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Value added tax, ethnic fragmentation and income inequality in Sub-Saharan Africa

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Background: The persistent and high levels of inequality in sub-Saharan Africa (SSA) pose significant challenges to achieving Sustainable Development Goal (SDG) 10, which aims to reduce inequality.

Aim: This study examines the combined effect of effective VAT (calculated as total VAT revenues divided by final consumption, reflecting the economic incidence of the tax) and ethnic fragmentation on income inequality in SSA.

Setting: The analysis covers 35 SSA countries from 1995 to 2021, based on Kripfganz and Schwarz's (2019) dynamic panel estimator of time-invariant effects.

Method: This study utilises the system generalised method of moments (SGMM) estimation to achieve its objective. The analysis covers 35 SSA countries from 1995 to 2021, based on Kripfganz and Schwarz's (2019) dynamic panel estimator of time-invariant effects.

Results: The findings indicate that effective VAT increases income disparity in both the short and long-run, with the long-run effect being more pronounced. Additionally, the findings suggest that ethnic-fragmentation amplifies the positive impact of effective VAT on income inequality over both time horizons, with a stronger effect in the long run. This suggests that ethnic-fragmentation hinders the ability of effective VAT to lower income disparity in SSA.

Conclusion: This study suggests that prioritising policies to strengthen the tax system and enhance social cohesion should be a focus in Sub-Saharan Africa (SSA).

Contribution: This study adds significant value to the literature by demonstrating the role of effective VAT on the relationship between ethnic fragmentation and income inequality in SSA. To solve the endogeneity issues, this study uses SGMM, incorporating forward orthogonal deviations, which distinguishes it from the traditional SGMM approach that does not account for these deviations (Roodman 2009a).

Keywords: effective VAT; income inequality; ethnic fragmentation; SGMM; Panel Data.

Introduction

Income inequality poses a significant challenge in sub-Saharan Africa (SSA), influenced by various factors, including tax policies and social dynamics. Among these, the effectiveness of value added tax (VAT) and the extent of ethnic fragmentation have garnered considerable attention in recent years. Effective value added tax (EVAT) is intended to enhance government revenue and promote equitable distribution. However, its impact on income inequality is heavily influenced by the socio-political context, particularly in ethnically diverse societies (Gordon & Li 2009). Ethnic fragmentation refers to the presence of multiple ethnic groups within a country, which complicates governance and resource allocation, often resulting in economic disparities (Easterly & Levine 1997). In SSA, where many nations are characterised by significant ethnic diversity, these dynamics play a crucial role in shaping economic outcomes. Value Added Tax, a tax levied on the value added at each stage of production and distribution, has been widely adopted across the region because of its potential to boost government revenue and support economic development (Gupta 2016). However, its effects on income inequality are complex and can vary substantially based on each country's socioeconomic conditions (Sullivan 2020).

A key factor influencing the effectiveness of VAT and its relationship with income inequality is ethnic fragmentation. While numerous studies have explored the connection between taxation and inequality through various lenses, the impact of ethnic diversity on this relationship remains underexplored. Factors such as democratisation (Acemoglu et al. 2013; Meltzer & Richard 1981),

compensatory measures (Asare, Davis & Kalu 2022) and corruption (Messy & Ndjokou 2021) have been cited as significant influences on VAT's effectiveness, yet the role of ethnic fragmentation warrants further investigation.

Research indicates that SSA countries are often characterised by strong cultural institutions (Cogneau & Dupraz 2015). Bird and Zolt (2015) emphasise the regressive nature of VAT, which disproportionately burdens lower-income households, including marginalised ethnic communities. Furthermore, Alesina and La Ferrara (2005) note that SSA nations exhibit high levels of ethnic diversity, with an ethnic fragmentation index averaging around 65%. Over 70% of these countries have diverse ethnic populations, presenting unique challenges for governance. For instance, Rwanda is identified as the least ethnically diverse country in the region, with an ethnic fragmentation index of 6%, while Uganda is the most fragmented, with an index of approximately 92.5%. Nigeria exemplifies significant ethnic diversity, housing over 250 ethnic groups. This division often correlates with higher levels of mismanagement and corruption (Mauro 1995), which can undermine the potential benefits of VAT and perpetuate inequality. Overall, SSA is distinguished by its high ethnic diversity, where various ethnic groups frequently coexist in close proximity (Collier & Hoeffler 2004). This ethnic fragmentation can influence economic policies and their outcomes in multiple ways, such as resource allocation, the effectiveness of tax administration and public perceptions of fairness in the tax system (Alesina, Baqir & Easterly 1999). Understanding the joint effect of EVAT and ethnic fragmentation on income inequality is crucial for developing policies that foster equitable growth in the region.

In nations with significant ethnic fragmentation, ensuring that EVAT revenues are fairly distributed and that tax policies do not worsen existing inequalities can be particularly challenging. Recent research indicates that ethnic fragmentation can influence the effectiveness of EVAT in mitigating income inequality. Ethnically diverse societies may encounter difficulties in policy implementation because of conflicting group interests and demands (Easterly & Levine 1997). This complexity can affect the progressivity of EVAT and its success in addressing disparities. Additionally, ethnic fragmentation can shape how different groups view and react to tax policies, potentially impacting compliance rates and overall tax revenue (Montalvo & Reynal-Querol 2005a). Scholars suggest that while EVAT can potentially reduce income inequality by funding public services and welfare programmes, its efficacy is significantly influenced by the degree of ethnic fragmentation (Bardhan & Mookherjee 2000). In countries with high levels of ethnic diversity, tax systems may be perceived as inequitable or ineffective, undermining their ability to alleviate poverty and inequality (Alesina et al. 2003). This dual influence of EVAT and ethnic fragmentation creates a complex interplay that can either mitigate or exacerbate income disparities.

This paper aims to evaluate how ethnic-fragmentation impacts the relationship between EVAT and income disparity in SSA. Taking ethnic-fragmentation into consideration when explaining how EVAT reduces income disparity could lead to significant policy implications. Different ethnic groups may have distinct behaviours towards the tax system. Nigeria, for example, is among Africa's most ethnically diverse nations, home to over 250 ethnic groups. The three largest groups are the Hausa-Fulani in the north, the Yoruba in the southwest and the Igbo in the southeast. This diversity often results in significant political and social fragmentation, impacting various governance aspects, including tax policy. For example, the southern regions, which have more commercial activity and higher economic output, may face stricter EVAT enforcement compared to the less economically developed northern regions with different administrative priorities. Additionally, political influence and preferential treatment along ethnic lines can affect EVAT policy implementation. Ethnic groups with greater political power may advocate for exemptions or reductions in EVAT rates for industries and businesses dominant in their regions. We suggest that ethnic fragmentation determines the degree to which EVAT affects income inequality. This hypothesis is grounded in sets of theories. Ethnic Fragmentation Theory suggests that high levels of ethnic diversity within a country can impede economic development and equitable income distribution. According to Alesina and Ferrara (2005), ethnically fragmented societies tend to demonstrate weaker social cohesion, posing challenges to effective governance and public policy implementation. This fragmentation often leads to unequal access to public goods and services, exacerbating economic disparities (Alesina et al. 1999).

