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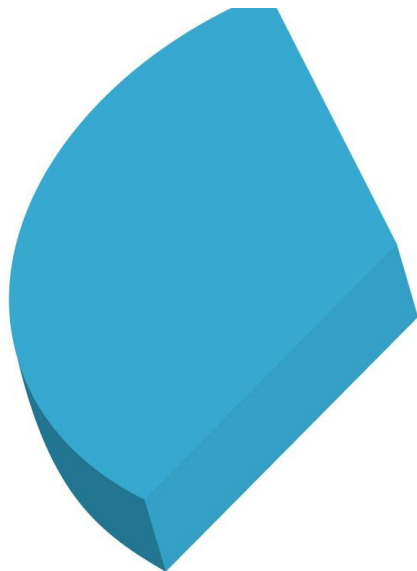
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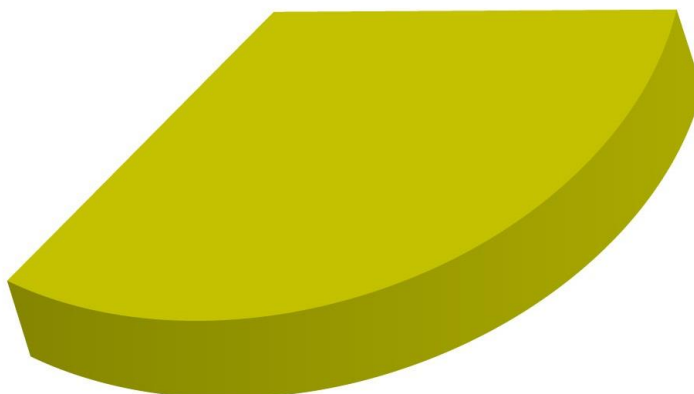
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**How does tax structure
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How does tax structure affect income inequality? Empirical evidence from Sub-Saharan Africa

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Abstract

Over the past few decades, taxation has been recognized as a powerful tool to finance long-term development and influence income distribution. This paper examines how the tax structures affect income inequality in 30 sub-Saharan African countries over the period 2000-2017. To achieve this objective, we focus on tax instruments and use the fixed-effects least-squares dummy variable [LSDV] and double ordinary least squares [2SLS] instrumental variables methods for estimations. The results from our battery of econometric tests and alternative specifications show that personal income tax is the only tax instrument that reduces income inequality. Additionally, high institutional quality and respect for property rights are essential in the process of reducing income inequality. This reduction is also sensitive to several structural characteristics; notably, tax progressivity is ineffective in military political regimes and in the presence of ethnic conflicts. These results inform policymakers that progressive tax instruments—specifically, personal income tax—are the best tool for fighting inequality. In essence, efficient, equitable, and socially coherent tax policies are essential for achieving Sustainable Development Goals 10.

Keywords: Tax structure; Income Distribution; Inequality; Sub-Saharan Africa

JEL Classification: D31 ; H20 ; D63 ; O15

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1 Introduction

Over the past few decades, most African countries have relied on improving internal revenue mobilization to achieve the financing needs of the Sustainable Development Goals (SDGs, 2015)¹ and strengthen accountability between citizens and the state. Various global crises have demonstrated the vulnerability to shocks of countries that are highly dependent on external resources, as well as their economic and social instability. Currently, the resources needed to finance the SDGs are significant (Mascagni et al., 2014), and advanced countries' ability to transfer resources through official development assistance is severely limited by their debt-to-GDP ratios, which now exceeds 100% of GDP on average and are expected to increase further following the crisis caused by COVID-19 (CEP, 2020).

Theoretically, taxation is seen as a powerful policy tool for collecting revenue for development (Musgrave, 1959; Burgess and Stern, 1993) whereas progressive taxes are considered strategically important to foster an increasingly inclusive economic development process (Kaldor, 1963). Thus, for Moore and Prichard (2017) as well as Dao and Godbout (2014), the essential points are how taxes are collected, from whom, and how revenue is spent. Given the uncertainties related to obtaining external financing, domestic revenue mobilization should not be achieved at the cost of impoverishing vulnerable populations or increasing income inequality. Extensive political economy literature proves that increasing inequality is detrimental to sustainability and economic growth (Dabla-Norris et al. (2015)), the growth cycle (Berg and Ostry (2017)), poverty reduction (Ravallion (2004)), the financial crisis (Riddiough et al., 2011; Stockhammer, 2015), labor productivity (Stiglitz (2015a)), political and economic stability (Sutherland and Hoeller, 2014; Cingano, 2014; Ostry et al., 2014), and conflict resolution (Bardhan, 2005).

In the current scientific debate on sustainable development, income inequality —more specifically, tax policy's effectiveness in influencing income distribution —is one of the most persistent, heated and widespread issues (Bird and Zolt, 2005; Stiglitz, 2015a; Bourguignon and Scott-Railton, 2015; Piketty and Saez, 2014; Chancel and Piketty, 2021; Atkinson, 2015; Dorling, 2014; Scheidel, 2017; Milanovic, 2016). Although progress has been made in achieving the Millennium Development Goals, most of the populations in low-income countries still face inequality, poverty, and vulnerability due to natural disasters, among other challenges. Generally, economic growth is expected to increase people's incomes, create jobs and opportunities by increasing the tax base, and reduce inequality. However, achievement of this expectation is sometimes hampered by the lack of a direct mathematical relationship among economic growth, reducing inequality, and increasing the tax base.

¹Sustainable Development Goals, to see more: <https://sdgs.un.org/fr/goals>

Public survey results indicate that rising income inequality has been accompanied by a growing public demand for income redistribution in developing countries [Clements et al. \(2015\)](#). Thus, the benefits of growth must be shared across a large part of the population to realize citizens' aspirations (high availability of public goods and the reduction of poverty and inequality) and thus induce them to comply with taxes. In this light, [Williams and Krasniqi's \(2017\)](#) analysis confirmed the existence of a negative correlation between income inequality and tax compliance. Furthermore, the existence of high inequality affects economies and reduces policies' effectiveness ([Stiglitz, 2015b](#)).

Sub-Saharan Africa is one of the world's most unequal regions, containing 10 of the world's 19 most unequal countries ([UNDP, 2017](#)). Recently, in studying the consequences of the COVID-19 crisis in terms of living standards, the [World Bank \(2020\)](#) estimated that 88–115 million people will fall into extreme poverty and that most of these vulnerable populations will be in sub-Saharan Africa and South Asia. These estimates are confirmed by a ([UN, 2021](#)) report that concluded that 119–125 million people have fallen back into poverty. Thus, the crisis exacerbates inequalities, disrupts achievements, jeopardizes the attainment of SDG 10 focused on (Reducing Inequality), and is directly linked to SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being), and especially to Aspiration 1 of the African Union's Agenda 2063 which calls for (A prosperous Africa based on inclusive growth and sustainable development)². From this perspective, the repercussions of the COVID-19 crisis are disastrous, and there exists the need for developing countries to implement economic and social policy reforms commensurate with the gravity of the situation.

Tax structure plays a key role in the debate on fiscal transition. Although many countries remain dependent on gate receipts (especially customs receipts)—a legacy of colonial rule—it is difficult (especially in warehouse countries) to mobilize domestic tax resources effectively ([Chambas, 2005](#); [Dufresnot and Diop, 2012](#)). Today, the theme of fiscal transition is highly prevalent in Africa and is the basis for structural transformation. Additionally, the pursuit of domestic resource mobilization objectives must be in harmony with the sustainable development goals set out in the 2030 Agenda. Given its importance in the current resource mobilization process, taxation also appears to be a powerful tool for influencing income distribution ([DeFina and Thanawala, 2004](#); [Coady and Gupta, 2012](#); [Clements et al., 2015](#); [Gu et al., 2015](#); [Alavuotunki et al., 2019](#); [Ciminelli et al., 2019](#); [Traore, 2019](#)). According to [Askari \(2011\)](#) controlling the redistributive impact of taxes should allow for a shift toward equity-oriented tax systems without sacrificing efficiency. Lessons from optimal taxation theory show that increased mobilization of certain types of taxes can distort the functioning of the economy ([Mirrlees, 1971](#)). This theory takes into account the redistributive effects of tax revenue mobilization. In this way, the

²African Union, to see more: <https://au.int/fr/agenda2063/objectifs>.

establishment of an optimal and equitable tax system is essential for financing public policies given the strong relationship between citizens and the state [Atkinson et al. \(2011\)](#). Overall, direct income taxes are more effective in achieving redistributive goals than other policy instruments [Atkinson and Stiglitz \(1976\)](#). Indirect taxes, whose regressive effect remains mixed for African countries in light of past studies. Moreover, [Sahn and Younger \(1999\)](#) found that value-added taxes are progressive in some African countries. Prominent economists such as ([Piketty and Saez, 2014](#); [Atkinson, 2015](#)) propose taxation as a powerful solution to promote a more equitable distribution of income. In addition, for [De Mooij et al. \(2020\)](#) it is essential to plan for postpandemic recovery to address inequality through a progressive approach to tax systems. The relationship between taxation and inequality in Sub-Saharan African countries remains ambiguous in the literature. Moreover, at this stage, few studies have focused on the effects of the tax structure on income inequality in African countries in particular. Thus, an important first step in this direction is offered. To provide both rational and constructive answers to our study, our concerns have been subdivided as follows: Do tax structures play a role in reducing inequality in Sub-Saharan Africa? Which tax instrument is appropriate in the context of an inclusive tax transition? Does an increased share of VAT revenues worsen income distribution? Through sensitivities, whether recent trends in government consumption expenditure offset or reinforce the effects of tax changes on income distribution was examined

Based on the literature on tax incidence, it can be hypothesized that (i) as PIT revenues increase as a percentage of GDP, PIT becomes more progressive; (ii) increasing income taxes in general improves tax progressivity; (iii) VAT, excise duties and customs duties are assumed to be regressive. Moreover, to our knowledge, little research has analyzed the influence of the institutional variable on the relationship between tax instruments and income inequality in African countries. Thus, a larger sample of countries was used, considering the role of institutional quality in this relationship and a battery of robustness tests were performed to verify the validity of our results. The objective of this study is to assess the effects of different types of tax revenue on income inequality in Sub-Saharan Africa over the period 2000-2017. An important question is how tax instruments affect income inequality.

