tax compliance. The findings contribute to public finance research and provide practical guidance for designing sustainable fiscal policies. Avenues for future research could include expanding the analysis to a broader set of countries.

Keywords: shadow economy, tax revenue, unemployment, trade openness, GDP, Sub-Saharan Africa, GMM model

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ВЛИЯНИЕ ТЕНЕВОЙ ЭКОНОМИКИ НА НАЛОГОВЫЕ ПОСТУПЛЕНИЯ В СТРАНАХ АФРИКИ ЮЖНЕЕ САХАРЫ: ДИНАМИЧЕСКИЙ ПАНЕЛЬНЫЙ АНАЛИЗ

Аннотация Теневая экономика в странах Африки южнее Сахары (АЮС) приводит к снижению налоговых поступлений государств. Изучение данной проблемы в контексте стран АЮС позволяет восполнить важный пробел в исследованиях по этой теме. В анализ включены данные по 15 странам АЮС за 15-летний период, применяется метод оценки GMM по Арреллано-Боверу / Бланделлу-Бонду. Валидность модели подтверждена с помощью тестов автокорреляции Арреллано-Бонда и критерия хи-квадрат Вальда, что гарантирует надёжность полученных результатов. Дескриптивный анализ показывает, что в странах АЮС налоговые поступления относительно невелики (в среднем 15,7 % ВВП), а масштабы теневой экономики значительны (в среднем 36,2 % ВВП). Установлено, что теневая экономика оказывает значительное негативное влияние на налоговые поступления ($\beta = -0{,}249$, $p = 0{,}010$). Налоговые поступления также демонстрируют эффект инерции — их текущий уровень существенно зависит от уровня в предыдущие периоды. Из контрольных переменных положительное влияние на налоговые поступления оказывают уровень безработицы ($\beta = 0{,}315$, $p = 0{,}002$) и открытость торговли ($\beta = 0{,}057$, $p = 0{,}006$). Прямые иностранные инвестиции ($\beta = -0{,}022$, $p = 0{,}071$) и доходы от добычи нефти ($\beta = -0{,}087$, $p = 0{,}002$), наоборот, отрицательно влияют на налоговые поступления, что, в свою очередь, отражает роль таких факторов, как налоговые льготы и ресурсная зависимость. Контроль над коррупцией оказывает умеренно положительное влияние на налоговые поступления ($\beta = 2{,}950$, $p = 0{,}096$). Такие переменные, как ВВП на душу населения, инфляция, доля сельского хозяйства в экономике, число налогов, уплачиваемых бизнесом, а также качество регулирования, не имеют значимого влияния. Представленное исследование подчёркивает пагубное воздействие теневой экономики на налоговые поступления в странах АЮС и указывает на необходимость разработки мер по формализации экономической деятельности и усилению налоговой дисциплины. Теоретическая значимость заключается в его вкладе в существующее поле исследований государственных финансов, а практическая — в рекомендациях по разработке устойчивой налоговой политики. Перспективным направлением для дальнейших исследований станет включение в анализ более широкого круга стран.

Ключевые слова: теневая экономика, налоговые поступления, уровень безработицы, открытость внешней торговли, ВВП, страны Африки южнее Сахары, модель GMM

Introduction

The shadow economy operates outside the formal regulatory framework and and deprives governments of potential tax revenue. This challenge is particularly pronounced in Sub-Saharan Africa (SSA), where the informal sector is relatively large and the tax-to-GDP ratio remains low. High unemployment rates are among the key drivers of the shadow economy in the region. Additionally, even formal businesses are often pushed into informal activity by excessive regulations and high tax burdens (Danquah et al., 2021). Weak tax law enforcement and widespread corruption further erode tax revenues. Together, these factors severely undermine efforts to expand the tax base, making it difficult for SSA governments to generate sustainable tax revenue (Nguimkeu & Okou, 2022; Rohman & Veiga, 2017). To tackle this issue, we need to gain a more nuanced understanding of the complex relationship between the shadow economy and tax revenue in SSA.

Prior research on the effect of the shadow economy on tax revenue for different countries (e.g. Ukraine, Iran, Central Europe, BRICS, and the EU) has produced inconclusive results. Bak et al. (2024), Motallebi et al. (2020), and Nchor (2021) suggest a linear and negative relationship between the shadow economy and tax revenue. In contrast, Nguyen and Duong (2022) and Achim et al. (2023) argue that the relationship is nonlinear. They find that the shadow economy initially contributes

positively to tax revenue up to a certain threshold, after which its effect turns negative.