Therefore, this study empirically investigates the combined effect of EVAT and ethnic fragmentation on income inequality from 1995 to 2021. In so doing, our paper answers two questions: (1) Does VAT impact income inequality, if yes, is the impact similar in short and long run? (2) Is the impact of EVAT on income inequality conditional on ethnic fragmentation? In answering the above questions, we contribute by expanding the literature of EVAT and income inequality in various ways: (1) while most scholars assess EVAT (focussing on its legal definition)-income inequality nexus and the ethnic fragmentation-income inequality association, this study empirically contributes to the previous studies by examining the joint impact of EVAT (calculated as total VAT revenues divided by final consumption, which reflects the economic incidence of the tax rather than its legal definition) and ethnic fragmentation on income inequality in both short and long run in SSA. Thus, the results from this study are expected to be robust and consistent given that it will help the policymakers in the reallocation of resources and may produce significant policy recommendations. (2) We employ the two-step system generalised method of moments (SGMM) estimation method, integrating forward orthogonal deviations, setting it apart from the traditional SGMM approach that does not account for these deviations (Roodman 2009a). This improves the reliability and efficiency of parameter estimates, especially in the presence of small samples, missing data and potential endogeneity issues. This makes it a robust choice for dynamic panel data analysis. (3) Research indicates

ethnic fragmentation affects income disparity (Chadha & Nandwani 2018).

Furthermore, Cogneau and Dupraz (2015) assert that understanding the development disparities in SSA requires an examination of their cultural and social specificities. Hence, it is important to assess the effect of EVAT on income disparity focussing on ethnic fragmentation. It is noted that the effects of variables such as gender and ethnic fragmentation cannot be directly estimated because these variables remain constant over time. To address these issues, this study employs the time-invariant regressors developed by Kripfganz and Schwarz (2019) in dynamic panel data analysis, specifically adapted to assess 'time-invariant' variables such as ethnic fragmentation. Traditional estimation methods are inadequate because they fail to accurately capture the true effects of 'time-invariant' variables. Additionally, they suffer from bias because of the correlation between explanatory variables and unit effects in random-effects models, and they face challenges in distinguishing the effects of observed heterogeneity from time-invariant unit heterogeneity in fixed-effects models. Thus, these challenges are effectively addressed by employing the regressors of Kripfganz and Schwarz, which are tailored to assess 'time-invariant' variables.

Following the Introduction section, the remaining sections are: In Section 2, the relevant literature is covered. The data and econometric model are covered in Section 3. The results are detailed in Section 4, while Section 5 contains the conclusion and policy recommendations.

Literature review

Income disparity is a critical issue in SSA, driven by various contributing factors. Among these, EVAT and ethnic fragmentation play significant roles. While the separate impacts of EVAT and ethnic fragmentation on income inequality have been researched, their combined effect has not been thoroughly investigated. This literature review seeks to comprehensively examine existing studies on the individual and combined impacts of EVAT and ethnic fragmentation on income inequality in SSA, identifying research gaps and proposing directions for future investigation.

Impact of effective value added tax on income inequality

Value added tax is a consumption tax applied at each stage of production and distribution, with the final burden falling on the consumer. In SSA, EVAT is a commonly utilised and dependable source of government revenue (Emran & Stiglitz 2005). Nevertheless, VAT is frequently criticised for its regressive nature, as it tends to disproportionately impact lower-income households that spend a larger share of their income on taxable goods and services. Research indicates that VAT can worsen income inequality because of its regressive nature. Emran and Stiglitz (2005) contend that in countries with significant informal sectors, VAT amplifies the tax burden on goods from the formal sector, disproportionately impacting low-income households. Similarly, Gemmell and Morrissey (2005) discovered that in Ghana and Kenya, the introduction of VAT resulted in heightened income inequality, with the tax burden falling more heavily on lower-income earners. To alleviate the regressive impact of VAT, strategies such as zero-rating essential goods and services have been suggested (Keen 2008). For example, South Africa exempts basic foodstuffs from VAT, which helps lessen the tax burden on lower-income households. Bird and Zolt (2005) propose that directing VAT revenues towards targeted social spending can counterbalance its regressive effects, indicating that the potential of VAT to reduce income inequality hinges on the manner in which the revenue is allocated.

The relationship between EVAT and inequality is complex. Value added tax is often viewed as a regressive tax that disproportionately impacts lower-income individuals (OECD 2018). As VAT rates increase, they can worsen income inequality, particularly in countries with lower gross domestic product (GDP) per capita, where a greater proportion of income is devoted to consumption (Piketty 2014). In contrast, in nations with higher GDP per capita, the adverse effects of VAT on income distribution may be alleviated by stronger social safety nets and more progressive taxation systems (Brys et al. 2016). According to UN Women (2020), VAT can place a disproportionate burden on women, who often constitute a larger share of low-income earners and are frequently responsible for household consumption. This regressive nature of VAT can further exacerbate income inequality and hinder efforts towards gender equality, as lower-income households, particularly those headed by women, experience greater financial strain (Baker 2018). Moreover, in societies that promote gender equality, tax systems tend to be more progressive, which can mitigate the negative impacts of VAT on vulnerable populations (Kabeer 2015). Additionally, VAT is generally regarded as a regressive tax that disproportionately affects lower-income households, leading to increased income inequality (Marr et al. 2019). As income inequality rises, access to quality education often diminishes for disadvantaged groups, perpetuating educational inequality (OECD 2018). Furthermore, countries with higher GDP per capita may have more resources available for equitable education funding, helping to address these disparities (Baker & McNally 2020). Finally, VAT can exacerbate income inequality by disproportionately affecting lower-income households, which allocate a larger share of their income to consumption (Santos & De Oliveira 2020). This added financial burden can result in increased inflationary pressures, as businesses may pass on VAT costs to consumers, further straining the budgets of low-income families (Bennett 2018). Conversely, higher GDP per capita can provide a buffer against these effects, as wealthier individuals are less impacted by VAT-induced price increases (OECD 2019).

Impact of ethnic fragmentation on income inequality

Ethnic fragmentation denotes the existence of multiple distinct ethnic groups within a country. In SSA, ethnic diversity is a prominent feature, with many nations comprising dozens,

if not hundreds, of ethnic groups. This fragmentation can significantly impact economic development and the distribution of income. Alesina and Ferrara (2005) contend that ethnic fragmentation undermines social cohesion, making it more challenging to implement effective governance and public policies. This fragmentation frequently leads to unequal access to public goods and services, thereby worsening economic disparities (Alesina et al. 1999). From the perspective of Political Economy Theory, ethnic fragmentation can influence the design and implementation of tax policies, with governments in ethnically diverse countries potentially prioritising policies that favour specific groups (Easterly & Levine 1997). Social Capital Theory highlights the importance of social networks, trust and norms in enabling economic transactions. According to Putnam (2000), ethnic fragmentation can deteriorate social capital by fostering divisions and diminishing trust among different groups, thereby impeding collective action and the provision of public goods. In SSA, the low social capital resulting from ethnic fragmentation complicates the implementation of fair EVAT policies, as trust in government and adherence to tax regulations tend to be lower in fragmented societies (Alesina & Ferrara 2005). Recent studies on the impact of ethnic fragmentation on income inequality employ various econometric techniques to reveal complex dynamics. Alesina, La Ferrara and Di Tella (2022) use fixed-effects panel regressions and find that ethnic diversity increases income inequality, especially in countries with weaker institutions. Montalvo and Reynal-Querol (2021) apply generalised method of moments (GMM) to SSA data, showing that ethnic fragmentation exacerbates long-term income inequality because of social divisions. Ravallion and Lokshin (2023) use system GMM in a dynamic panel analysis, indicating that ethnic fragmentation significantly amplifies income disparities, particularly in regions with high diversity and low economic integration. Collier and Hoeffler (2022) use fixed-effects and random-effects models to demonstrate that ethnic fragmentation leads to greater income inequality in developing economies where ethnic groups are isolated from one another. These findings collectively underscore the detrimental impact of ethnic fragmentation on income distribution, highlighting the need for targeted policy interventions.