This paper aims to quantify the effects of tax structures on income inequality. Thus, the originality of this paper is that it examines how tax instruments influence income inequality and, hence, the inclusive tax transition. This study contributes to advancing the literature on tax policy and income inequality by studying how the tax structure (the different tax instruments) affects income inequality. Indeed, different tax instruments have different returns, different tax bases and specific characteristics.

This study differs from previous studies in three respects. First, previous studies focus on the impact of direct and indirect taxation on inequality. They generally use the tax/GDP ratio as the variable of interest. In this paper, in addition to the effect of the direct and indirect tax weight, these variables are disaggregated to use individual tax instruments.

Second, to our knowledge, this is the first study that empirically tests the effect of tax structure on income inequality by considering mimicry in the design of tax policies in the case of SSA. Thus, we apply a spatial econometric strategy using a weighting matrix. Indeed, the choice of this instrument is based on the importance of tax mimics and tax spillovers in policy design in developing countries. Finally, the determinants of income inequality are multidimensional. To this end, factors that are little discussed in the literature on the case of sub-Saharan African countries are taken into account, such as the shadow economy and the globalization index.

Finally, we consider that the determinants of income inequality are multidimensional. To this end, we take into account factors that are little discussed in the literature on the case of sub-Saharan African countries, such as the shadow economy and the globalization index.

Our results first indicate that only personal income taxes are effective in significantly reducing income inequality in SSA. In contrast, indirect taxes and international trade taxes increase inequality. Even if the coefficient remains negative, no effect of corporate income tax was found, as well as for excise duties on inequality. Similarly, a nonsignificant positive effect of VAT was found. Furthermore, it is shown that respect for property rights and good institutional quality reduce income inequality. Finally, through a battery of robustness tests, it is confirmed that our results are robust to any change.

The rest of the document is organized as follows. Section 2 presents the stylized facts; Section 3 discusses the different approaches found in the literature; then, the focus is on the data used and the methodology in Section 4. Section 5 presents the empirical results and robustness tests. Finally, a sixth section concludes and provides policy recommendations.

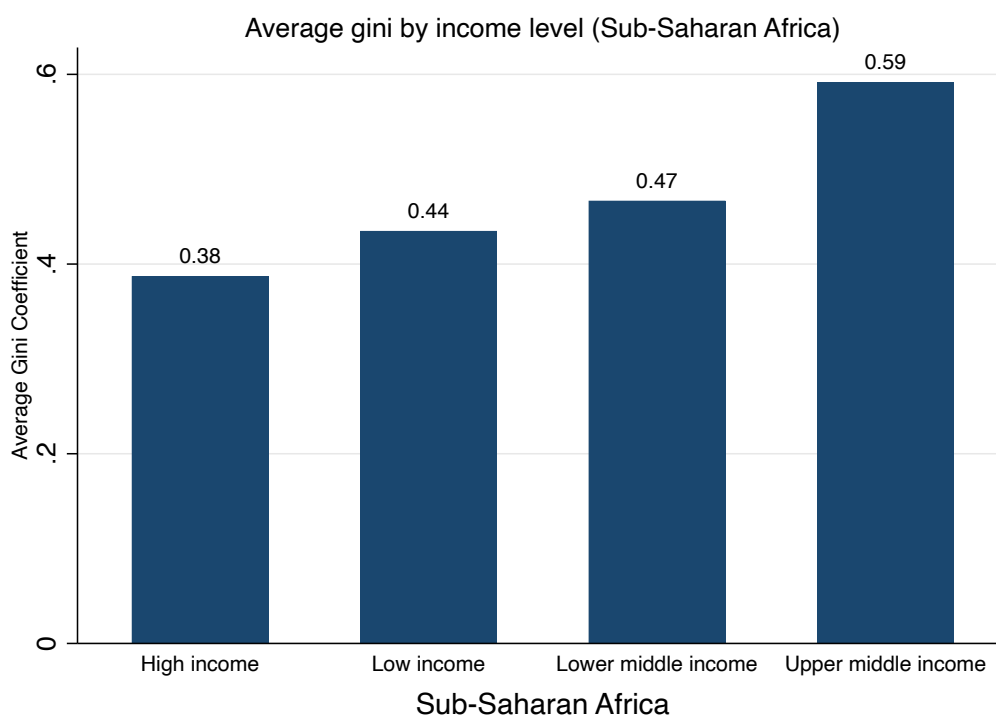
2 Stylized facts

In this section, some stylized facts that characterize income inequality and tax structure in Sub-Saharan African countries are presented. While it is one of the most dynamic continents in terms of economic prosperity in the last decade, Africa is second only to Latin America in terms of high inequality in the world [Klasen \(2016\)](#). The map below³ illustrates the average evolution of inequality based on the Gini index (SWIID) in Sub-Saharan African countries over the period 2000 to 2017. As can be seen, inequality differs according to country characteristics. There is a large body of literature on the relationship between inequality and growth, as measured by the level of per capita income.

Figure 1 shows us the average level of income inequality measured by the Gini index over the period 2000-2017 in the countries in our sample. On average, we can conclude that countries with a high level of income are the least unequal. More precisely, the Figure1 shows us that average inequalities go from 0.44 for low income countries to 0.47 for lower middle income countries, 0.59 for upper middle income countries and 0.38 for high income countries.

The description in Figure 1 is in accordance with the hypothesis known as the "inverted U" introduced by the work of [Kuznets \(1955\)](#).

Figure 1: Author's realisation based on SWIID database



³See appendix: Figure 6 Map of average inequality over the period 2000-2017

Indeed, the assumption is that at very low levels of income, inequality must be low, because virtually everyone lives at or near the subsistence level. As the growth process begins, income inequality increases as agents migrate from the low-income (traditional) agricultural sector to (modern) industrial sector. Subsequently, Kuznets process of increasing inequality refers to a secular relationship generated by long-term changes in economic structure.

The shift of agents from the traditional to modern sector raises inter-sectoral inequality and within industry there is a huge disparity between wage earners which will raise intra-sectoral inequality. Finally, beyond a certain threshold, the trend is reversed, the inequalities are stabilized and then decrease until they attain the lowest level that can be observed in high income economies.

The tax composition from 2000 and 2019 clearly illustrates the changes in tax structure. Overall, according to table 1 there is an average increase in all tax instruments. In particular, VAT revenue as a percentage of total tax revenue has improved by 9%, while the share of income tax revenue has increased by only 3% and the corporate tax by 6% on average over the same period (2000-2019) for our sample countries.

Table 1: Table of Tax composition in 2000 and 2019 in Sub-Saharan Africa countries

Year	VAT	Personal Income	Corporate Income
2000	22%	16%	11%
2019	31%	19%	17%
Variation 2000-2019	+9%	+3%	+6%

The changes in the composition of tax revenues since the 2000s have been driven by many factors. First, development strategies have established VAT as a tool for domestic revenue mobilisation and thus a strategic component of the tax transition. Secondly, improved economic performance has contributed to the creation of jobs and the emergence of a new middle class. However, despite its potential, personal income tax has evolved rather marginally over the same period.

Figure 2 shows a positive and increasing relationship between the Gini coefficient and total tax revenue mobilization (tax revenue). Most countries in our sample have average tax revenues around 16% of GDP. This positive relationship between inequality and tax revenue might seem counterintuitive but could be explained by the low level of revenue mobilization in these economies.

This description remains consistent with the idea that only increased tax revenue mobilization could reduce income inequality (Bird and Zolt, 2005; Agnello and Sousa, 2014). Otherwise, the current level of revenue would be insufficient to provide good quality public services, transfers and public infrastructure, which are essential to address income inequality.

