



# The Effects of Taxation on Income Inequality in Sub-Saharan Africa

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## Abstract

This paper investigates the effects of taxation on income inequality in an unbalanced panel of 45 countries in Sub-Saharan Africa over the period 1980–2018. We use two-stage least squares and the instrumental variables quantile regression estimates. We find that taxation widens income inequality and that the increasing effects of taxation on income inequality are higher in the most unequal countries than in the least unequal ones. The paper provides evidence that countries in Sub-Saharan Africa should improve the progressivity of their tax systems, so that taxation policy can be used to reduce income inequality.

**Keywords** Income inequality · Taxation · Sub-Saharan Africa

**JEL Classification** C26 · D31 · O15

## Introduction

Income inequality has been a long-standing issue for economic development and its widening remains a political, economic, and social challenge for policymakers (Blanchard and Rodrik 2021; Holcombe and Boudreaux 2016; Karakotsios et al. 2016). Income inequality is a key source of low productivity, economic inefficiency, lessened aggregate demand, shorter growth cycles, low growth, political and economic instability, and conflict that reduces investment and deprives the poor of the ability to stay healthy and accumulate human capital (Doyle and Stiglitz 2014; Ostry

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et al. 2014; Stiglitz 2012). Higher inequality leads to less investment in infrastructure, technology, and education (Doyle and Stiglitz 2014). It also increases the likelihood of succumbing to a severe recession (Berg and Ostry 2017) and poverty (Fosu 2018). In addition, addressing income inequality is an important issue in current development Agenda. For example, Sustainable Development Goal (SDG) 10 aims at reducing inequality within and among countries. African Union Agenda 2063 also aims at reducing income inequality between individuals in African economies.

Despite the economic growth recorded in recent decades, Sub-Saharan Africa (SSA) remains one of the regions with the highest levels of inequality in the world (Odusola 2017; Xu et al. 2021). According to International Monetary Fund (IMF 2015) and the United Nations Department of Economic and Social Affairs (2019), SSA is the second most unequal region in the world after Latin America and the Caribbean (LAC). It is also home to 10<sup>1</sup> of the 19 most unequal countries in the world and seven economies considered as outliers of inequality [United Nations Development Programme (UNDP), 2017]. Furthermore, the richest 10 per cent alone held about 55 per cent of national income in SSA in 2016 (Alvaredo et al. 2018). In 2020, the global top 10 per cent income share is established at 56 per cent, the share of the top 1 per cent at 22 per cent against only 9 per cent for the bottom 50 per cent (Chancel and Piketty 2021). The global top 1 per cent and 10 per cent share was respectively 22 and 32 times higher than the bottom 50 per cent in the same year (Chancel and Piketty 2021).

As addressing income inequality is an important issue in policy efforts to lower poverty and increase welfare, understanding why it is high in SSA is crucial (Fosu 2018). One factor that has recently attracted the attention of economists and other social scientists is taxation (Duncan and Sabirianova 2016)<sup>2</sup>. Taxation has been viewed by some economists as a powerful solution to promote a more equal income distribution (Atkinson 2015; Musgrave 1959; Piketty 2014). Since the 1980s, countries in SSA have experienced notable tax policy reforms aimed at increasing domestic resources mobilization.

Despite this renewed focus on the redistributive effects of taxation and the persistence of income inequality in SSA, empirical investigations generally dwelt on developed countries (Atkinson and Leigh 2010; Brinca et al. 2021; Ciminelli et al. 2018; Muinelo-Gallo and Roca-Sagalés 2013). Empirical studies based on developing countries focus on LAC (Martorano 2018) and Asia (Cevik and Correa-Caro 2019), while other studies use mixed panels (Claus et al. 2013; Duncan and

<sup>1</sup> South Africa, Namibia, Botswana, Central African Republic, Comoros, Zambia, Lesotho, Swaziland, Guinea Bissau, and Rwanda.

<sup>2</sup> Other drivers of income inequality have attracted the attention of social scientists. These include growth (Risso et al. 2013), human capital (Li and Yu 2014), globalization (Heimberger 2020), international trade (Huang et al. 2022), foreign direct investment (Pan-Long 1995), natural resource exploitation (Kim et al. 2020), political regime (Bahamonde and Trasberg 2021), urbanization (Sulemana et al. 2019), inflation (Al-Marhubi 1997), financial development/liberalization (Koudalo and Wub 2022), employment/unemployment (Björklund 1991), Economic freedom (Compton et al. 2014) and remittances (Bang et al. 2016).