Joint impact of value added tax and ethnic fragmentation on income inequality

In societies with ethnic diversity, the implementation of EVAT might be influenced by political dynamics and preferential treatment based on ethnic affiliations. For instance, regions with more political influence may advocate for VAT exemptions or reductions for industries prevalent in their areas, resulting in uneven enforcement and distribution of tax burdens and benefits (La Porta et al. 1999). This preferential treatment can exacerbate income inequality, especially if marginalised groups bear a disproportionate tax burden while receiving fewer benefits. Understanding the combined impact of VAT and ethnic fragmentation on income inequality is crucial for devising effective policy measures. Governments and policymakers must take into consideration the socio-political context of ethnically diverse regions when formulating EVAT policies. Initiatives such as promoting financial literacy, ensuring fair access to public goods, and utilising EVAT revenues for targeted social programmes can help alleviate the negative effects of EVAT and ethnic fragmentation on income inequality. Nabi and Daoud (2021) analyse how VAT affects income inequality in SSA's ethnically diverse societies. They discover that VAT's ability to mitigate income inequality is less effective in regions with high ethnic fragmentation, where implementing and distributing tax policies equitably is more challenging. The study uses Ordinary Least Squares (OLS) to explore the link between VAT and income inequality, Fixed Effects Models to account for country-specific differences and Instrumental Variables (IV) to manage potential endogeneity issues. Their findings reveal the intricate relationship between VAT, ethnic diversity and income inequality. Alemayehu and Haile (2021) explore the impact of ethnic diversity on fiscal policy outcomes in SSA, finding that significant ethnic fragmentation can obstruct effective policy implementation and fair resource distribution. They employ OLS to assess the direct effects of ethnic diversity on fiscal results, use Fixed Effects and Random Effects Models to manage country-specific and time-related variables and apply GMM to tackle endogeneity issues. Their results highlight the challenges that ethnic diversity poses for achieving effective and equitable fiscal policies.

Despite some scholars investigating the link between VAT and inequality in the context of SSA and others assessing the relationship between ethnic fragmentation and fiscal policy, their results may be inconsistent because of the econometric techniques used as seen precedingly: (1) OLS can suffer from biases and inconsistencies if endogeneity issues arise, such as omitted variables or measurement errors (Wooldridge 2010). (2) Instrumental Variables (IV) methods depend on finding valid instruments, and weak or invalid instruments can result in biased estimates and high variability (Stock & Yogo 2005). (3) GMM may produce inefficient estimates if the moment conditions are not well-chosen, requiring large sample sizes for reliable results (Arellano & Bond 1991; Hansen 1982). In contrast, this study investigates the role of ethnic fragmentation on the link between EVAT and inequality using SGMM. This technique offers several advantages: it enhances efficiency by utilising both level and differenced equations, better addresses endogeneity by employing lagged variables as instruments and effectively handles measurement errors and unobserved heterogeneity, making it particularly suitable for complex dynamic panel data models (Blundell & Bond 1998; Roodman 2009b). While previous studies have examined the individual effects of VAT and ethnic fragmentation on income inequality in SSA, the combined influence of these factors – VAT and ethnic fragmentation – on income inequality using SGMM remains underexplored. Bridging this research gap is vital for crafting more efficient and equitable tax policies. The results of this study reveal that

an effective VAT system exacerbates income inequality both in the short term and, more significantly, in the long term. Moreover, ethnic fragmentation intensifies the impact of effective VAT on income disparity over both time periods, with a more pronounced effect in the long run. This implies that ethnic fragmentation hinders the effectiveness of VAT in reducing income inequality in SSA. This study contributes to existing literature by showing that effective VAT systems can increase income inequality both in the short term and more markedly in the long term. It also demonstrates that ethnic fragmentation intensifies VAT's negative impact on income disparity, suggesting that VAT is less effective at reducing inequality in ethnically diverse societies. These insights enhance our understanding of how ethnic diversity affects tax policy outcomes and highlight the necessity for tax reforms in SSA to consider ethnic fragmentation for more equitable outcomes. Future studies should concentrate on empirical investigations that examine the simultaneous impact of EVAT and ethnic fragmentation on income disparity in SSA, offering valuable insights for governments and policymakers aiming to address income disparities in ethnically diverse regions.

Methodology and data

Econometric model

A dynamic panel data model

Political Economy Theory is used as a theoretical framework for this study. This theory offers a valuable lens for understanding how ethnic fragmentation affects tax policy in SSA. In ethnically diverse societies, governments may craft tax policies that favour powerful or influential ethnic groups to secure political support, resulting in uneven policy implementation and benefits. This preferential treatment can lead to disparities where some groups enjoy tax relief and better services, while others face higher tax burdens and fewer benefits. Such inequities exacerbate income inequality, as marginalised groups are left with greater economic challenges compared to their more favoured counterparts. By recognising these dynamics, Political Economy Theory underscores the need for more equitable and consistent tax policies that address ethnic biases and promote fair resource distribution, ultimately helping to mitigate income inequality and improve social cohesion. To analyse the association between EVAT, ethnic fragmentation and inequality; firstly, we use the Dumitrecu and Hurlin causality test to check the directional causality of the variables of interest and secondly, system GMM is applied to account for omitted variables, measurement error and endogeneity.

The models are specified as follows:

Model 1 excludes the interaction between EVAT and other regressors or control variables (see Equation 1):

$$lnGini_{it} = \beta_1 lnGini_{it-1} + \beta_2 lnEVAT_{i,t} + \beta_3 lnETH_{i,t} + \beta_4 \acute{X}_{i,t} + \theta_i + \Omega_t + \epsilon_{it} \quad \text{[Eqn 1]}$$

Model 2 incorporates the interaction between EVAT and ethnic fragmentation (see Equation 2):

$$lnGini_{it} = \beta_0 + \beta_1 lnGini_{it-1} + \beta_2 lnEVAT_{i,t} + \beta_4 ElnTH_{i,t} + \beta_5 EVAT_{i,t} * ETH_{i,t} + \beta_6 \acute{X}_{i,t} + \theta_i + \Omega_t + \epsilon_{it} \quad \text{[Eqn 2]}$$

Where $Gini_{it}$ is income inequality, $Gini_{it-1}$ is the dynamic characteristic of the equation, $EVAT_{i,t}$ is EAVT in GDP (the logarithm of real per capita GDP); and X represents the vector of control variables such as GDPpc is GDP per capita, VAT, inflation, corruption, gender equality (GEN), ethnic-fragmentation (ETH), educational inequality (EDINEQ). $EVAT_{i,t} * ETH_{i,t}$ describes the interaction term of EVAT with ethnic fragmentation. This shows that the impacts of VAT on inequality are conditional on ethnic fragmentation. $\acute{\theta}_i$ *and* Ω_t are country-specific effect and time-specific effect, respectively. ϵ_{it} is the error term and β is a vector estimated coefficients.