Figure 2: Correlation between income inequality and total tax revenue as a percentage of GDP

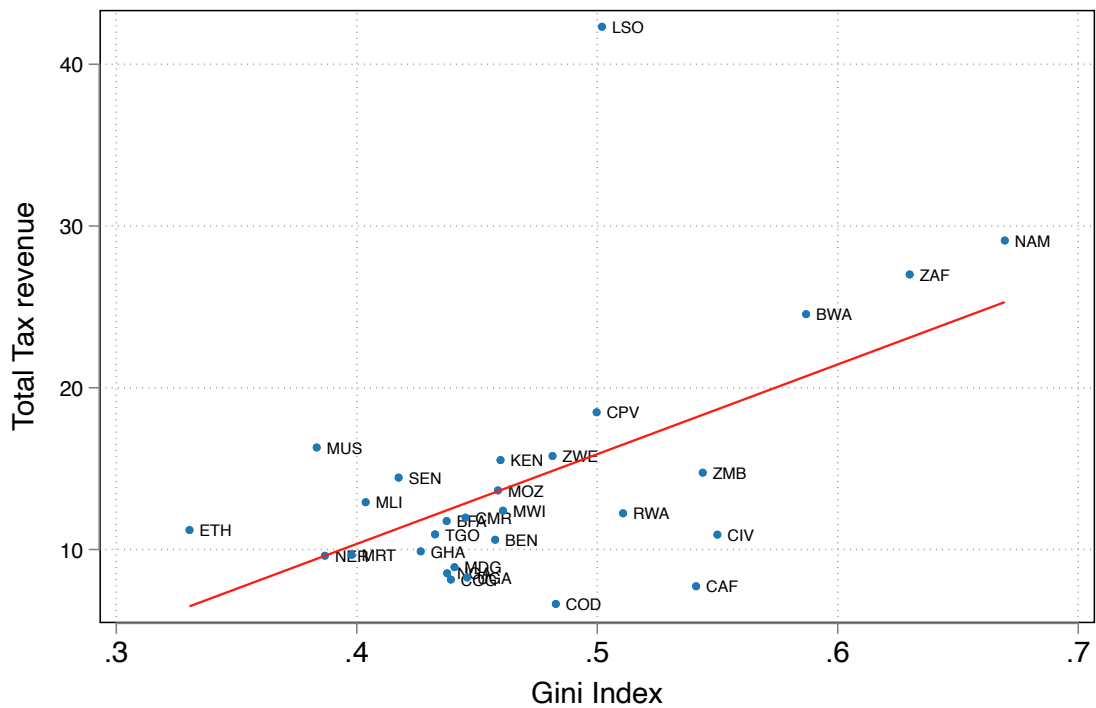
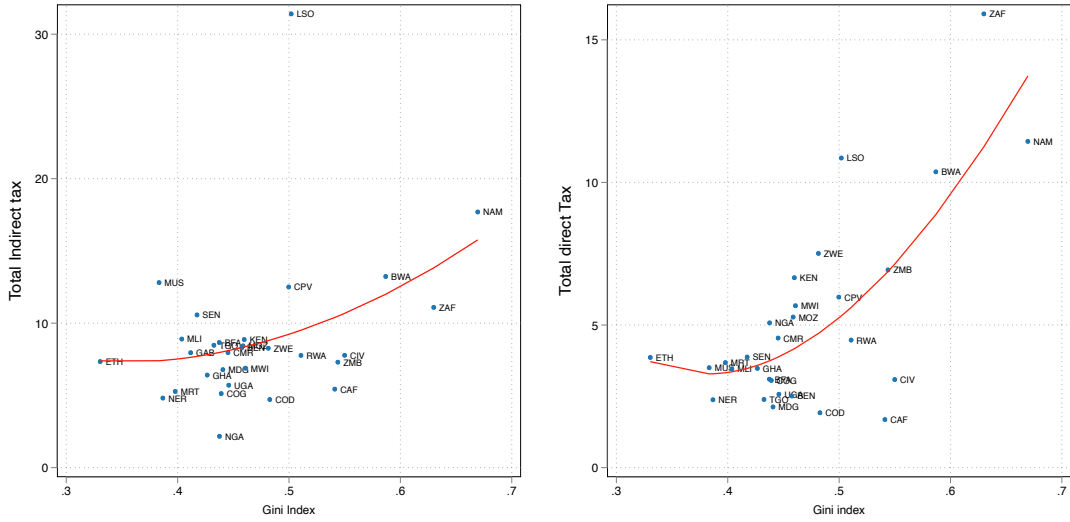


Figure 3 below describes the relationship between income inequality and indirect and direct taxes as a percentage of GDP. Indirect tax revenues are found to be positively correlated with income inequality measured by the Gini index (SWIID). This is consistent with general assumptions about the regressivity of indirect taxes. However, contrary to the idea of the progressivity of direct taxes, we find that the trend line representing the correlation indicates that inequality and direct taxes are positively related in the countries of our sample.

Figure 3: Relation between income inequality and Total indirect/direct tax as a percentage of GDP



The trend line is correlation, not causation, suggesting that the relationship obtained from the graphical analysis may be biased by econometric issues such as reverse causality of taxes to inequality and the existence of other factors that affect the inequality-tax link (Yogo and Njie, 2018). We therefore undertake an econometric analysis to explore the impact of these tax instruments in more detail.

3 Literature review

3.1 Theoretical approach

In this section, the theoretical link between income inequality and tax policies is developed to formalize the testable empirical implications of the relevant theoretical literature. Overall, optimal taxation theory shows that increased mobilization of certain types of taxes can distort the functioning of the economy (Mirrlees, 1971). Newbery and Stern (1988) provide some cardinal principles on the design of effective redistributive tax policies in developing countries. Indeed, direct taxes such as personal income taxes are likely to be more effective in achieving redistribution goals than policy instruments under certain conditions Atkinson and Stiglitz (1976).

Tax on personal income is best equipped to tax people according to their ability to pay. Moreover, progressive PITs (usually combined with income transfers) play a major role in many countries in raising revenue while reflecting concerns about income inequality. The redistributive impact of tax policy depends not only on the volume of taxes and expenditures but also on their composition. Differences in the level and composition of taxes have shown that the potential redistributive impact of tax policies in developing countries is considerably reduced compared to advanced economies. Furthermore, studying the contribution of direct taxes in reducing inequalities in recent decades, [Coady et al. \(2015\)](#) confirm that direct income taxes and transfers have reduced inequality by an average of one-third in advanced economies. Therefore, income taxes are often designed to collect a larger proportion of the income of the rich than of the poor, to reduce the inequality of disposable income relative to taxable income. While taxes on capital appear to be progressive, in theory it is administratively difficult to tax capital because of its mobility, which gives rise to many opportunities for evasion and avoidance [Clements et al. \(2015\)](#). In addition, the mobility of capital also allows companies to shift much of the burden of these taxes to labor. The policy literature on the redistributive character of indirect taxes has not received sufficient attention [Prasad and Deng \(2009\)](#).

The general theoretical arguments postulate that indirect tax instruments appear regressive. In terms of its character, VAT taxes final consumption and it is recognized that poor households have a higher marginal propensity to consume than rich households. Thus, an increase in consumption taxes could negatively affect the income of poor households. Indeed, a limitation of almost all cross-country studies on this topic is that the hypothesis of VAT regressivity has not been systematically tested as put by [Hoeller et al. \(2014\)](#); [Timmons \(2010\)](#). Thus, the "paradox" so widely noted in the literature is that, despite their internal regressivity, these taxes may ultimately achieve greater redistribution

3.2 Empirical approach

At the empirical level, the empirical evidence from econometric studies that have explored the subject in the past is examined. In general, empirical studies have focused on the relationship between different types of fiscal instruments and economic growth.

Taking the results of the most conservative authors, the literature on developing countries has found clear non-consensual relationships, notably ([Skinner and Mundial, 1988](#); [Easterly et al., 1994](#); [ul Haq Padda and Akram, 2009](#); [Ocran, 2011](#); [Worlu and Nkoro, 2012](#); [Canavire-Bacarreza and Hanauer, 2013](#)). Other authors, notably ([Wenli and Sarte, 2004](#); [Arnold et al., 2011](#); [Sepulveda and Martinez-Vazquez, 2011](#)), have found a strong association between tax structure and growth.

After World War II, taxation was used as a specific tool to promote redistribution of wealth through the introduction of high-income tax rates [Cornia et al. \(2011\)](#). Subsequently, the different crises that have arisen have questioned the effectiveness of taxation in influencing income distribution and correcting market failures. Although it is strongly suggested and more relevant to use public spending in the search for equity [Bird and Zolt \(2005\)](#), there are recent studies for example, ([Piketty and Saez, 2014](#); [Atkinson, 2015](#)) showing that taxation can be a powerful solution to promote more equitable income redistribution.

Thus, the relationship between taxation and inequality has been widely discussed in the literature and the results remain mixed depending on the specificities of the methodology and the study sample. Although they take into account the progressivity of the tax structure, deductions and tax credits, many studies on developing countries ([Goñi et al., 2011](#); [Joumard et al., 2013](#); [Martinez-Vazquez et al., 2012](#)) have shown that transfers are more effective than taxation in reducing inequality. Indeed, some authors suggest that tax systems dominated by indirect taxes are regressive and therefore unequal ([Mirrlees, 1971](#); [De Wulf, 1975](#)). Similarly, export taxes are regressive and generally affect small agricultural production units (which, while not poor, have relatively low incomes). Thus, the removal of these taxes, combined with the reduction of other implicit taxes on agriculture, should have a positive impact on distribution and the poor.