While previous studies offer conflicting findings, they often fail to account for key variables that shape the relationship between the shadow economy and tax revenue, influencing both its direction and intensity. Among these variables, oil revenues tend to exacerbate the already negative impact of the shadow economy on tax revenue (Ishak & Farzanegan, 2020). Corruption also drives businesses away from the formal sector, leading to higher shadow economy activity and reduced tax revenues (Neog & Gaur, 2021; Mazurenko et al., 2023). In contrast, international trade encourages businesses to operate formally, thereby strengthening tax revenues (Rolandas Giedraitis et al., 2023; Gnangnon, 2023). These complex and intertwined dynamics highlight the need for a more comprehensive analysis of the shadow economy's impact on tax revenues.

In the context of Sub-Saharan Africa, there remains a lack of comprehensive studies that incorporate relevant control variables and analyse multiple SSA countries over an extended period (Ajide, 2021; Alabede, 2018; Omodero, 2019; Ya'u et al., 2024).

Hence, this study incorporates underexplored control variables, such as regulatory quality, control of corruption, and oil revenue, along with 15 years of data from 15 SSA countries to address this research gap. By including these variables, the study provides a more nuanced and robust analysis of the shadow economy's effect on tax revenue in the region.

The study aims to examine the impact of the shadow economy on tax revenue in SSA countries. The study seeks to answer two research questions: How large is the shadow economy in SSA countries? And to what extent does the shadow economy affect the tax revenue of these countries?

The main hypothesis of the study is as follows:

H_1: The shadow economy has a negative and significant effect on the tax revenue of SSA countries.

Additionally, the following sub-hypotheses have been formulated for the control variables:

— H_2: GDP per capita positively and significantly affects tax revenue.

— H_3: Inflation negatively and significantly affects tax revenue.

— H_4: Unemployment negatively and significantly affects tax revenue.

— H_5: Trade openness positively and significantly affects tax revenue.

— H_6: Foreign Direct Investment (FDI) negatively and significantly affects tax revenue.

— H_7: The number of taxes paid by businesses negatively and significantly affects tax revenue.

— H_8: Regulatory quality positively and significantly affects tax revenue.

— H_9: Control of corruption positively and significantly affects tax revenue.

— H_{10}: Net revenue from oil production negatively and significantly affects tax revenue.

— H_{11}: The role of the agriculture sector in the economy negatively and significantly affects tax revenue.

This paper was organized into six sections. It begins with introduction, which provides an overview of the general context. The next section reviews existing literature, offering a robust theoretical and empirical foundation for the study. The Methods section outlines the research design, variables, techniques, models, and software employed in the analysis. This is followed by the Results and Discussion section, which examines and compares the findings to existing studies. The final section offers some concluding remarks.

Methods

The selection of 15 SSA countries was based on three key criteria: data availability, regional representation, and the prevalence of shadow economy activities. First, we prioritized countries with complete and reliable 15 years' data from 2009 to 2023, sourced from the World Bank, Global Economy, and central bank websites. Second, to ensure geographical diversity, we included nations from central, west, east, and southern Africa, capturing a wide range of economic contexts. Finally, we focused on countries with relatively higher levels of shadow economy activity, as this aligns with the study's core focus. The selected countries— the Democratic Republic of the Congo, Republic of the Congo, Equatorial Guinea, Ethiopia, Madagascar, South Africa, Lesotho, Namibia, Zambia, Botswana, Burkina Faso, Ghana, Ivory Coast, Mauritius, and Togo—collectively meet these criteria. This approach ensures a balanced and representative sample, enabling a robust analysis of the shadow economy's impact on tax revenue across SSA.

Regarding the operational definitions of variables, the dependent variable Tax Revenue represents the total tax income collected by the government from various types of taxes. It is expressed as the ratio of tax revenue to a country's GDP. The independent variable, Shadow Economy, refers to economic activities that fall outside government regulation. This study uses shadow economy data calculated through the MIMIC method, which is considered the most robust

approach (Fukuda, 2019; Dybka et al., 2019; Dell'Anno et al., 2018).