In this section, a panel dataset of 35 countries from 1995 to 2021 is assessed to examine the impact of EVAT on income disparity. The list of countries is provided in Appendix 1. We take 3-year averages for all time-variable in order to diminish short-term fluctuations because of business cycles.[1] Additionally, our key variables of interest, such as inequality, EVAT and GDP per capita vary slowly over time. The following model is estimated in this study using Blundell and Bond's (1998) methodology: Because aggregate variables such as inequality have considerable time persistence, we have included lagged inequality as an explanatory variable in Equation 2 and Equation 3. In fact, serial correlation of income inequality over years is well established (Kurosaki 2011). This allows us to examine a dynamic panel data. Over time, income disparity slowly varies within countries. This shows that some unobserved factors may be responsible for this time persistence. If these factors are associated with our regressors in this context, fixed-effects estimates are biased. The lag of income disparity must be included as a regressor in order to address this problem. To compute a long run impact of an increase in EVAT on income gap, this study follows Wooldridge (2013:635). Note that the following challenges need to be handled in order to estimate Equation 3: (1) the lag dependent variable, incorporated as a regressor, is endogenous. (2) As previously argued, omitted variable bias, reverse causality and measurement errors make it difficult to examine the impacts of EVAT, ethnic fragmentation and inequality. We employ SGMM to address the aforementioned issues even though we take advantage of the fact that the individual dimension in our panel data is bigger than the time dimension. All variables were chosen based on existing literature. This study employs interpolation and extrapolation techniques to address any missing data.

Regarding measurement errors, it is well known that the variables taxation and inequality are correlated with measurement errors. The lack of a consensus measure for these variables in the literature serves as evidence for this. Some key

1.(1995–1997, 1998–2000, 2001–2003, 2004–2006, 2007–2009, 2010–2012, 2013–2015, 2016–2018, 2019–2021).

variables may be left out of the model in terms of omitted variables. Despite the fact that a number of determinants of income inequality are important, these variables are not included because they may be associated with other factors in the model. Finally, the reverse causality issue may be demonstrated by the fact that, although EVAT influences inequality, the reverse causation is also possible because of the fact that an increased EVAT can lead to the higher level of income inequality. The inclusion of the lagged variable of income disparity in the model, however, makes it even more crucial to take into account its memory impact because income inequality is a path-dependent process that depends on its prior development (Teng & Yue 2019). Because of all of the aforementioned factors, SGMM is the estimation method that best fits our study. The SGMM estimator is preferable because, as was said earlier, our dependent variable is time persistent. Furthermore, by employing an appropriate endogenous variable (EVAT) as a reliable instrument, it becomes possible to address the potential endogeneity of our variables. In addition, the moderating influence of ethnic fragmentation on the association between EVAT and income inequality is examined using the dynamic panel estimator for time-invariant variables developed by Kripfganz and Schwarz (2019). This method is particularly advantageous as it offers resilience against specification errors stemming from the exogeneity assumption. Moreover, it facilitates the accurate capture of the genuine impact of time-invariant variables, a facet often overlooked by alternative methodologies. An important benefit of this two-step approach is its capacity to rectify estimates derived from conventional methods, which frequently rely on poorly specified assumptions regarding time-invariant regressors that may not influence the outcomes of time-series estimation.

Except for GDPpc, which contains some negative values, this study uses the variables in logarithmic form in order to reduce white noise because of outliers. We use extrapolation and interpolation techniques to fill in the missing data. Our left-hand-side variable makes it improbable to observe the contemporaneous impact of the right-hand-side variables: income inequality is persistent and changes slowly. Hence, this study utilises lagged values of all the regressors, which accidentally also allow us to deal with the potential reverse-causality problems. In fact, one of the issues may be with regard to the stationarity properties of the variables used in our model. The majority of the series employed in this study hardly have stochastic trends by their nature. The Gini coefficient index, for instance, varies between 0 and 100, and the EVAT variable as a share of GDP may contain a deterministic trend, hardly non-stationary. In addition, endogeneity can also be an issue: fiscal policy (EVAT) may influence income inequality, but the policymakers' willingness to diminish it may cause spending and tax decisions, leading to a possible two-way association among the series. This is why this study employs SGMM estimates, treating EVAT as an endogenous variable. To avoid the issue of too many instruments in the SGMM estimator, we used EVAT as instruments. This decision is also influenced by the criterion that the number of instruments should, in theory, be less than the number of countries (Roodman 2009a) and the autoregressive (AR) (3) test results. Our key results are robust to limiting the endogenous variable utilised as instruments.

Income inequality is influenced by a variety of economic and social factors, necessitating the inclusion of several important variables in its analysis. Effective VAT and ethnic fragmentation are key regressors because of their potential impact on income distribution. Effective VAT is examined because tax policies directly influence disposable income and consumption patterns (Keen & Lockwood 2010). Ethnic fragmentation is considered because of its effect on social cohesion and economic inequality (Alesina et al. 2003). Control variables are essential for isolating the effects of the primary regressors: GDP per capita (GDPpc): Higher GDPpc usually correlates with lower income inequality, as it allows for more resources to be redistributed (Forbes 2000). Inflation: High inflation can erode real incomes, disproportionately affecting lower-income households and increasing inequality (Easterly & Fischer 2001). Corruption: Corruption often worsens income inequality by enabling the wealthy to gain disproportionate benefits (Gupta, Davoodi & Alonso-Terme 2002). Gender Equality: Greater gender equality can help reduce income inequality by providing more opportunities and fair income distribution (World Bank 2011). Educational Inequality: Reducing educational inequality can create a more skilled workforce and lead to more equal income distribution (Barro 2000). These variables are included to control for broader economic and social influences, ensuring a more accurate assessment of the impact of EVAT and ethnic fragmentation on income inequality.

Data description

Definition of variables used in this study is provided in Table 1.

Ethical considerations

This article does not contain any studies involving human participants performed by any of the authors.

Results

Basic results

Before estimating the association between EVAT, ethnic fragmentation and inequality using SGMM, we first examine the descriptive statistics, the correlation matrix, the Variance Inflation Factor (VIF), the Ramsey RESET test fits and the correlation for our variables of interest. Table 2 presents the summary statistics. The mean of income inequality is 56.4, with a standard deviation of 6.97, indicating that income inequality remains high in Africa. This finding aligns with Asongu and Odhiambo (2019), who emphasise the importance of reducing income disparity in developing regions to achieve Sustainable Development Goal (SDG) 10. The mean of EVAT is 3.04, with a standard deviation of 1.45. The maximum value of income inequality is 66.5, and the minimum is 34.0, highlighting heterogeneity in the sample, which is also reflected in the standard deviation.

TABLE 1: Source and definition of the variables.

Variable	Description	Source
Gini coefficient	We obtained our annual data on aggregate net income inequality from the Gini coefficient series recently released in version 8.2 of the SWIID, published by Solt (2019). In this study, we use the disposable Gini coefficient, as it offers a comprehensive view of inequality in SSA countries.	SWIID
VAT	The revenue of VAT in GDP as a proxy of each tax rate variable.	UNU WIBER 2020 (GRD)
EVAT	Effective VAT is computed as total VAT revenues divided by final consumption.	Author computation
Inflation	This variable is measured by the consumer price index, which reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services, with the composition of this basket being either fixed or adjusted at specified intervals, such as annually.	World Development Indicators (WDI)
GDP per capita	GDP per capita has been included in our equations 1 and 2 to capture countries' development levels. We have transformed this variable in natural logarithm in order to reduce its high skewness.	WDI
Corruption	This variable is ranked between 0 (most corrupted) and 12 (least corrupted). The ICRG corruption index refers to the evaluation of foreign investors on the level of corruption in the country.	International Country Risk Guide (ICRG)
Gender Equality	This variable assesses the effectiveness of a country's institutions and programmes in enforcing laws and policies that ensure equal access for men and women to education, health services, economic opportunities and legal protection. It is expected to reduce income inequality.	World Bank
Education level	As measured by the gross secondary school enrolment rate expressed in percentage terms.	WDI
Educational Inequality	Standard deviation of the level of education	Author computation
Ethnic Fragmentation	Ethnic fragmentation is measured using the ethnic fractionalisation index (ethfrag), which is based on 650 identified ethnic groups across 190 countries. This index reflects the probability that two randomly selected individuals in a country belong to different ethnic groups, capturing the diversity within the society. The index ranges from 0 to 1 (or 100), with 1 (or 100) indicating complete diversity where each individual belongs to a different ethnic group, and 0 indicating a completely homogeneous society.	From the database of Alesina et al. (2003)

Note: Please see the full reference list of the article, Voto, T.P., Ngepah, N. & Gerendawele, N.H., 2024, 'Value added tax, ethnic fragmentation and income inequality in sub-Saharan Africa', *South African Journal of Economic and Management Sciences* 27(1), a5793. https://doi.org/10.4102/sajems.v27i1.5793, for more information.