However, Mirrlees warns that the progressivity of income taxes can be questioned, as it varies according to the analysis methodology used. On the basis of a partial equilibrium analysis, personal and corporate taxes are found to be regressive [Westlake \(1973\)](#) but progressive in a general equilibrium analysis ([Mwega, 1986](#)). However, indirect taxes or subsidies based on consumption do not redistribute income efficiently, as high-income households generally account for a much larger proportion of consumption than low-income households [Sah \(1983\)](#). In the case of African countries, [Sahn and Younger \(1999\)](#) found that the value added tax is progressive. Indeed, authors such as [Jacquemot and Raffinot \(2018\)](#) argue that in such countries, the poorest typically do not have access to formal markets because of the entry costs and the high share of informality. In this context, the overall view that VAT is regressive remains to be proven. Other studies have shown that it can be less progressive than the consumption taxes it replaced, so that these reforms may ultimately be regressive ([Cho and Muñoz, 2003](#); [Hossain, 1995](#)). However, these studies also show that the progressivity of a value-added tax can be enhanced by adopting lower rates for commodities or by setting the tax threshold high enough to exclude most small businesses, which tend to be used intensively by low-income groups [Jenkins et al. \(2006\)](#). Indeed, ([Acosta-Ormaechea et al., 2019](#)) confirmed that consumption and property taxes are more growth-friendly than income taxes. Similarly, ([McNabb and LeMay-Boucher, 2014](#); [Drucker et al., 2017](#)) found that reducing the share of income

tax in the revenue mix would increase GDP growth. The effectiveness of consumption taxes and their role in enhancing equity was examined in a qualitative study by [Correia \(2010\)](#). For efficiency purposes, a single rate is preferred to increase revenue yield, combined with a well-targeted transfer program ([Engel et al., 1999](#); [Okner, 1975](#)). The more consumption taxes contribute to government revenue, the greater the efficiency and welfare effects on low-income people. This view of consumption taxes contrasts with the common view that consumption taxes are regressive ⁴. Thus, the AfDB (2010) calls for the removal of tax exemptions and incentives in the Kenyan tax system, as they undermine tax equity and lead to revenue losses. [Askari \(2011\)](#), analyzing the Iranian case, found that direct taxes negatively affect income distribution due to tax evasion, while indirect taxes have a positive impact on income distribution. Also [Karanfil and Özkaya \(2013\)](#), also found that indirect taxes have a positive long-term impact on poverty in Turkey. The distributional impact of value added taxes has been mixed ([Bird and Zolt, 2005](#); [Coady et al., 2015](#)).

On the other hand, the results of ([Martinez-Vazquez et al., 2012](#); [Coady et al., 2012](#); [Woo et al., 2013](#)) show that progressive personal income tax and corporate tax reduce income inequality. However, these results need to be related because [Saez \(2004\)](#) shows that the choice of direct taxation is not systematically effective in reducing income inequality. According to [Saez \(2004\)](#), direct taxation ceases to be relevant when the taxation of labor is based solely on income and when there is imperfect substitution of types of labor in the production function. The author therefore suggests that the choice of tax instrument should be based on short- or long-term objectives. To this end, he recommends that in the short run, the fight against income inequality should be conducted through indirect taxation. On the other hand, he suggests that in the long term, direct taxation should be used to fight income inequality. In addition, [Duncan and Sabirianova Peter \(2016\)](#) research has shown that tax progressivity to reduce inequality is only effective when countries are democratic.

However, an incorrectly designed redistributive tax policy can have negative consequences for efficiency, growth and even income distribution (IMF 2012). Given the limitations of the tax structure to reduce inequality, [Martorano \(2018\)](#) in his analysis suggests that tax revenues should be mobilized to reduce income inequality. Finally, in light of its effectiveness in raising revenue in developing countries, indirect taxes can play a role in redistribution. In this respect [Kenworthy and McCall \(2008\)](#) conclude that “the chief contribution of taxes to inequality reduction is indirect. Taxes provide the money to fund the transfers that reduce inequality.”

⁴This regressivity can be mitigated by applying differentiated rates: lower rates for basic goods and higher rates for luxury goods, although this complicates tax administration and is not optimal (Saez, 2010)

As the literature clearly indicates, there is little consensus on the relationship between tax instruments and inequality. Moreover, most studies have focused on developed or developing countries and less on the Sub-Saharan African region. Through our empirical analysis, a first step is made in this direction.

4 Data and methodology

4.1 Data

The sample includes annual data for the period 2000 to 2017 for 30 sub-Saharan African countries. The choice of this sample of countries is dictated by the availability of data on both inequality and various independent variables.

Measurement of the dependent variable

The data on income inequality refer to the Gini index extracted from the Standardizing the World Income Inequality Database (SWIID)⁵; in our study, we use net income inequality (after taxes and transfers). The choice of Gini net is related to the fact that it measures the ability of taxation to reduce income inequality. The SWIID database is an attempt to solve the problem of data scarcity. However, some authors have been highly critical of the widespread use of imputations in general, as well as the imputations used by SWIID, and caution against using the dataset in econometric work (Jenkins, 2015; Ferreira G et al., 2015). Any costs arising from its implementation must be considered alongside the potential benefits from wider coverage. The value of SWIID depends on the plausibility of the assumptions underlying the imputation model (potential bias issues) and the correct use of the multiply imputed data (accuracy issues).

Therefore, even if SWIID has some weaknesses, it is important to note that SWIID uses a transparent procedure to increase the comparability of available data on cross-national inequalities. Although it is not ideal for all research on economic inequality, its advantages over other cross-national datasets make it a prestigious research tool. Additionally, SWIID provides uncertainty estimates for the observations, which means that users can easily perform robustness tests against the chosen inequality measure.

Measurement of the variable of interest

To address the methodological challenges in this study, the literature to measure our variable of interest on taxation was relied upon.

⁵The goal of the Standardized World Income Inequality Database (SWIID) is to meet the needs of those engaged in broadly cross-national research by maximizing the comparability of income inequality data while maintaining the widest possible coverage across countries and over time

Fundamentally, measuring the tax pressure by the different statutory tax rates does not capture the complexity of the tax system and, therefore, does not provide a clear indicator of the implicit tax policy. For instance, some authors (Bird and Zolt, 2005; Mourfou and Ouedraogo, 2021; Gemmell and Morrissey, 2005) use the ratio of revenue by tax (direct; indirect; commercial) to GDP as an indicator for measuring the tax burden that characterizes the tax structure. However, there is a criticism of the calculation of the tax ratio. Indeed, the bias in the calculation of tax rates results from the fact that GDP is expressed in purchasers' prices and the relationship between tax rates and GDP is not immediate Lurton (2007). Authors postulate that the average tax rate approach seems the most appropriate. It consists of taking into account the taxes actually paid, while relating them to a reduced tax base to approximate the real tax base Lurton (2007). However, in order to properly assess what one wishes to measure with this indicator, one would need to have microeconomic accounting data, which are difficult to obtain and to homogenize across countries.

In our study, constraints on the availability of accounting data to estimate tax bases restrict us from using the revenue-to-GDP ratio. Unlike previous studies, we also disaggregate our variable of interest (taxation). For this purpose, in addition to measures, such as the percentage of direct/indirect tax revenues, individual tax instruments were also used, i.e., the ratio of (PIT, CIT, VAT, Trade Tax) to GDP. Based on the determinants of inequality in the literature, data from the Government Revenues Database was utilized (ICTD- UNUWIDER) Prichard et al. (2014)⁶.

Drawing on the recent empirical and theoretical literature on inequality and revenue mobilization, control variables were used that capture the simultaneous factors influencing income inequality and tax instruments.

(i) **GDP/capita**. . The level of development by GDP/capita was approximated. The growth rate of gross domestic product (GDP growth), which controls the economic cycle and fiscal conditions. It is assumed that GDP/capita growth reflects a certain economic productivity and remains a reliable indicator of economic wealth creation in a country. The coefficient on GDP per capita is expected to be positive because lower inequality and poverty are associated with a higher income level.

(ii) **Education**. Education is measured by the Penn World Table (PWT) 8.0 Dataset Human Capital Index per capita. The variable is based on the average number of years of

⁶Where missing, the ICTD-GRD tax revenue data was supplemented with tax revenue data as a percentage of GDP from the recent IMF Longitudinal Global Revenue Dataset (WoRLD). As well as from the Sub-Saharan Africa Tax Revenue Database (Mansour, 2014) if data are missing from the ICTD-GRD and IMF-WoRLD datasets.

schooling, taken from the work of [Barro and Lee \(2013\)](#), and associated with an assumed rate of return for primary, secondary, and tertiary education. Education is an important component of well-being and is generally used in the measurement of quality of life. Higher levels of education are associated with higher levels of household and individual income and could reduce income inequality.

(iii) **Trade openness.** Trade openness as a percentage of GDP. From a theoretical point of view, the Stolper-Samuelson theorem confirms that in a two-factor framework of two countries, increased trade openness (through tariff reduction) in a developing country with low-skilled labor would increase wages for low-skilled workers and reduce compensation for high-level skill workers, resulting in reduced income inequality [Stolper and Samuelson \(1941\)](#). [Edwards \(1997\)](#) argues that there is no evidence linking openness to evidence linking openness to trade liberalization to an increase in inequality. The results of [Reuveny and Li \(2003\)](#) show that trade openness is associated with a more equitable distribution of income within countries. It is suspected that it will have a negative impact on inequality.