To isolate the specific effect of the shadow economy on tax revenue, the study includes ten essential control variables. The following section provides the definitions and measurements of these control variables:

1) GDP per Capita: Studies show that lower GDP per capita is significantly associated with larger shadow economies and lower tax revenue, and vice versa (Dokas et al., 2024).

2) Inflation: Higher inflation tends to push businesses into the shadow economy, thereby reducing tax revenue (Dutta, 2020; Mihaljek, 2023).

3) Unemployment: Higher unemployment rates drive people toward informal work, which decreases tax revenue (Dokas et al., 2024; Irandoust, 2024).

4) Trade Openness: Trade openness provides opportunities for participants of the shadow economy to move into formal jobs, which ultimately increases tax revenue (Gnangnon & Brun, 2019; Makun & Singh, 2025; Fedajev et al., 2022). This variable is measured by the sum of exports and imports as a share of GDP.

5) Foreign Direct Investment (FDI): FDI can have both positive and negative effects on tax revenue. On the positive side, FDI reduces informal activities through job creation, increasing tax revenue (Gaspareniene et al., 2022; Nguyen & Duong, 2022). Conversely, some scholars argue that tax incentives offered to attract FDI may erode potential revenue gains (Silajdzic & Mehic, 2022; Marjanović & Domazet, 2021). FDI is measured as a percentage of GDP.

6) Number of Taxes Paid by Businesses: A higher number of taxes paid by businesses can push firms into the informal sector, reducing revenue (Lavic, 2023; Bruhn & Loeprick, 2016).

7) Regulatory Quality: Excessive regulation and the resulting difficulties in formal operations lead businesses to engage in shadow activities, which decreases tax revenue (Wang et al., 2024; Yamen et al., 2018). Regulatory quality is measured on a scale ranging from low (-2.5) to high (2.5).

8) Control of Corruption: This reflects the level of corruption control in a country. Higher corruption drives businesses and individuals into the shadow economy, reducing tax revenue (Nguyen & Duong, 2022; Omodero, 2019). This variable is measured by an index where lower values indicate higher corruption and the maximum score of 100 represents no corruption.

9) Net Revenue from Oil Production: Greater government reliance on oil revenues reduces the

tax base and encourages the shadow economy (Ishak & Farzanegan, 2020; Maji et al., 2017). This is measured as net oil revenue as a percentage of GDP.

10) Role of the Agricultural Sector: In SSA countries, agriculture is mainly composed of smallholder farmers operating in the informal sector. A larger agricultural sector's share in the economy is associated with lower tax revenue (Kireenko & Nevzorova, 2019). This variable is measured by the agricultural sector's contribution to GDP.

Model selection, model specification, and validity test

Before selecting the appropriate model for this study, it was necessary to check for endogeneity and understand the persistence and dynamic nature of the dependent variable.

Endogeneity (bi-directionality) means that the shadow economy affects tax revenues by reducing the tax base, while tax policies and administration can, in turn, influence the size of the shadow economy (Sartov et al., 2023; Achim et al., 2023). To test for endogeneity, the residual approach was applied using SPSS 20 (Geraci et al., 2018). The results showed that the coefficient of the residual term was statistically significant, indicating that the shadow economy is endogenous in this context.

Additionally, the statistical significance of the lagged dependent variable shown in Table 2 confirms its persistence and dynamic nature. Previous studies also support that tax revenue as a percentage of GDP exhibits both persistence and dynamic characteristics (Menescal & Alves, 2024; Kubaje et al., 2025; Wilkins, 2018).

Given the presence of endogeneity and the dynamic behaviour of the dependent variable, the System dynamic panel-data estimation method (Arellano-Bover/Blundell-Bond estimator) was found appropriate for this study (Ahmad & Hussain, 2024; Sitkiewicz & Białek-Jaworska, 2024).

The econometric specification can be expressed as follows:

$$\textbf{\textit{TaxRev}}_{it} = \alpha \cdot \textbf{\textit{TaxRev}}_{i(t-1)} + \beta_1 \cdot ShadowEcon_{it} + \Sigma\gamma k \cdot ControlVar_{kit} + \mu_i + \in_{it}$$

Where

— Dependent Variable (**_TaxRev_**$_{it}$): Tax revenue as a percentage of GDP for country *i* at time *t*.