GDP, gross domestic product; VAT, value added tax; EVAT, effective value added tax; SSA, Sub-Saharan Africa; SWIID, Standardized World Income Inequality Database; GRD, Government Revenue Dataset.

TABLE 2: Summary statistics.

Variable	Obs	Mean	SD	Min	Max
GINI	960	56.40	6.97	34.00	66.50
EVAT	960	3.04	1.45	0.10	8.44
EDINEQ	960	6.24	4.35	1.40	25.30
GDPpc	960	1.36	4.99	-47.80	36.98
CORR	1079	2.96	0.63	1.00	4.90
INFL	960	11.99	18.95	-72.70	83.30
ETH	1080	65.70	0.46	5.90	89.70
GEN	1024	0.69	0.06	0.49	0.90

Note: The Jarque–Bera test, test the null hypothesis of normality against the alternative of non-normality. The significance of the Jarque–Bera statistic indicates the rejection of the null of normality.

EVAT, effective value added tax; GEN, gender equality; ETH, ethnic-fragmentation; GDPpc, gross domestic product per capita; EDINEQ, educational inequality; CORR, Corruption; INFL, inflation; Obs, Observation; SD, standard deviation.

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

TABLE 3: Correlation matrix.

Variable	Coefficient	Gini coeff	EVAT	EDINEQ	GDPpc	CORR	INFL	ETH	GEN
Gini coeff	-	1.00	-	-	-	-	-	-	-
EVAT	-	-0.32	1.00	-	-	-	-	-	-
	-	0.00	-	-	-	-	-	-	-
EDINEQ	-	0.02	-0.05	1.00	-	-	-	-	-
	-	0.48	0.19	-	-	-	-	-	-
GDPpc	-	0.49	0.36	-0.03	1.00	-	-	-	-
	-	0.00	0.00	0.33	-	-	-	-	-
CORR	-	-0.00	0.09	-0.07	0.11	1.00	-	-	-
	-	0.94	0.00	0.03	0.00	-	-	-	-
INFL	-	-0.18	-0.03	-0.15	0.06	0.14	1.00	-	-
	-	0.00	0.41	0.00	0.05	0.00	-	-	-
ETH	-	-0.04	0.03	-0.03	0.03	-0.05	-0.03	1.00	-
	-	0.00	0.00	0.00	0.08	0.06	0.05	-	-
GEN	-	-0.01	0.07	-0.09	-0.02	0.09	0.07	0.02	1.00
	-	0.56	0.83	0.01	0.43	0.07	0.95	0.38	-

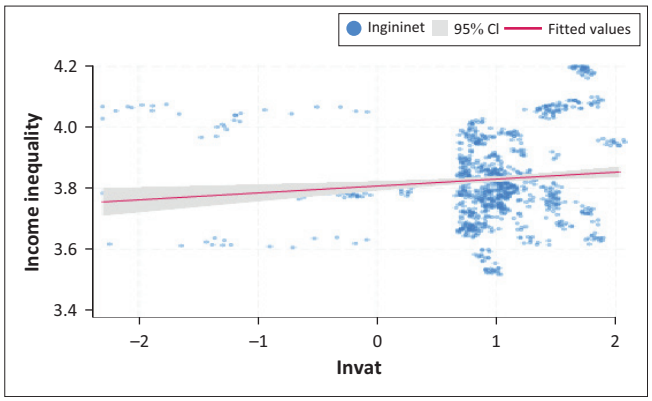
EVAT, effective value added tax; GEN, gender equality; ETH, ethnic-fragmentation; GDPpc, gross domestic product per capita; EDINEQ, educational inequality; CORR, Corruption; INFL, inflation.

Table 3 shows the correlation matrix, revealing that both EVAT and ethnic fragmentation individually have a negative correlation with income disparity. To detect multi-collinearity in the regression analysis, this study uses the VIF. Table 4 indicates no multi-collinearity, as all VIF values are less than 10, demonstrating the reliability of the regression models. To ensure the robustness and appropriate specification of the model, this study also performs the Ramsey RESET test. The Ramsey RESET test results show a *p*-value of 0.967, which is greater than the chosen significance level of 0.05. Thus, we fail to reject the null hypothesis (Ho: Model has no omitted variables), indicating no strong evidence of omitted variables or model misspecification. However, Figure 1 reveals a slight positive correlation while Figure 2 shows a positive correlation. Even though Figure 1 and Figure 2 show the correlation between our variables, they do not give directional causality. To observe the directional causality, we perform a panel causality between our main variables (see Table 5). The results reveal a bidirectional causality between EVAT and inequality. However, the bi-directional causality outcomes in SSA imply that changes in EVAT lead to changes in inequality and vice versa. In other words, a change in EVAT may affect inequality and vice versa. Therefore, the causality results in both SSA revealed possible endogeneity issues in the model. The bidirectional causality observed between EVAT and income inequality highlights a dynamic interplay consistent with economic theory. Initially, EVAT's regressive nature increases income inequality by

TABLE 4: Variance Inflation Factor.

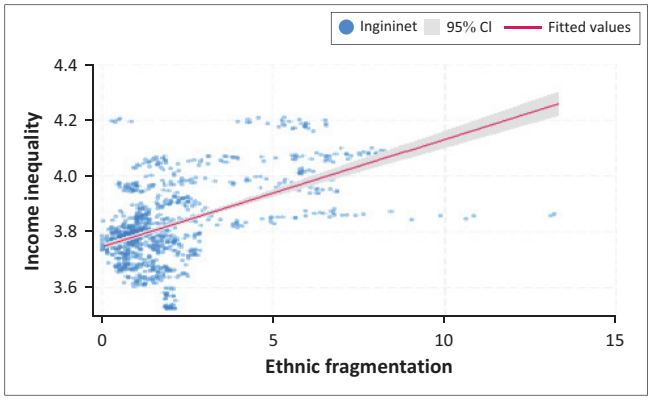
Variable	VIF	1/VIF
EVAT	1.16	0.86
EDINEQ	1.16	0.86
GDPpc	1.05	0.95
CORR	1.04	0.96
INFL	1.03	0.97
ETH	1.12	0.96
GEN	1.07	0.93
Mean VIF	1.09	0.91

EVAT, effective value added tax; GEN, gender equality; ETH, ethnic-fragmentation; GDPpc, gross domestic product per capita; EDINEQ, educational inequality; CORR, corruption; INFL, inflation; VIF, variance inflation factor.



VAT, value added tax; CI, confidence interval.

FIGURE 1: Scatter plot between inequality and effective VAT.



CI, confidence interval.

FIGURE 2: Scatter plot between inequality and ethnic fragmentation.

TABLE 5: Pairwise Dumitrescu and Hurlin (2012) panel causality tests results.