Sabirianova 2016; Martínez-Vázquez et al. 2012). These studies do not provide insights into the formation and dynamics of income inequality in SSA.

In terms of empirical strategy, previous research on the link between taxation and income inequality has been based on ordinary least squares (Alavuotunki et al. 2019; Odusola 2017; Song 2013) and instrumental variables (IV) methods such as Generalized Methods of Moments (Cornia et al. 2011; Martorano 2018) and two stages least squares (Odusola 2017). These approaches have disadvantages, as they only estimate the parameters of interest at the mean evaluation by a conditional distribution of the dependent variable (Billger and Goel 2009). However, it is necessary to examine the effects of taxation at different intervals throughout the income inequality distribution, given the possibility that inequality feeds on itself. If this is the case, income inequality would tend to become more entrenched in already unequal nations. Finally, the effects of taxation are not necessarily uniform. For example, the impact of direct taxes on inequality may differ from indirect taxes: direct taxes are generally considered progressive whereas indirect taxes are considered regressive (Martínez-Vázquez et al. 2012). Therefore, the differentiated effects of taxation on income inequality should also be accounted for.

This paper investigates the distributional effects of taxation in an unbalanced panel of 45 countries in SSA. The data used are annual and cover the period 1980–2018. The variables used are stationary. The paper makes three contributions to the growing empirical literature on the relationship between taxation and income inequality in developing countries. First, the paper focuses on the SSA region, given its high-income inequality traits (Odusola 2017; Xu et al. 2021) and its challenges in raising tax revenue. While most of the existing research and policy discussions have focused on developed and developing countries in other regions, less attention has been paid on the SSA region<sup>3</sup>. This paper contributes to fill this gap by analyzing the effects of taxation on income inequality in SSA. Second, this paper analyses the effects of different taxes on income inequality. This allows us to identify the types of taxes that increase (or decrease) income inequality. The disentanglement of the specific contribution of different types of taxes provides more evidence on the relationship between taxation and income inequality. The understanding of the distributional effects of different taxes can be helpful in moving towards tax systems with more equity, without sacrificing the efficiency (Nantob 2016). Third, this paper investigates the effect of taxation on different parts of the income distribution. For example, the effects of taxes may be different at different quantiles of the distribution of income inequality. In addition, the effects on income inequality may be different in countries with different levels of income inequality (low, moderate, or high inequality).

The rest of the paper is organized as follows. "Literature review" section presents a brief literature review on the effects of taxation on income inequality. "Data and methodology" section describes the data and presents the methodology. "Results and discussions on the effects of taxation on income inequality in SSA" section presents

<sup>3</sup> Inequality in the region has received limited attention historically from a research, policy, and political perspective (Cornia et al. 2017).



and discusses the estimated effects of taxation on income inequality in SSA. "Conclusion" section concludes and discusses some policy implications.

## Literature Review

Theoretically, it is recognized that taxation is one of the tools used by government to address income inequality (Clements et al. 2015; De Freitas 2012). Taxation can be seen from two angles: the amount of tax revenue collected and the tax structure, which both, matter for income inequality reduction (Odusola 2017). The literature suggests that there are two channels through which taxation can affect the distribution of income. The tax system attenuates income inequality directly by increasing its progressiveness, and indirectly by increasing additional revenue to finance income inequality reduction expenditures.

On the one hand, direct channel indicates that a country's ability to reduce income inequality depends on its level of tax revenue collected and tax structure (Hubmer et al. 2016; Mirrlees 1971; Piketty 2001; Ramsey 1927). The interest in the redistributive role of the tax structure can be traced back to the work of Meltzer and Richard (1981). They argue that when average income rises relatively to median income in the income distribution, most low-income earners are more inclined to demand higher taxes in the form of progressive taxes. Progressive taxes reallocate and redistribute resources from the most fortunate to the poorest (Odusola 2017). Generally, direct taxes are progressive meaning that tax rates rise along with income. Direct taxes are paid by the taxpayer to the entity that levy it and include personal income tax, corporate income tax, taxes on payroll and workforce as well as taxes on property. Given that direct taxes reduce the concentration of wealth in the top end of the distribution, a tax system based on progressive tax (income taxes, individual and corporate taxes) is equalizing (Benhabib et al. 2011; De Freitas 2012; Hubmer et al. 2016; Mirrlees 1971; Odusola 2017; Piketty 2001; Ragot 2017).