(iv) **FDI.** FDI as a percentage of GDP. The effect of FDI on income distribution is mixed in the literature. FDI can contribute to a more unequal distribution of income in less developed host countries. Indeed, [Tsai \(1995\)](#), reports that there is a positive and statistically significant correlation between FDI and income inequality. This conclusion is supported by [Basu and Guariglia \(2007\)](#); [Gopinath and Chen \(2003\)](#). They argue that FDI flows into developing countries and can broaden the skill set of skilled workers. Thus, the wage gap between skilled and unskilled workers increases. Furthermore, [Choi \(2006\)](#) found that the Gini coefficient increases with FDI intensity. These results indicate that FDI flows lead to labor market segmentation, with skilled labor receiving higher wages and increasing income inequality. Therefore, a positive impact of FDI on income inequality is expected.

(v) **The Financial Development Index** The Financial Development Index measures and analyses the factors that enable the development of financial systems in different economies. The index takes into account the quality of each country's financial laws and regulations, the business environment and the likelihood of a financial crisis, among other things. According to [Bittencourt \(2006\)](#), financial development can improve the poor's access to credit, mitigate extreme inequality and thus improve welfare without distorting economic efficiency. By increasing growth, financial development can participate in improving the incomes of the poor.

(vi) **Public Debt.** The links between public debt and inequality have not been widely

studied in modern macroeconomics. The relationship has remained mixed since the early theories. More recently the idea that public debt could reduce inequality has been debated. Thus, due to borrowing constraints, public debt can have redistributive effects, depending on whether prices are flexible (in which case Ricardian equivalence holds globally) or rigid (in which case public debt can have redistributive effects, to the benefit of the borrowing classes, forced to borrow.. In this model – with sticky prices – public debt (used to finance tax cuts) has redistributive as well as expansionary effects for the whole economy [Bilbiie et al. \(2013\)](#).

(vii) **Shadow economy.** The shadow economy is, by nature, difficult to measure, as agents engaged in shadow economy activities try not to be detected. The shadow economy is a major source of inequality. However, the literature indicates that the direct link between income inequality and the informal economy is not always clear. As the size of the shadow economy increases, more goods and services are produced outside the formal economy. The most consistent results indicate a positive and statistically significant relationship between the size of the shadow economy and income inequality, both in the long run and in the short run, all else being equal [Chong and Gradstein \(2007\)](#).

Table 2: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gini	445	.472	.076	.327	.674
Log GDP/capita	540	6.925	1.037	4.72	9.288
Log Trade Openness	504	4.145	.411	3.031	5.106
PIT	539	2.298	2.17	.025	13.38
CIT	540	2.036	1.351	.119	8.04
VAT	525	3.916	1.928	0	8.68
Tax Trade	540	3.426	4.639	.154	40.861
Direct Tax	513	5.075	3.567	.199	17.442
Indirect Tax	539	8.956	5.589	.374	48.618
Financial Development	522	.151	.121	.029	.638
Shadow Economy	480	38.07	10.024	19.23	69.08
Education	522	1.813	.448	1.069	2.885
Public Debt	522	1.546	1.649	0	19.553

4.2 Methodology

Identification strategy

Our objective is to analyze whether and how the tax structure affects inequality. The choice of the appropriate estimation model for this research is made on the basis of the structure of our data. Equation (1) is a model inspired by (Martinez-Vazquez et al., 2012; Dao and Godbout, 2014; Martorano, 2018). Ordinary least squares (OLS) models are inefficient in the presence of potential endogeneity variables. Thus, in this study, the estimation technique used was the fixed-effects least squares dummy variable method (LSDV). The choice of this method was based on its simplicity and advantages. Indeed, the fixed effects make it possible to correct the biases caused by the autocorrelation of errors and heteroscedasticity. Finally, this method takes heterogeneity into account in a simple way and allows for testing the uniformity of behavior.

To test the sensitivity of income inequality to the tax structure, our model is formalized as follows:

$$Gini_{i,t} = \alpha + \beta Tax_{i,t} + \rho X_{i,t} + \epsilon_{i,t} \quad (i = 1; 2; \dots; N; t = 1; 2; \dots; T) \quad (1)$$

where $Gini_{i,t}$ represents the Gini inequality index of country i at time t ; α_i is a constant; $Tax_{i,t}$ is the composition of tax revenues from different taxes; $X_{i,t}$ represents the other explanatory variables and $\epsilon_{i,t}$ is the error term. Beyond that, X identifies a set of variables included in the econometric model to control for several economic factors that may have affected the evolution of inequality in Sub-Saharan Africa over the period considered.

However, the effectiveness of fixed effects may be limited. This is because omitted fixed effects create an endogeneity bias. According to the literature, there is an inverse causal relationship between income inequality and taxes (Meltzer and Richard, 1981; Persson and Tabellini, 1999). Drawing on the results of econometric estimations by (Bird and Zolt, 2005; Agnello and Sousa, 2014), high levels of inequality increase incentives to mobilize revenue and conversely increased revenue mobilization reduces income inequality. Similarly, a high existence of income inequality reduces the opportunities for a good institutional environment and conversely a good quality of institutions favors the reduction of inequality (Martinez-Vazquez et al. (2012)). Thus, a potential existence of endogeneity due to reverse causality is suspected. To address this issue, the robustness of our results is developed by the instrumental variables method, more precisely, the double ordinary least squares (2SLS). We use two instruments in this paper. The first one is inspired by the literature, namely the lagged endogenous variable, and the second one is based on the distance matrix. The choice of this technique is justified, as endogeneity is suspected between some variables.

Implementation of the instrumental variable

To overcome these biases, [Lee and Gordon \(2005\)](#) instrument personal and corporate tax rates using the weighted average of personal and corporate tax rates in other countries by considering the inverse of the distance between the two countries.

Recently, [Duncan and Peter \(2016\)](#) exploited the spatial correlation of tax rates between neighboring countries to instrument their measure of structural tax progressivity.

In this article, a spatial econometric model was used. To estimate spatial autocorrelation, how countries are connected to each other needs to be defined. The reasoning behind the use of the geographical distance weighting matrix is related to the fact that geographically close countries are more relevant tax competitors - countries compete for the tax base - since productive capital is highly mobile between geographically close countries due to relatively lower transport and information costs. This is in line with the first law of geography: "Everything is related to everything else, but things close together are more related than things far apart" [Tobler \(1970\)](#), which explains the wide use of inverse geographical distance in spatial econometrics to measure connectivity. Algebraically, after normalization, the weights $w_{i,j}$ of the geographical distance weighting matrix are given as follows:

$$w_{i,j} = \begin{cases} \frac{1/d_{ij}}{\sum_j 1/d_{ij}}, & \text{for } i \neq j \\ 0, & \text{for } i = j \end{cases} \quad (2)$$

where d_{ij} is the Euclidean distance between the capital of country i and that of country j for $i \neq j$.

The choice of this instrument is also explained by the importance of tax spillover effects in policy design across developing countries [Cornia et al. \(2011\)](#). Indeed, governments are more likely to reform their tax system if neighboring countries and countries with a similar economic and institutional framework do the same. As an example, the recent double taxation reform implemented in Uruguay influences the design of taxation in other Latin American countries.

5 Empirical results and robustness check

5.1 Empirical results

(i) Baseline results

Here, the basic results with the fixed effect model (LSDV) are presented. The results in Table 3 highlight the effect of each tax instrument on income inequality. As expected, the results confirm that personal income tax is negatively associated with income inequality. Moreover, the associated coefficient is strongly negative and significant (Column 1). Then, increasing the level of personal income tax (PIT) collection reduces inequality. In other words, a 1% increase in personal income tax (PIT) leads to a decrease in income inequality of 0.17 percent. This finding confirms the progressivity of the PIT, suggesting that the PIT may be the best tool to affect income distribution. This result is in accordance with past work of [Paulus and Peichl \(2009\)](#); [Martinez-Vazquez et al. \(2012\)](#); [Barnes \(2015\)](#), which shows the redistributive impact of a progressive tax structure. However, this conclusion contrasts with [Bird and Zolt \(2005\)](#), who reported that PIT would have a very limited, if any, effect on reducing income inequality in developing countries. They argue that the tax system is less progressive, the costs are excessive, and the gains are too small. For corporate taxes, in Column (2), a nonsignificant negative impact on inequality was found. This result suggests that corporate taxes have no effect on inequality in sub-Saharan African countries. Indeed, given the importance of the informal sector and tax evasion in these countries, governments are not able to raise sufficient revenues from large (especially international) firms to address the equity issue. In addition, the effectiveness of corporate income tax is eroded by many exemptions and favors granted to companies. Thus, no significance was observed for the CIT. This result is consistent with the analysis of the IMF (2014), which shows that international tax competition will pose increasing problems for developing countries in protecting corporate tax revenues. Moreover, the increasing international mobility of capital and the associated opportunities for tax evasion, fraud, and avoidance present increasing administrative challenges. Column 3 of Table (3) suggests that the VAT increases inequalities, but the coefficient is not significant. In fact, the VAT taxes final consumption, whereas it is accepted that the poorest households devote a larger share of their income to consumption. Therefore, they are likely to pay a higher average tax compared to higher income groups. However, few empirical works have tested this general conjecture. In view of the result, we postulate that the effect of VAT on inequalities remains mixed. In Column (4), we found that trade taxes accentuate inequality, which can be explained simply by the fact that the existence of barriers to entry is likely to create monopolies within the country, reducing competition favorable to consumption, especially by the poor.