Region	Direction	Null	W-stat	Z-Stat	*p*
SSA	Gini ↔ EVAT Bi-directional	Gini ↛ EVAT	5.70	12.53	0.01
		EVAT ↛ Gini	3.59	19.20	0.01
	Gini → ETH Uni-directional	Gini ↛ ETH	4.76	35.26	0.35
		ETH ↛ Gini	2.95	3.25	0.00

Note: ↔ and → denote bidirectional and unidirectional causality respectively. 0 ↛ 0 denote does not homogeneously cause (H0).

SSA, Sub-Saharan Africa; EVAT, effective value added tax; ETH, ethnic-fragmentation.

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

disproportionately burdening lower-income households, who spend a larger share of their income on taxed goods. This exacerbates income disparities, aligning with theories on regressive taxation (Alesina et al. 2003). In response, rising income inequality can prompt demands for VAT adjustments or compensatory measures, such as targeted subsidies or refunds, to mitigate its impact (Bird & Zolt 2015). Thus, the feedback loop reveals that while EVAT policies shape income inequality, the resulting inequality may drive reforms or changes in EVAT practices to address the adverse effects (Montalvo & Reynal-Querol 2005b). This underscores the importance of considering both the immediate and evolving impacts of EVAT policies on income distribution in policymaking.

It has also been observed that there is a unidirectional causality from ethnic fragmentation to inequality in SSA. The observation of unidirectional causality from ethnic

TABLE 6: Short run system generalised method of moments results.

Variables	2-SGMM without interaction		3-SGMM with Interaction	
	Coefficient	*p*	Coefficient	*p*
Gini coeff	-	-	-	-
$Gini_{it-1}$	0.92**	0.030	0.94**	0.04
EVAT	0.02	0.180	0.07*	0.04
GDPpc	-0.10*	0.950	-0.08*	0.76
CORR	0.05*	0.080	0.09*	0.01
INFL	-0.49	0.830	-0.58	0.77
EDINEQ	0.09*	0.060	0.08*	0.03
GEN	0.09	0.950	0.08	0.87
ETH	0.08	0.050	0.08*	0.05
EVAT*ETH	-	-	0.07	0.05
Constant	0.12	0.075	0.06	0.10
Time FE	Yes	-	Yes	-
Obs	493.00	-	442.00	-
N. of Countries	22.00	-	40.00	-
AR(2) (*p*-value)	0.00	-	0.00	-
AR(3) (*p*-value)	0.76	-	0.89	-
Hansen Test	0.92	-	0.86	-
N. Instrument	15.00	-	29.00	-

EVAT, effective value added tax; GEN, gender equality; ETH, ethnic-fragmentation; GDPpc, gross domestic product per capita; EDINEQ, educational inequality; CORR, Corruption; INFL, inflation; FE, Fixed Effects; Obs, Observation; AR; autoregressive; SGMM, system generalised method of moments.

***, ** and * demonstrate that the null is rejected at 1%, 5% and 10%, respectively.

fragmentation to income inequality in SSA aligns with economic theories that link social fragmentation to economic disparities. Ethnic fragmentation often leads to unequal resource distribution and social exclusion, which can exacerbate income inequality by hindering effective policy implementation and economic integration (Alesina & Ferrara 2005). The Social Capital Theory suggests that high ethnic diversity can reduce social cohesion and trust, making it challenging to implement redistributive policies and thus perpetuating income disparities (Putnam 2000). This causal direction indicates that while ethnic fragmentation drives increased inequality, the reverse effect – inequality influencing ethnic fragmentation – is less pronounced in this context (Montalvo & Reynal-Querol 2005a). Thus, addressing ethnic fragmentation could be crucial for reducing income inequality and improving economic outcomes in the region.

System generalised method of moments results

Table 6 displays the estimation outcomes for the dynamic panel data using a SGMM estimator. However, Column 2 of Table 6 depicts the results without the interaction term. Column 3, on the other hand, presents the findings incorporating the interaction of EVAT with ethnic fragmentation. The model specification and the reliability of our instrument are supported by the failure to reject the Hansen J test. However, the AR (1) test reveals serial correlation between the error terms. Therefore, we re-estimate our model utilising an adjusted instrument set. The AR (2) test shows that the error term does not exhibit serial correlation, confirming the validity of our instruments. Additionally, because the *p*-value of the Hansen J statistic (0.957) is greater than 0.05, we fail to

TABLE 7: Long-run system generalised method of moments results.

Variables	Coeff	*p*
Gini coeff	-	-
EVAT	1.19*	0.02
GDPpc	0.90*	0.79
CORR	1.63*	0.04
INFL	0.21	0.68
EDINEQ	1.47*	0.01*
GEN	0.10	0.58
ETH	1.34	0.99
EVAT*ETH	1.28*	0.03

EVAT, effective value added tax; GEN, gender equality; ETH, ethnic-fragmentation; GDPpc, gross domestic product per capita; EDINEQ, educational inequality; CORR, Corruption; INFL, inflation.

***, ** and * demonstrate that the null is rejected at 1%, 5% and 10%, respectively.

reject the null hypothesis, further indicating that the instruments are valid.

This study considers EVAT a reliable instrument because it is exogenous to the error term in the income inequality equation. Effective VAT rates are typically determined by economic policies and administrative efficiency rather than by the current level of income inequality. This separation implies that changes in EVAT rates are not directly influenced by existing income inequality, making EVAT a plausible instrument (Keen & Lockwood 2010). Furthermore, EVAT is independent of ethnic fragmentation. Effective VAT rates are generally set at the national level and influenced by factors such as administrative capacity and economic policy, rather than ethnic composition. This distinction suggests that EVAT rates are unlikely to be directly affected by ethnic fragmentation, thereby supporting the validity of using EVAT as an instrument (Bird & Gendron 2007).

As revealed in Table 6, the coefficients of the lagged predicted variable are significant and positive. This suggests that there is a high degree of time persistence in income inequality, further supporting the usefulness of the SGMM estimate approach. We observe that the coefficients of EVAT are positive and statistically significant. The results indicate that a 1% increase in EVAT raises inequality by 0.068% in the short term and by 1.193% in the long term, showing a significant and greater long-term[2] impact. Economically, this suggests that while EVAT's immediate effects on inequality are modest, they become substantially more pronounced over time. This could lead to deeper income disparities, reduced consumer spending and slower economic growth in the long run. Socially, worsening inequality can strain social systems and diminish social cohesion. These findings highlight the need for policymakers to consider both short-term and long-term effects of EVAT and implement measures to mitigate its impact on income inequality. Long run SGMM results are described in Table 7.

It is observed from our results that GDPpc, gender equality and inflation are insignificant in affecting income inequality in SSA. However, we also find that corruption is positive and significant. The findings show that a 1% increase in corruption raises inequality by 0.093% in the short term and by 1.631% in the long term, indicating a severe and lasting impact. Ethnic fragmentation increases inequality by 0.076% in the short term but becomes insignificant over time, suggesting its short-term effects might not persist. Conversely, educational inequality significantly impacts inequality, with a 1% increase raising it by 0.084% in the short term and 1.474% in the long term. Economically, corruption and educational inequality both contribute to worsening income disparities, potentially leading to reduced economic growth and increased social instability. Socially, persistent inequality because of corruption and education gaps can undermine social cohesion and limit upward mobility. Addressing these factors is crucial for fostering equitable growth and social stability. The significant interaction between EVAT and ethnic fragmentation shows that as ethnic fragmentation increases alongside EVAT, the rise in inequality is more pronounced. Specifically, a 1% increase in this interaction results in a 0.073% increase in inequality in the short term and a 1.280% increase in the long term.