— Lagged Dependent Variable (**_TaxRev_**$_{i(t-1)}$): The inclusion of a one-period lag of tax revenue enables us to capture its persistence over time.

— Independent Variable (*ShadowEcon*$_{it}$): The size of the shadow economy as a percentage of GDP for each country.

— Control Variables (*ControlVar$_{kit}$*): The set of control variables includes GDP per capita, inflation rate, unemployment, trade openness, FDI, number of taxes paid by businesses, regulatory quality, control of corruption, net revenue from oil production as a percentage of GDP, and the agriculture sector's role in the economy.

— Country-Specific Effects (μi): Time-invariant effects unique to each country that may influence tax revenue.

— Idiosyncratic Error Term (εit): Captures random shocks not explained by the included variables.

The Arellano-Bond autocorrelation tests, described by Baum et.al (2007) and Roodman (2009), were performed using robust standard errors. These tests confirm the absence of problematic second-order serial correlation (AR (2), *p* = 0.1324), supporting both the model's overall validity and the reliability of the results.

It should be noted that while an analysis of short – and long-term dynamics using cointegration methods would be valuable, this study did not include such techniques. Cointegration analysis requires several steps, such as unit root tests, cointegration checks, and error correction models, which combined with the GMM approach used here would make the study less focused. It would be better to explore these dynamics in a separate study.

Results

Descriptive statistics analysis

The descriptive statistics provide a snapshot of the key variables in this analysis of SSA economies from 2009 to 2023. Tax revenue averaged 15.7 % of the GDP. Tax revenue ranges from a low of 0.5 % to a high of 40 %. This substantial variation suggests significant disparities in tax collection efficiency across the region. This average tax revenue of SSA countries is lower than the developing countries worldwide (Lozano-Espitia & Arias-Rodríguez, 2021; & Aizenman et.al, 2019).

The shadow economy of SSA countries averaged 36.2 % of GDP, with a range between 20.8 % and 49.2 %. This figure aligns with estimates for other developing economies (Ebeke & Ehrhart, 2012; Irandoust, 2024; & Schneider et.al, 2010). Such considerable size of the informal sector definitely has significant effect on tax revenue.

GDP per capita average was $3,445.7. The GDP per capita ranged from $191.8 to nearly $20,000, reflecting the diverse levels of economic development among the SSA countries. Inflation averaged 6 %, fluctuating between – 16.9 % and 44.4 %. This volatility could influence economic decisions and potentially drive activities into the informal sector. The average unemployment rate of 9.8 %, with a range from 0.6 % to 25.5 %, highlights potential labour market challenges and the possibility of informal employment absorbing a significant portion of the workforce. Trade openness, averaging 81.3 % and spanning from 24 % to 166.2 %, suggests a substantial reliance on international trade, which could be both a source of tax revenue and a channel for tax avoidance.

FDI, as percentage of GDP, averaged a modest 4.1 %, ranging from –17.3 % to 37.3 %. This relatively low level and high variability raise questions about the region's attractiveness for foreign investment and its potential contribution to tax revenue.

Businesses in the SSA countries on average faced 35.2 different taxes. In SSA, the number of taxes businesses pay ranges from as few as 7 to as many as 67. This complex tax landscape can create significant compliance burdens and may encourage informal economic activity.

The study found that regulatory quality in SSA countries is relatively low, with an average score of – 0.5, indicating significant room for improvement. Control of corruption scored an average of 35.5 out of 100, suggesting that weak corruption control may hinder tax revenue collection. Net revenue from oil production averaged 4.5 % of GDP, with some countries reporting no oil revenues and others relying on oil for as much as 52.4 % of their GDP. This high dependence on oil revenue could discourage efforts to diversify revenue sources. Finally, the agriculture sector's contribution to the economy averaged 13.6 %, ranging from 0.9 % to 45.9 %, reflecting its varying importance across the region. Detailed data are presented in Table 1.

Model output

The regression output reflects the results of a dynamic panel data analysis using the Arellano-Bover/Blundell-Bond estimation method. Below is an interpretation of the key findings.