This result is consistent with [Siddique \(2021\)](#), who found that trade taxes and tariffs have a negative impact on income distribution. Direct taxes in general seem to be negative, but we did not reach a significant score (Column 5). Indeed, revenues from direct taxes clearly suffer from tax evasion and the prevalence of a large informal sector. In Column 6, indirect taxes positively and significantly affect inequality.

It is clearly observed that a 1% increase in indirect tax revenues as a percentage of GDP increases income inequality by 0.029%. This is because of the regressive nature of this tax and the dependence on trade tax revenues in most countries. On the other hand, (Column 7) excise taxes that could increase the progressivity of these various taxes have remained on the sidelines of the tax transition and remain an unexploited potential (Geourjon 2014)⁷. Assessing the impacts of the control variables on income inequality in sub-Saharan countries, we found that most of the control variables are statistically significant and have the predicted sign, as discussed in the literature. The focus is more on the interpretation of the coefficient and sign of Model 1 with the PIT in Table 3.

The results of the impact of trade openness on inequality support the hypothesis that the Stolper-Samuelson theorem (1941) does not describe the only channel through which trade can influence income inequality. It is observed that increasing trade openness improves equity. In other words, a 1 percent improvement in trade openness leads to a 0.70 percent decrease in inequality. This result is consistent with the literature supported by (Rodrik, 1997; Birdsall et al., 1998) trade makes it easier for developing country firms to replace unskilled labor with inexpensive imports, weakening the bargaining power of workers. Thus, trade intensifies economic competition, leading to lower prices for basic consumer goods. This benefits the poor more than the rich because the poor spend relatively larger shares of their income on basic consumer goods. In addition, competition also reduces the monopoly position enjoyed by the upper class as well as income inequality Birdsall et al. (1998). Another argument is that trade increases labor productivity, which leads to higher wages and reduced inequality Held (1999). Finally, Blanchard (2000) found that although trade openness may reduce the wages of unskilled labor, it provides incentives for workers to acquire training and for firms to employ more unskilled labor, again reducing inequality.

We observed that the increase in GDP increases inequalities significantly. Economic growth is not systematically associated with lower income inequality. Specifically, a one percent increase in GDP increases inequality in the margin by 0.09 to 0.07 percent depending on the fiscal instrument. These results are opposed to Kuznet's inverted curve theory. However, they are consistent with the idea of (Piketty and Saez, 2014; Myles, 2014) who challenged Kuznet's work.

Regarding financial development, there is a positive and significant effect on income inequality, which could be explained by the idea that in the early stages of financial development, loans are targeted at a minority of wealthy households, who can benefit from these credits. Otherwise, poorer segments of the population will find it difficult to access credit from financial institutions due to lack of collateral and financial literacy (Beck et al., 2004; Claessens and Perotti, 2007).

⁷<https://www.imf.org/external/french/np/seminars/2014/waemu/pdf/geourjons4.pdf>

Furthermore, the results of [Tan and Law \(2012\)](#) support the existence of a U-shaped relationship between financial deepening and inequality for developing economies. Fundamentally, financial markets are inefficient in improving income distribution in these countries. Foreign direct investment positively and significantly affects inequality. This result is explained by the fact that FDI to these countries is generally invested in capital-intensive sectors (extractive sector). This result is consistent with ([Basu and Guariglia, 2007](#); [Gopinath and Chen, 2003](#)) who argue that FDI flows to developing countries can broaden the skill set of skilled workers. Thus, the wage gap between skilled and unskilled workers increases. T. This result confirms the fact that sub-Saharan African countries have made loans in the expansionary policy choice, which explains the redistributive effect of debt. On the side of the informal economy, a strong positive and significant relationship with inequality was observed. In other words, as the size of the informal sector increases, the more distortions related to evasion, fraud and activities that escape the government perpetuate inequality. An important component of well-being, it is generally used in the measurement of quality of life; education, instead of reducing inequality, increases it. Indeed, our measure of inequality is characterized by considering the number of years of education. There is a large gap between the performance of higher education and that of primary and secondary education, which in most countries is virtually free and therefore accessible. For the rest of the document, the estimation with PIT will be considered because of its importance in reducing inequalities.

Table 3: Baseline result, tax structure and inequality in Sub-Saharan Africa Countries

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
PIT	-0.170** (0.0693)						
CIT		-0.0207 (0.0486)					
VAT			0.00886 (0.0507)				
Tax Trade				0.0312*** (0.00961)			
Direct Tax					-0.00898 (0.0405)		
Indirect Tax						0.0298** (0.0150)	
Excises Tax							-0.0469 (0.0505)
Log GDP_capita	0.0985*** (0.0347)	0.0990*** (0.0358)	0.0918** (0.0355)	0.0937*** (0.0359)	0.0849** (0.0362)	0.0921*** (0.0354)	0.0709** (0.0355)
FDI	0.0381*** (0.00789)	0.0349*** (0.00731)	0.0322*** (0.00802)	0.0344*** (0.00724)	0.0347*** (0.00806)	0.0317*** (0.00707)	0.0276*** (0.00998)
Log Trade_Openess	-0.702** (0.282)	-0.719** (0.280)	-0.739*** (0.277)	-0.764*** (0.280)	-0.764*** (0.283)	-0.773*** (0.277)	-0.743** (0.298)
Financial Dev	3.178* (1.784)	3.129* (1.748)	3.278* (1.885)	3.402* (1.785)	2.987* (1.783)	3.173* (1.770)	2.045 (2.072)
Public Debt	-0.0354* (0.0189)	-0.0506*** (0.0191)	-0.0470** (0.0199)	-0.0580*** (0.0189)	-0.0522** (0.0207)	-0.0503** (0.0194)	-0.0648*** (0.0199)
Shadow Eco	0.0429*** (0.0152)	0.0409** (0.0172)	0.0453*** (0.0162)	0.0424** (0.0164)	0.0442** (0.0171)	0.0439*** (0.0164)	0.0424** (0.0177)
Education	1.707*** (0.467)	1.331*** (0.484)	1.269*** (0.484)	1.224*** (0.459)	1.310*** (0.488)	1.245*** (0.474)	1.356*** (0.488)
Constant	43.26*** (1.671)	43.88*** (1.839)	43.75*** (1.839)	44.00*** (1.763)	43.84*** (1.816)	43.79*** (1.769)	43.89*** (1.827)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	279	280	278	280	270	279	249
R-squared	0.996	0.996	0.996	0.996	0.995	0.996	0.996

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(ii) Endogenous treatment

It is possible that the above results are still ineffective due to endogeneity. To address this issue, an ordinary double least square model with fixed effects (2SLS FE) was applied using the instrument we have constructed. The results of this model indicate that the effect of PIT on inequality is negative and significant at the 1% level, rising from -0.17 to -0.40%. Otherwise, this result confirms that the progressivity of this tax is the best tool to act on income distribution. Moreover, the p values of the associated F tests are lower than 1%, and the p values of the Kleibergen and Paap (2006) under-identification test prove that the instruments are correlated with the endogenous variables. Finally, the null hypothesis of the Sargan test is not rejected, which confirms the validity of the

instruments. The results appear as follows.

Table 4: Result of PIT and income inequality

VARIABLES	2SLS FE Result
PIT	-0.400*** (0.108)
Log GDP_capita	0.0967*** (0.0363)
FDI	0.0431*** (0.00837)
Log Trade_Openess	-0.575** (0.293)
Financial Development	5.738*** (1.856)
Public Debt	-0.00365 (0.0220)
Shadow Economy	0.0517*** (0.0145)
Education	2.154*** (0.542)
Country dummies	Yes
Endogeneity test	0.0015
Sargan statistic	0.172
Observations	253
Number of id	26
R-squared	0.182
Robust standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1

5.2 Sensitivity analysis

In this section we analyze some conditional factors that may affect the relationship between taxation and income inequality.

Some indicators of the policies that a country can implement to achieve inclusive development are considered here. For example, countries may decide to increase final government consumption expenditures to provide services and goods (including road and infrastructure repair, national defense, schools, health care and including employee salaries). In addition, SSA countries currently face a strong resurgence of conflict, ethnic tensions, and military presence in politics. We then introduce an interaction variable, considering the presence of PIT*ethnic tensions and PIT*military as political leader. In fact, the existence of these factors determines the effectiveness of progressive taxation. To this end, using ICRG and the PRM Dataset, we estimate the sensitivity of our findings in the presence of these social scourges.