Economically, this indicates that in ethnically diverse societies, EVAT can worsen income disparities more dramatically over time. Socially, this can intensify divisions and increase tensions, as disadvantaged ethnic groups may be hit hardest by both the tax and its amplified effects. Policymakers need to address these factors to prevent worsening inequalities and support more equitable growth.

Discussion

We now focus on the relationship between the EVAT, ethnic fragmentation, inequality and other variables, along with their implications. The EVAT is calculated as total VAT revenues divided by final consumption, reflecting the economic incidence of the tax rather than its legal definition. It is assumed that the tax burden is transferred to end consumers, making final consumption an appropriate tax base. Table 6 presents the SGMM estimates for EVAT, ethnic fragmentation, inequality and other control variables. Thus, when the interaction form is incorporated in the model in column 3 of Table 6, it is noticed that the significant impact on income disparity is strengthened. However, this paper focusses on the results of SGMM from column 3 of Table 6 to examine the link between our series.

In SSA, an EVAT exacerbates income inequality in both the short and long term, with a more pronounced effect over time. Gordon and Li (2009) offer a comparative perspective, showing that while EVAT generally increases inequality in developing countries, the magnitude and timing of its impact can vary depending on local economic and social conditions. This research confirms the broader pattern observed in the literature, highlighting the significant long-term impact of EVAT on income inequality in SSA. Initially, EVAT's regressive nature increases the cost of goods and services, disproportionately affecting low-income households and

2.Following Wooldridge (2013:635), we calculate the long-term impacts of our variables (see Table 7). Note that we interpret only the long run coefficients for significant short-run coefficients. The long-run impacts for the K^{th} parameter is computed as: $\beta_k/[1-Ø]$. Where β_k is the short run coefficient and Ø represents the lag of the dependent variable. Stata command for the long run: nlcom (_b[indep var])/(1-_b[L1.dep var]).

causing a noticeable but limited rise in income inequality (World Bank 2019). Over time, this effect intensifies as the cost of living continues to rise, further straining low-income households and widening the income gap, while wealthier households more easily absorb these costs (OECD 2020). This long-term impact is worsened by weak governance and inefficient public spending, hindering the effective use of VAT revenue for social programmes (Transparency International 2021). These findings support the Regressive Theory of EVAT in SSA. To address these issues, policymakers should consider targeted EVAT exemptions for necessities, strengthen social protection programmes and implement comprehensive tax reforms to increase reliance on progressive taxes (African Development Bank 2019; IMF 2018; UNICEF 2020). Comparative studies from Latin America emphasise the need for robust redistributive policies to counteract VAT's regressive impacts (Bird & Zolt 2015; ECLAC 2018). Addressing VAT's long-term impact on inequality is crucial for economic stability and growth, as high inequality can lead to social unrest and reduced consumer spending (UNCTAD 2019).

To understand the impact of EVAT on persistent income inequality in SSA, the variable of ethnic fragmentation and its interaction with EVAT must be considered. Ethnic fragmentation has a positive and significant short-term impact on income inequality because of social segregation and unequal resource access, exacerbating disparities within diverse communities (Alesina et al. 2003). Societies with diverse ethnic compositions tend to experience higher levels of income inequality in the short run. This is in line with Ethnic Fragmentation Theory, which indicates that high levels of ethnic diversity within a country can impede economic development and equitable income distribution. However, in the long term, while ethnic fragmentation continues to have a positive effect on income inequality, it becomes statistically insignificant, possibly because of increased social cohesion and the development of inclusive institutions mitigating its impact over time (Montalvo & Reynal-Querol 2005b). The diminishing significance of ethnic fragmentation on income inequality in the long run highlights the potential for institutional development and inter-ethnic integration to counteract its negative effects. Policymakers need to prioritise inclusive policies promoting social cohesion and equitable resource distribution across diverse communities (Alesina et al. 2003). Additionally, investments in inclusive governance structures and economic development programmes can contribute to reducing income disparities across ethnic lines in the long term (Montalvo & Reynal-Querol 2005a). These findings align with empirical evidence and comparative studies, suggesting that effective policies and institutional reforms can mitigate the initial impacts of ethnic diversity on income inequality (Fearon 2003).

The interaction between EVAT and ethnic fragmentation exacerbates income inequality in SSA both in the short and long term, with the long-run effect being more pronounced. In the short term, the combination of high VAT and ethnic diversity intensifies income disparities because of factors such as unequal resource allocation and social segregation prevalent in ethnically fragmented societies (Alesina et al. 2003; Bird & Zolt 2015). Over time, these disparities are compounded by the ongoing regressive impacts of EVAT, leading to deeper and more entrenched income inequalities as ethnic divisions and unequal tax burdens perpetuate economic disadvantages (Montalvo & Reynal-Querol 2005a). To address these issues, policymakers must implement measures to mitigate the regressive impacts of EVAT, such as progressive tax policies and ensuring EVAT revenues support social programmes for marginalised groups, while also promoting social cohesion and reducing ethnic tensions (Alesina et al. 2003; Bird & Zolt 2015b). Long-term strategies should focus on inclusive governance, educational opportunities and equitable resource distribution to alleviate the compounded effects of EVAT and ethnic fragmentation, ultimately fostering inter-ethnic integration and reducing income disparities (Montalvo & Reynal-Querol 2005b). These findings align with empirical evidence from other regions, highlighting the persistent impact of tax policies and ethnic diversity on income inequality and the necessity of integrated policy approaches to address both tax equity and social cohesion (Bird & Zolt 2015; Fearon 2003). These results are in accordance with Putnam (2000), who finds that ethnic fragmentation can undermine social capital by creating divisions and reducing trust among different groups, which hampers collective action and the provision of public goods.

In SSA, the low social capital caused by ethnic fragmentation makes it difficult to implement fair EVAT policies, as trust in the government and compliance with tax regulations are typically lower in fragmented societies (Alesina & Ferrara 2005). The contribution of this study lies in highlighting the compounded effect of EVAT and ethnic fragmentation on income inequality in SSA, emphasising both short- and long-term impacts, with a notable focus on the long-run exacerbation. While existing studies, such as those by Alesina et al. (2003) and Bird & Zolt (2015), discuss the regressive nature of EVAT and the challenges posed by ethnic diversity, our research adds a nuanced perspective by demonstrating how these factors interact over time to deepen income disparities. Furthermore, this study emphasises the need for integrated policy approaches that not only address the regressive impacts of EVAT but also promote social cohesion and equitable resource distribution, a synthesis that provides a more comprehensive view of the problem compared to previous studies. This integrated approach is less explored in the existing literature, which often treats EVAT and ethnic fragmentation as separate issues rather than as interacting factors exacerbating income inequality.

Educational inequality significantly contributes to income inequality in SSA. This aligns with the Skill-Biased Technological Change (SBTC) theory, which indicates that differences in skills between workers lead to differences in productivity and income. However, the long-term effects are more pronounced than the short-term ones. In the short run, disparities in access to quality education lead to

immediate income disparities, as individuals from disadvantaged backgrounds struggle to secure well-paying jobs. Over time, these educational disparities compound, resulting in more entrenched income inequalities. The cumulative benefits of education mean that those who lack educational opportunities face persistent economic disadvantages, leading to a widening income gap. Addressing educational inequality is crucial for policymakers, who should focus on increasing funding for education, implementing targeted interventions, improving educational infrastructure and promoting inclusive policies. Empirical evidence from other regions, such as Latin America, supports the need for equitable education systems to reduce income inequality (Black & Devereux 2011; Bourguignon, Ferreira & Menéndez 2007; Milanovic 2016; OECD 2019; Psacharopoulos & Patrinos 2018; UNESCO 2018; UNICEF 2019; World Bank 2018).