Firstly, the lagged value of tax revenue (L1. tax revenue) has a positive and highly significant coefficient of 0.456 and p-value of 0.000. This suggests that tax revenue in the previous year has a strong and positive influence on current tax revenue, highlighting the persistence of tax revenue generation over time. Such persistence may result from structural or policy-related factors in the tax system that carry over from one year to the next. The shadow economy variable has a negative (β = –0.249) and statistically significant (*p* = 0.010) effect on tax revenue. This indicates

Descriptive statistics results

Variables	Minimum	Maximum	Mean	Std. Dev
Tax revenue, percent of GDP	0.5	40.0	15.7	8.7
Shadow economy, MIMIC method	20.8	49.2	36.2	7.5
GDP per capita	191.8	19 849.7	3 445.7	3 902.4
Inflation	−16.9	44.4	6.0	5.8
Unemployment rate	0.6	25.5	9.8	7.4
Trade openness	24.0	166.2	81.3	30.6
FDI, percent of GDP	−17.3	37.3	4.1	5.4
Number of taxes paid by businesses	7.0	67.0	35.2	15.6
Regulatory quality index (-2.5 to 2.5)	−1.7	1.2	−0.5	0.7
Control of Corruption (100 show no corruption)	16.0	65.0	35.5	12.2
Net revenue from oil production, percent of GDP	0.0	52.4	4.5	11.3
Agriculture Sector role in the economy	0.9	45.9	13.6	11.2

Source: World Bank database, Global Economy database, and central banks of the sample countries

that an increase in the size of the shadow economy is associated with a decrease in tax revenue. This finding aligns with expectations, as the shadow economy typically includes unregulated and untaxed activities, which undermine formal tax collection efforts.

Among the control variables, several findings are noteworthy. Unemployment has a positive ($\beta = 0.315$) and significant ($p = 0.002$) effect on tax revenue. Trade openness also has a positive ($\beta = 0.057$) and statistically significant ($p = 0.006$) effect on tax revenue. This suggests that greater trade integration may contribute to higher tax revenue, possibly through increased customs duties or the broadening of the tax base due to trade-related economic growth. FDI has a negative ($\beta = -0.022$) but marginally significant ($p = 0.071$) effect on tax revenue. This result could reflect the tax incentives or exemptions often granted to foreign investors, which might reduce the overall tax revenue despite the potential economic benefits of FDI. Variable Control of Corruption ($\beta = 2.950$ & $p = 0.096$) affects the tax revenue positively. Net revenue from oil production, expressed as a percentage of GDP, also has a significant negative ($\beta = -0.087$ & $p = 0.002$) effect on tax revenue. This means that reliance on oil revenue may crowd out other sources of tax collection, a phenomenon commonly referred to as the "resource curse".

Other control variables (GDP per capita, inflation, the number of taxes paid by businesses, regulatory quality, and the role of the agriculture sector) do not exhibit statistically significant effects on tax revenue. Although these factors may influence tax revenue in other contexts, their lack of significance here could be due to specific regional dynamics or the inclusion of other stronger predictors in the model.

The overall model's goodness-of-fit is demonstrated by the Wald chi-squared statistic, which is highly significant (chi2 (12) = 6 260.12, p-value = 0.000). This indicates that the explanatory variables collectively provide a strong explanation for variations in tax revenue across the sample of SSA countries.

In conclusion, the results highlight the harmful impact of the shadow economy on tax revenue and emphasize the need to address informal economic activities to improve tax collection. The regression output is presented below in Table 2.

Hypothesis tests

Drawing on the study's findings, the hypotheses were tested and are summarized below. For a hypothesis to be accepted, its results must show the expected direction (sign) and a statistically significant effect on the dependent variable. The outcomes of the hypothesis testing, using these criteria, are presented as follows.

Discussion

The positive and highly significant coefficient of 0.456 for the lagged value of tax revenue (L1. tax revenue) indicates that tax revenue collection in these SSA countries exhibits persistence over time. The positive coefficient shows that higher tax revenues in the prior period are likely to lead to higher tax revenues in the current period. This can be attributed to favourable factors that influence tax revenue positively over successive periods. This finding was in line with prior studies (Chamisa & Sunde, 2024; & Kebede et.al, 2024).