Table 5: Testing for sensitivity analysis

VARIABLES	(1)	(2)	(3)
PIT	-0.307** (0.122)	-0.263** (0.120)	-0.596*** (0.187)
Gov_consumption	0.0460*** (0.0158)		
PIT*Military in politics		0.0522** (0.0226)	
PIT*EthnicTensions			0.125*** (0.0379)
Log GDP_capita	0.0899** (0.0355)	0.0651 (0.0451)	0.0285 (0.0423)
FDI	0.0375*** (0.00809)	0.0456*** (0.00869)	0.0405*** (0.00786)
Log Trade_Openess	-0.622** (0.295)	-0.907*** (0.324)	-0.971*** (0.313)
Financial Development	4.196** (1.914)	6.326*** (2.129)	4.273* (2.438)
Public Debt	-0.0106 (0.0250)	-0.0371 (0.0279)	-0.0205 (0.0323)
Shadow Economy	0.0632*** (0.0200)	0.0441** (0.0198)	0.0128 (0.0199)
Education	2.209*** (0.508)	1.350* (0.780)	0.112 (0.629)
Country dummies	Yes	Yes	Yes
Endogeneity test	0.0249	0.0190	0.0697
Sargan statistic	0.0584	0.6656	0.3656
Observations	237	203	194
R-squared	0.259	0.198	0.188
Number of id	25	21	20
Robust standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1		

It is generally agreed that the relationship between government expenditure and inequality is complex. Our results in Table (5) Column 1 show that final government consumption expenditures, which do not include transfers or indirect subsidies, have a positive effect on inequality, even if the coefficient is quite low. This finding is consistent with the idea that a large part of the benefits of government spending on health and education and including employee salaries in developing countries are received by middle-income groups in urban areas (Tanzi, 1974; Alesina et al., 1998; Asawanuchit et al., 2003). Particularly in low- and middle-income countries, much doubt has been raised about the effectiveness of public expenditure as a redistributive policy. This effect, which seems counterintuitive, is readily explained by the fact that for reasons of political economy, such spending often disproportionately benefits higher income groups. The occurrence of conflict and political instability (the presence of the military in politics) positively affects

income inequality. This is because tensions and instabilities discourage investment and increase perceived inequality. Furthermore, the literature admits a correlation between tensions and the absence of real socioeconomic opportunities (Collier et al., 2000; Hugon, 2003). As a reminder, inequalities between groups defined by religion, ethnicity or regional identities are linked to a significantly higher risk of armed conflict (World Bank, 2018). Therefore, in the presence of technical and military tensions in politics, progressive taxation is found to have a positive effect on income inequality. In view of the strong link between citizens and the state, this finding is explained by citizens' noncompliance and distrust. Furthermore, based on the political economy literature, this could be due to the bias of the tax system in a military and therefore autocratic regime.

5.3 Robustness checks

To check the validity of our findings we undertake several robustness exercises.

(i) Testing for additional controls on baseline specification

Further controls were added in the baseline specification to take into account other variables likely to affect income inequality. These additional controls are the Globalization KOF Index, Natural Rent and Exclusion/Socio-Economic Group. The results are reported in Table 5. In the context of global integration, notably globalization, the increased international mobility of national resources could affect the relationship between taxation and inequality. Furthermore, it is argued that integration into the global economy promotes economic growth, which helps to address problems of poverty, inequality and the lack of democracy. To address this issue, the KOF index was used, which measures the economic, social, and political dimensions of globalization. The regression results in Table (5), especially in Column (1), show that global integration leads to a reduction in income inequality. Indeed, political and social globalization may lead countries to set common minimum standards and thus increase equality within countries Dreher (2006). Additionally, empirical evidence suggests considerable poverty reduction under globalization in the case of India and China (Cammett and Bhagwati, 2005; Liu et al., 2017). Regarding the relationship between inequality and natural rents, there is no consensus in the economic literature. The results of our estimations show that natural rents have a significant negative impact on income inequality. Otherwise, an increase in rent helps to reduce inequality. This result is consistent with the work of Kim and Lin (2018). The authors' analysis showed that in the long run, oil abundance and dependence mitigate income inequality, implying that the poor benefit more from oil booms. The index of socioeconomic exclusion captures the social and economic relegation or marginalization

of individuals and is a relevant indicator of equal access to public services ⁸. We observe a positive and significant relationship on income inequality. Indeed, the increase in social exclusion accentuates poverty and thus increases inequalities.

Table 6: Results of additional controls on baseline specification

VARIABLES	Baseline Result	(1)	(2)	(3)
PIT	-0.400*** (0.108)	-0.333*** (0.110)	-0.404*** (0.120)	-0.350*** (0.123)
Log GDP_capita	0.0967*** (0.0363)	0.0942*** (0.0365)	0.0848** (0.0378)	0.0891** (0.0371)
FDI	0.0431*** (0.00837)	0.0453*** (0.00849)	0.0486*** (0.00883)	0.0474*** (0.00880)
Log Trade_Openess	-0.575** (0.293)	-0.452* (0.274)	-0.284 (0.279)	-0.265 (0.273)
Financial Development	5.738*** (1.856)	6.326*** (1.894)	6.664*** (1.865)	6.925*** (1.840)
Public Debt	-0.00365 (0.0220)	-0.0135 (0.0218)	-0.00434 (0.0218)	-0.0109 (0.0212)
Shadow Economy	0.0517*** (0.0145)	0.0444*** (0.0147)	0.0403*** (0.0139)	0.0448*** (0.0139)
Education	2.154*** (0.542)	2.365*** (0.549)	2.177*** (0.543)	2.100*** (0.526)
Globalisation_KOF Index		-0.0270* (0.0149)	-0.0259* (0.0148)	-0.0272* (0.0143)
Log Natural_Rent			-0.255*** (0.0820)	-0.225*** (0.0795)
Exclusion/Socio-Economic Group				4.905*** (1.856)
Country dummies	Yes	Yes	Yes	Yes
Endogeneity test	0.0015	0.0032	0.0017	0.0036
Sargan statistic	0.172	0.7143	0.7366	0.7440
Observations	253	253	253	253
R-squared	0.182	0.214	0.217	0.249
Number of id	26	26	26	26
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

⁸To see more: Pemstein et al. (2021, V-Dem Working Paper Series 2021:21)

(ii) Testing the role of institutional quality and property rights in the implementation of tax policy favorable to the reduction of income inequality

The effects of tax policy on inequality in terms of the institutional quality of countries is examined here. The reduction in income inequality also depends on governance in terms of the quality of the rule of law index and the enforcement of property rights. Indeed, the rule of law index is derived from the V-dem project (Varieties of Democracy) and is formed by taking point estimates from a Bayesian factor analysis of the indicators. This variable reflects the extent to which "laws [are] applied transparently, independently, predictably, impartially, and equally, and the extent to which the actions of government officials comply with the law", and it consists of 15 indicators⁹.

Regarding the role of institutions in the effect of tax policy on inequality, Table (6) shows the negative sign of the rule of law and property rights index on income inequality. This result implies that in a rule of law with less corrupt governments, rules and laws respected, personal income tax is collected efficiently and better redistributed by financing for example pro-poor expenditures. Thus, high-quality institutions help the government control corruption and thus eliminate tax evasion. As a result, governments with better institutions are likely to have better policies to rebalance the incomes of the richest and poorest citizens, which of course reduces income inequality. In conclusion, good institutional quality enhances the principle of impartiality by keeping democratic procedures accountable and prevents bureaucrats from pursuing their own interests more effectively, which in turn leads to downward pressure on income inequality.

⁹(Respect for the high court and the judiciary; independence of the high court and lower courts; respect for the constitution by the executive; rigorous and impartial public administration; transparent laws and predictable enforcement; and the quality of governance; access to justice for men and women, judicial accountability, judicial corruption decisions, public sector corruption, public sector theft, executive corruption and corrupt exchanges, embezzlement, and executive theft).

Table 7: Effects of institutional variables

VARIABLES	Baseline Result	(1)	(2)
PIT	-0.400*** (0.108)	-0.346*** (0.104)	-0.420*** (0.105)
Log GDP_capita	0.0967*** (0.0363)	0.111*** (0.0378)	0.0956*** (0.0359)
FDI	0.0431*** (0.00837)	0.0414*** (0.00812)	0.0461*** (0.00866)
Log Trade_Openess	-0.575** (0.293)	-0.590** (0.285)	-0.614** (0.295)
Financial Development	5.738*** (1.856)	5.781*** (1.813)	6.418*** (1.852)
Public Debt	-0.00365 (0.0220)	-0.0116 (0.0224)	0.00715 (0.0235)
Shadow Economy	0.0517*** (0.0145)	0.0496*** (0.0141)	0.0574*** (0.0144)
Education	2.154*** (0.542)	2.125*** (0.545)	2.457*** (0.553)
Rule of law Index		-1.571** (0.673)	
Property Righth			-2.221*** (0.758)
Country dummies	Yes	Yes	Yes
Endogeneity test	0.0015	0.0039	0.0006
Sargan statistic	0.172	0.7745	0.566
Observations	253	253	253
R-squared	0.182	0.216	0.194
Number of id	26	26	26
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1	

(iii) Testing for an alternative main dependent variable

Thus far, the Gini index from SWIID [Solt \(2020\)](#) was used as the dependent variable. Here, a new measure of income inequality, namely, the Gini index from the World Development Indicator, is considered (WDI, 2021). This index is calculated from primary household survey data and is used to determine the extent to which the distribution of income between households or individuals within a country deviates from a situation of perfect equality. Statistically, the Gini index refers to the area between the Lorenz curve and a hypothetical line of perfect equality, expressed as a percentage of the maximum area under that line. The result of the estimation using the Gini index from the World Bank database is presented in Table 7, Column (2). As seen, our baseline results remain broadly consistent. The coefficient associated with personal income tax remains negative and statistically significant. Evidence that increasing personal income taxes reduces income inequality in sub-Saharan African countries.