The findings also indicate that corruption exacerbates inequality in SSA. This occurs because corruption facilitates tax evasion, shifting the tax burden primarily onto the poor through EVAT, which benefits the wealthy. Additionally, corruption reduces social spending that is meant to support the poor. Gupta et al. (2002) confirm this analysis.

The study's findings reveal that EVAT increases income inequality in SSA both in the short and long term, with the long-term effects being more pronounced, and that ethnic fragmentation exacerbates this impact, particularly over time. This supports the theory that EVAT is regressive, disproportionately burdening lower-income households, but it also challenges existing models by highlighting that the negative effects of EVAT deepen over time and are amplified by ethnic divisions. These results suggest that EVAT policies need to account for both long-term impacts and social fragmentation, indicating a need for more nuanced and context-sensitive tax reforms. Such policies should integrate considerations of local socio-economic and ethnic contexts to effectively address income inequality and ensure equitable outcomes.

Conclusion and policy implications

The persistent and high levels of inequality in SSA pose significant challenges to achieving SDG 10, which aims to reduce inequality. Despite the global economy growing at an ever-increasing rate in recent years, income disparity has been increasing in both developing and developed economies. The drivers of income disparity have been studied in existing literature, including tax system. However, the empirical evidence on the relationship between tax system and income disparity has so far yielded conclusions that are strongly contradictory, and ethnic fragmentation has received little attention. Therefore, this study investigates the joint impacts of EVAT (calculated as total VAT revenues divided by final consumption, which reflects the economic incidence of the tax rather than its legal definition as mostly used in the literature) and ethnic fragmentation on income inequality in SSA.

We use SGMM estimation, incorporating forward orthogonal deviations, which distinguishes it from the traditional SGMM approach that does not account for these deviations (Roodman 2009a). This technique allows to account for the potential endogeneity issue. Firstly, we test whether EVAT increases income inequality in SSA in both short and long run. Secondly, we examine whether the relationship between EVAT and income inequality depends on ethnic fragmentation in both short and long term. We find that EVAT augments income gap in both short and long run. With this result, the Regressivity Theory of EVAT, which states that a rise in EVAT leads to a rise in income inequality in SSA, is confirmed. However, the impact of the long term is stronger than that of the short run. In addition, the findings show that ethnic fragmentation increases the positive effect of EVAT on income inequality in SSA. This suggests that ethnic fragmentation plays a main role in affecting the impact of EVAT on income inequality. This is in line with Ethnic Fragmentation Theory, which shows that high levels of ethnic diversity within a country can impede economic development and equitable income distribution.

To better understand the relationship between EVAT and higher and persistent income disparity in SSA, this study contributes to the literature by including some significant control variables such as gender equality, educational inequality, ethnic fragmentation, among others. Specifically, we find that ethnic fragmentation is one of the significant factors that impedes effective VAT to lower income disparity in short and long run in SSA. In addition, educational disparity plays a significant role in driving income disparity in SSA, aligning SBTC theory.

To achieve SDG 10, the following policy recommendations are proposed based on the above results: To address income inequality in SSA, it is crucial to enhance tax administration and compliance by improving EVAT systems and reducing evasion, particularly among the wealthy and large corporations. Specifically, providing EVAT refunds or rebates to low-income households can help alleviate the financial strain caused by VAT. Allocating EVAT revenues to enhance social safety nets, including cash transfers and food subsidies, can benefit marginalised groups. It's also important to invest in community-based initiatives that encourage inter-ethnic dialogue and reduce social fragmentation. Additionally, improving tax administration and fostering inclusive policy-making can increase trust and ensure equitable implementation of EVAT reforms, thereby addressing both income inequality and ethnic fragmentation in SSA. To tackle the regressive nature of EVAT and its impact on income inequality, policymakers should implement reforms such as applying reduced EVAT rates or exemptions to essential goods and services such as food, healthcare and education, which are more heavily relied upon by lower-income households. Additionally, raising the EVAT registration thresholds to exclude smaller businesses and informal sector operators can lessen the tax burden on these entities, which are commonly found in poorer communities. These steps are designed to

ease the disproportionate effects of EVAT on low-income individuals, making the tax system fairer. Increasing and better targeting social spending towards the poor and vulnerable, with a focus on healthcare, education and social safety nets, is also vital. Addressing ethnic fragmentation through inclusive policies and fostering dialogue among ethnic groups can build trust and ensure equitable resource distribution.

To implement the proposed EVAT reforms, policymakers should first draft and pass legislation to adjust EVAT rates for essential goods, raise registration thresholds for small businesses and establish EVAT refunds for low-income households. Engaging in public-private partnerships will be crucial, involving businesses and financial institutions to facilitate compliance and manage refunds. Community engagement strategies should focus on raising awareness about the changes and supporting local initiatives that promote inter-ethnic dialogue. Additionally, improving tax administration through enhanced technology and training for officials will ensure efficient and transparent implementation. Inclusive policy-making should involve diverse stakeholders and continuous impact monitoring to address both income inequality and ethnic fragmentation effectively.

Reducing educational inequality by investing in education and promoting skill development in line with SBTC is crucial. Implementing progressive taxation that places a higher burden on the wealthy while easing it for lower-income individuals, along with exploring wealth and property taxes, can further reduce inequality. Promoting inclusive economic growth through policies that ensure broad economic benefits and supporting small and medium enterprises (SMEs) and inclusive business models is important. Lastly, enhancing governance and transparency to reduce corruption and improve public resource allocation, as well as increasing transparency in government spending and tax collection, is necessary to build public trust and effectively reduce inequality. By implementing these policy recommendations, SSA countries can address the multifaceted issues contributing to income inequality and work towards achieving the goals set out in SDG 10.

The study faces limitations because of missing data and constraints within the panel dataset. Incomplete or unavailable data could impact the accuracy of the findings, potentially leading to biased results or an incomplete understanding of how EVAT affects income inequality and interacts with ethnic fragmentation. These data issues could compromise the validity of the policy recommendations, as they may not fully account for the complex effects of EVAT across different income groups and ethnic contexts. To address these limitations, this study employs interpolation and extrapolation. These advanced techniques were used for handling missing information. Additionally, conducting longitudinal studies across various SSA regions could offer a more thorough assessment of EVAT's impacts and help validate the proposed policies under diverse conditions.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

T.P.V. was responsible for designing the study, collecting data, and performing initial analysis. He also has contributed to drafting sections of the manuscript related to methodology and results. N.N. involved in literature review, theoretical framework, and interpreting findings. He has contributed to data analysis and writing sections on the implications or conclusions of the study. N.H.G. focused on data interpretation, writing the introduction and discussion sections, and finalizing the manuscript for submission. He has also contributed to statistical analysis and reviewing the paper for coherence.

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Data availability

Data are available from the corresponding author, T.P.V, under reasonable request.

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Appendix 1

List of countries:

- Botswana
- Lesotho
- Burkina Faso
- Burundi
- Cabo Verde
- Ethiopia
- Gabon
- Gambia
- Madagascar
- Mali
- Mauritius
- Mauritania
- Senegal
- Swaziland
- Cameroon
- Central African Republic
- Chad
- Côte d'Ivoire
- Guinea
- Equatorial Guinea
- Guinea-Bissau
- Ghana
- Kenya
- Mozambique
- Namibia
- Niger
- Nigeria
- Tanzania
- Rwanda
- Seychelles
- Sierra Leone
- Uganda
- Zambia
- Zimbabwe
- South Africa