The major findings of the study show that the shadow economy has a negative ($\beta = -0.249$) and statistically significant ($p = 0.010$) effect on tax revenues in SSA countries. This result aligns

Regression output

System dynamic panel–data estimation					Number of obs = 210	
Group variable: countries					Number of groups = 15	
Number of instruments = 116					Wald chi2(12) = 6260.12	
					Prob > chi2 = 0.0000	
tax revenue	**Coef.**	**Robust std error**	**z**	**P > |z|**	**[95 % CI]**	
L1. tax revenue	0.456	0.071	6.400	0.000	0.317	0.596
Shadow economy	−0.249	0.097	−2.570	0.010	−0.438	−0.059
GDP per capita	−1.202	1.424	−0.840	0.399	−3.993	1.589
Inflation	−0.002	0.025	−0.090	0.926	−0.052	0.048
Unemployment	0.315	0.102	3.100	0.002	0.116	0.514
Trade Openness	0.057	0.021	2.740	0.006	0.016	0.098
FDI	−0.022	0.012	−1.800	0.071	−0.046	0.002
Number of taxes paid by businesses	−0.025	0.032	−0.780	0.438	−0.087	0.038
Regulatory quality	0.832	1.437	0.580	0.563	−1.985	3.648
Control of Corruption	2.950	1.771	1.670	0.096	−0.521	6.421
Net revenue from oil production, percent of GDP	−0.087	0.028	−3.150	0.002	−0.142	−0.033
Agriculture Sector role in the economy	0.078	1.361	0.060	0.955	−2.591	2.746
_cons	9.489	18.349	0.520	0.605	−26.474	45.451

Source: stata 15 & (World Bank, Global Economy, and central banks of sample countries)

Hypothesis testing results

Hypothesis	β	*P* value	Decision (based on both the β sign and *p* value of 0.1)
Major hypothesis			
H₁: Shadow economy negatively and significantly affects the tax revenue of SSA countries.	−0.249	0.010	Accepted
Sub-hypotheses			
H₂: GDP per capita positively and significantly affects tax revenue.	−1.202	0.399	Rejected
H₃: Inflation negatively and significantly affects tax revenue.	−0.002	0.926	Rejected
H₄: Unemployment negatively and significantly affects tax revenue.	0.315	0.002	Rejected
H₅: Trade openness positively and significantly affects tax revenue.	0.057	0.006	Accepted
H₆: FDI negatively and significantly affects tax revenue.	−0.022	0.071	Accepted
H₇: The number of taxes paid by businesses negatively and significantly affects tax revenue.	−0.025	0.438	Rejected
H₈: Regulatory quality positively and significantly affects tax revenue.	0.832	0.563	Rejected
H₉: Control of Corruption positively and significantly affects tax revenue.	2.950	0.096	Accepted
H₁₀: Net revenue from oil production negatively and significantly affects tax revenue.	−0.087	0.002	Accepted
H₁₁: Role of the agriculture sector in the economy negatively and significantly affects tax revenue.	0.078	0.955	Rejected

with prior research (Dokas et al., 2024; Mazhar & Méon, 2017; Omodero, 2019), underscoring the persistent negative impact of the shadow economy on tax revenue.

Regarding the control variables, unemployment exhibits a positive (β = 0.315) and statistically significant (*p* = 0.002) effect on tax revenues, which may seem counterintuitive at first. However, closer examination reveals several economic mechanisms behind this relationship.

First, governments often respond to rising unemployment by increasing taxes on employed individuals and businesses to fund unemployment benefits and stabilize the economy. Although aimed at addressing joblessness, these measures can inadvertently boost tax revenues (Le & Elliott, 2023; Zirgulis & Šarapovas, 2017; Šehović et al., 2021; Zimmermannová et al., 2016). Second, fiscal policies designed to create jobs, such as infrastructure projects or subsidies, can stimulate economic growth and further increase tax revenues (Barkoulas & Chionis, 2024). Third, since many SSA countries depend heavily on trade taxes, policy shifts like trade liberalization can enhance tax revenues even during periods of high unemployment (Kassim, 2024). Fourth, rising unemployment is often associated with increased corruption, prompting governments to enforce stricter tax compliance measures that improve revenue collection despite economic challenges (Pérez-Oviedo et al., 2024).

Together, these factors illustrate how unemployment can trigger policy responses and behavioural changes that ultimately raise tax revenues, highlighting the complex interaction between labour markets, fiscal policy, and revenue generation in SSA.