Table 8: Alternative data source for income inequality

VARIABLES	Gini (SWIID) (1)	Gini (World_Bank) (2)
PIT	-0.400*** (0.108)	-2.086*** (0.536)
Log GDP_capita	0.0967*** (0.0363)	0.0791 (0.254)
FDI	0.0431*** (0.00837)	0.209*** (0.0415)
Log Trade_Openess	-0.575** (0.293)	-0.631 (1.359)
Financial Development	5.738*** (1.856)	10.19 (11.88)
Public Debt	-0.00365 (0.0220)	0.0103 (0.214)
Shadow Economy	0.0517*** (0.0145)	0.328*** (0.0774)
Education	2.154*** (0.542)	5.517** (2.691)
Country dummies	Yes	Yes
Endogeneity test	0.0015	0.0035
Sargan statistic	0.6787	0.2222
Observations	253	271
R-squared	0.182	0.139
Number of id	26	25
Robust standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1	

(iv) Testing for an alternative empirical strategy

In this section, we include lagged income inequality to account for the persistence of income inequality. To achieve this, we applied a dynamic model. Our regression equation is as follows:

$$Gini_{i,t} = \alpha + \sigma Gini_{t-1} + \beta Tax_{i,t} + \rho X_{i,t} + \epsilon_{i,t} \quad (i = 1; 2; \dots; N; t = 1; 2; \dots; T) \quad (3)$$

To solve the endogeneity problem and to conclude on good estimates, we retain the GMM estimators (Generalized Moment Method). The GMM estimator is more suitable for dynamic panel data and especially when the time dimension is small compared to the individual dimension. The Blundell and Bond estimator combines two equations, one in level and one in first difference. The level equation uses lagged first differences as instruments for the endogenous variables while the first difference equation uses lagged levels as

instruments. To check the validity of the instruments, we use the standard Hansen test for over-identifying restrictions and the Arellano and Bond test which checks for second order serial correlation. second-order serial correlation in the residuals in first difference. The result of the estimation using the GMM is presented in the following table. These results remain broadly consistent with our baseline findings (Table 11)¹⁰.

6 Conclusion and policy implications

In this article, the role of tax policy is explored, particularly its effectiveness in influencing income inequality in sub-Saharan African countries. This paper confirms that tax instruments, given their returns, different tax bases and specific characteristics, affect the evolution of income inequality differently. Our research contributes to the debate on the relationship between taxation and income inequality that guides public policy in achieving the objective of sustainable development 10.

A sample of 30 countries for the period 2000-2017, focusing on fiscal instruments, were considered. Fixed-effect estimation techniques (LSDV) were used, then the method of double ordinary least squares with instrumental variable (2SLS) and finally robustness in the GMM (generalized method of moments). First, our results indicate that only personal income taxes are effective in significantly reducing income inequality in SSA. On the other hand, indirect taxes and taxes on international trade increase inequality. Even if the coefficient remains negative, no effect of corporate taxes and excise duties on inequality were found. Similarly, a nonsignificant positive effect of VAT was found. In addition, these results were further developed by some analyses of heterogeneity. Thus, presenting some evidence confirming that respect for property rights and good institutional quality reduce income inequality. Finally, our results reveal that progressive taxation is ineffective in military political regimes and in the presence of ethnic conflicts. Based on a battery of robustness tests, our results are robust to any change.

Overall, it is clear that the effectiveness of taxes in promoting equity in sub-Saharan Africa is limited by several factors. In particular, the structure of tax rates, the narrowness of the tax base, the high level of informality and tax evasion limit the impact of taxation on reducing inequality. In a post-COVID-19 world marked by the uncertainties of a fragile recovery— fuelled by climate shocks and conflicts between the world’s largest food producers—the design of inclusive fiscal policies is crucial to ensure sustainable economic recovery. Thus, the practice of progressive taxation must be pursued to identify appropriate tax measures to improve revenues in an inclusive and growth-friendly manner.

¹⁰see in appendix

In this sense, personal income tax can still be important for inclusive development if it is well designed and revenues are well used. Despite its modest role in the composition of tax revenues, our results show that this tax is an essential fiscal instrument in the economic recovery of African countries undermined by the effects of the COVID-19 crisis. Moreover, the history of taxation in advanced economies shows that as countries develop, personal income taxes should become a more important source of revenue.

From a policy recommendation perspective, the main conclusion is that sub-Saharan African countries could reduce income inequality on the one hand by improving the progressivity of personal income taxes; on the other hand, many taxpayers are partially or totally exempt from this tax. It is crucial to broaden the personal income tax base to give it a greater place in the composition/design of taxes. Finally, we introduce and enforce rules that improve institutional quality. Although we were able to highlight some novelties in our analysis, there is still room for improvement. Indeed, future research could focus on improving the design of personal income tax. Given that a high marginal tax rate distorts incentives to produce/work and encourages tax avoidance and evasion, the optimal level of progressivity must be a fair balance between fairness and efficiency. Additionally, given the possible distortions, it is important to examine the effectiveness of exemption policies and reduced rates (of certain primary goods) in tackling inequality and extreme poverty to establish a better trade-off and/or a beneficial mix for inclusive growth. To achieve the 2030 Agenda for Sustainable Development, tackling inequalities is not only crucial for political stability and social cohesion, but it is also a sound economic practice and imperative for sustainable development.

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7 Appendix

Table 9: Definition and sources of variables

Variables	Descriptions	Sources
Gini index (SWIID)	Estimate of Gini index of inequality in equalized (square root scale) household disposable (post-tax, post-transfer) income, using Luxembourg Income Study data as the standard.	(SWIID)
Indirect Tax	Indirect taxes comprise the sum of taxes on goods and services, international trade and transactions, and other taxes.	ICTD Government Revenue Dataset (GRD)
Direct Tax	Direct taxes include taxes on income, profits and capital gains, taxes on payroll and workforce as well as taxes on property.	
Individual Tax	Individual Income Tax Revenue as a % of GDP	
Corporate Tax	Corporate Income Tax Revenue as a % of GDP	GRD & IMF World Revenue Longitudinal Data (WoLRD)
VAT Revenue	VAT Revenue as a % of GDP	
Excises Tax	Excise Tax Revenue as a % of GDP	
Tax trade	Trade Tax Revenue as a % of GDP	
Financial Development	Financial development is defined as a combination of depth, access, and efficiency to provide financial services	Global Financial Development Database (GFDD)
Government Consumption	General government final consumption expenditure	
Trade Openness	Sum of exports and imports of goods and services, % of GDP.	
Natural resources rents	Total natural resources rents (% of GDP)	
GDP per capita	GDP per capita is gross domestic product divided by midyear population. (Annual %)	
FDI	Net inflows (new investment inflows less disinvestment) in a given economy from foreign investors, divided by GDP.	
Gini (World Bank)	Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution	WDI
GDP/Capita Growth	Annual percentage growth rate of GDP per capita based on constant local currency.	
Rule of law index	The extent to which laws are applied transparently, independently predictably, impartially and equally and also the extent to which the actions of government officials comply with the law.	V-Dem Database
Property right	measures the respect of property rights	
Exclusion/Socio-Economic Group	Index of (political) exclusion by socio-economic group	
Education	The variable is based on the average number of years of schooling. Human Capital Index per capita.	Pen World Table (PWT) 8.0 Dataset
Globalisation_KOF Index	The KOF Globalization Index measures the economic, social, and political dimensions of globalization.	2020 KOF Globalisation Index
Military leader in politics	Yearly measure on the regime leader's connection to the armed forces.	PRM Dataset
Shadow Economy	the shadow economy is an unobserved phenomenon (latent variable) that is estimated using the causes of illicit behaviour, and indicators reflecting illicit activities.	Leandro Medina and Friedrich Schneider(IMF,2017)
Ethnic tension	This component is an assessment of the degree of tension within a country attributable to racial, nationality, or language divisions.	ICRG

Table 10: List of countries

List of countries		
Benin	Kenya	Senegal
Botswana	Lesotho	South Africa
Burkina Faso	Madagascar	Togo
Cameroon	Malawi	Uganda
Cape Verde	Mali	Zambia
Central African Republic	Mauritania	Zimbabwe
Congo, Dem. Rep.	Mauritius	
Congo, Rep.	Mozambique	
Cote d'Ivoire	Namibia	
Ethiopia	Niger	
Gabon	Nigeria	
Ghana	Rwanda	

Table 11: Alternative empirical strategy

VARIABLES	(1)
Lag gini_disp	0.917*** (0.0101)
PIT	-0.0666* (0.0359)
Log GDP_capita	0.0688* (0.0354)
FDI	0.0131** (0.00606)
Log Trade_Openess	-0.0226 (0.195)
Financial Development	0.0677 (0.522)
Public Debt	0.0912*** (0.0274)
Shadow Economy	0.00889 (0.00731)
Education	0.421*** (0.123)
Constant	-1.903*** (0.717)
AR1:P-value	0.006
AR2:P-value	0.236
Hansen	0.884
Observations	266
Number of id	26
Number of Instrument	23
Robust standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1

Figure 4: Map of income inequality in SSA Constructed by the author using SWIID data and Qgis software