On the other hand, trade openness has a positive (β = 0.057) and statistically significant (p = 0.006) effect on tax revenue. This result supports earlier findings by Rahman & Islam (2023) and Gnangnon & Brun (2019), reinforcing the beneficial role of trade openness in enhancing tax revenues across various regions and contexts.

FDI has a negative (β= −0.022) but marginally significant (p= 0.071) effect on tax revenue, which aligns with prior research indicating a negative effect of FDI on tax revenue in the long term (Omodero & Yado, 2024; & Meniago & Lartey, 2021). These findings collectively suggest that while FDI can bring economic benefits, it may also pose challenges to tax revenue collection in the region, mainly because of tax exemptions for FDI.

Control of corruption positively (β = 2.950 & *p* = 0.096) affects tax revenue, suggesting that higher control over corruption correlates with higher tax revenue. This finding aligns with prior evidence of a positive relationship between these variables (Oanh et.al, 2024).

Net revenue from oil production, expressed as a percentage of GDP, has a significant negative effect on tax revenue (β = −0.087, *p* = 0.002). This confirms that countries reliant on oil income tend to have weaker tax systems. The finding aligns with prior research showing that increased oil revenues can reduce tax revenue mobilization (Shehabi, 2020; Ali & Harvie, 2013).

Finally, five of the ten control variables do not significantly influence tax revenue in SSA countries, as all their p-values exceed the conventional 0.05 threshold. GDP per capita (β = −1.202, *p* = 0.399) shows a negative but insignificant relationship, suggesting that economic growth alone may not directly impact tax collection. Similarly, inflation (β = −0.002, *p* = 0.926) and the number of taxes paid by businesses (β = −0.025, p = 0.438) have negligible effects, indicating that price stability and tax complexity may not be primary concerns in SSA countries. Regulatory quality (β = 0.832, *p* = 0.563) and the agriculture sector's role in the economy (β = 0.078, p = 0.955) also show no meaningful impact, highlighting the need to investigate other structural factors affecting tax revenue.

Conclusion

This dynamic panel data analysis using the Arellano-Bover/Blundell-Bond method sheds light on key factors influencing tax revenue in SSA countries. It confirms the negative impact of a large shadow economy, which deprives governments of vital tax income due to its informal and untaxed nature. To tackle this problem, policymakers should prioritize formalization by simplifying tax systems, reducing compliance costs, and incentivizing informal businesses to register. Strengthening tax enforcement and leveraging technology for better monitoring can further curb shadow economic activities.

The study also highlights the persistence of tax revenue streams, indicating that past collection strongly predicts future performance. This persistence reflects structural features or lasting policy effects, emphasizing the need for robust and efficient tax administrations to ensure steady revenue over time.

Some of our findings, however, were unexpected. Unemployment shows a positive effect on tax revenue, likely driven by government responses such as increased taxes, job creation programs, and trade liberalization, which collectively boost revenues despite rising joblessness. Policymakers should

explore this dynamic to design interventions that alleviate fiscal pressures during high unemployment.

Trade openness positively affects tax revenue, suggesting that policies encouraging international trade can enhance fiscal resources. However, these should be paired with measures to support local businesses' global competitiveness.

The negative impact of oil revenue on other tax sources confirms the "resource curse." To counter this, governments should diversify income by investing in non-oil sectors and reduce dependency on resource rents. Mechanisms like sovereign wealth funds or earmarking oil revenues for development projects could help mitigate adverse effects.

A marginally significant negative association between FDI and tax revenue suggests that tax incentives to attract foreign investment might reduce fiscal income. Policymakers should balance incentives with potential revenue losses through transparent, performance-based frameworks.

Corruption control, though marginally significant, positively influences tax revenue. Strengthening anti-corruption institutions and promoting transparency can improve compliance and collection.

Theoretically, this study underscores the importance of informal economies and their fiscal impact while contributing to debates on FDI and trade openness effects. Practically, it offers valuable guidance for SSA policymakers, highlighting the urgent need to formalize informal activities and enhance tax compliance for sustainable revenue growth and economic development.

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Автор заявляет о том, что при написании этой статьи не применялись средства генеративного искусственного интеллекта.

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Автор заявляет об отсутствии конфликта интересов.

Conflict of interests

The author declares no conflicts of interest.