Conversely indirect taxes are regressive (Martínez-Vázquez et al. 2011). Indirect taxes, levied on the seller but paid by the buyer, comprise taxes on goods and services, and international trade and transactions. A tax structure reliant on taxes on goods and services (sales taxes, value-added taxes-VAT-, excises taxes, customs duties) and international trade and transactions are assumed to be regressive and expected to have a negative impact on income distribution (Martínez-Vázquez et al. 2011). So, the reliance of tax system on direct or indirect taxes determines its progressivity and therefore its capacity to reduce income inequality.

On the other hand, the indirect channel reveals that the use of taxes matters in reducing income inequality (Muinelo-Gallo and Roca-Sagalés 2011). A high fiscal capacity gives governments more fiscal space to undertake expenditures on public goods such as education and health in favor of the poorest segments of the society (Clements et al. 2015). These expenditures may foster the income of marginalized people. Likewise, spending on social security can shift income toward the middle and bottom part of its distribution, thus reducing income inequality (Salotti and Trecroci 2018). In the same vein, Bird (2003) argues that the main role of fiscal



policy including taxation is to foster economic growth and then reduce income inequality.

Empirical studies have looked at the effect of taxation on income inequality in developed and developing countries and both group of countries, with controversial results. In a heterogeneous panel of developed and developing countries, by conducting a descriptive and documentary analysis on 22 developed and 128 developing countries with data covering the period 1990–2005, the IMF (2015) shows that taxation reduces income inequality. Adam et al. (2015) investigate the effect of capital taxation and tax on workers' income on income inequality in 75 developing and developed countries for the year 2010. They find that tax on capital increases income inequality whereas tax on workers' income reduces it.

Based on work undertaken in developed countries, Piketty (2001) reveals that the progressive taxes introduced at the beginning of the 20th century in France have led to a significant reduction in income inequality over a long period. Work carried out in the United States supports this result. Hayes and Vidal (2015) investigate the effect of tax policies on the level of income inequality using panel data on 50 United States of America (USA) states over the period 1976–2006. Using dynamic fixed effects and error correction methods, they find that distributive expenditures, such as unemployment benefits, lead to a reduction in income inequality. Ragot (2017) attributes the growth of income inequality in the USA over the last 30 years to the reduction in the progressivity of taxation on capital. Ramos and Roca-Sagales (2008) studying the effects of tax on the income inequality in the United Kingdom (UK), find that there are significant distributional effects associated with taxation. In the same vein, Ciminelli et al. (2018) analyze the effects of tax composition on income inequality in 16 Organization for Economic Co-operation and Development (OECD) countries using panel data covering the period 1978–2012. Using a Vector Autoregressive (VAR) model, their results show that indirect taxes reduce income inequality more than direct taxes. Similarly, Muinelo-Gallo and Roca-Sagalés (2013), using a sample of 21 OECD high income countries for the 1972–2006 period, find a negative effect of direct taxes on inequality and an insignificant effect of indirect taxes. Goñi et al. (2011), through a comparative analysis, show that in Europe, direct taxes reduce the Gini coefficient of income by an average of 15 per cent.

In developing countries, Martorano (2018) analyses the redistributive role of taxes in 18 Latin American countries over the period 1990–2015. Using the dummy-variable least squares estimator, difference and system GMM, he shows that taxation reduces income inequality over the period 1990–2015. However, over the sub-period 1990–2001, the increase in tax revenue was linked to that of indirect taxes (taxes on sales and more specifically value-added taxes) so that taxation did not reduce income inequality. Conversely, over the sub-period 2002–2015, the change in tax structure with the predominance of direct taxes (taxes on income, profits, and capital gains) reduced income inequality. Goñi et al. (2011), show that unlike in Europe, where direct taxes significantly reduce income inequality, their redistributive effect is limited in Latin America.

Engel et al. (1999) quantify the distributional impact of the Chilean tax system. They assess the sensitivity of income distribution to changes in the structure of taxes and tax rates. The authors find that the tax structure has had little effect



on income distribution, the increase in VAT (an indirect tax) from 18 to 25% increases income inequality, while the abolition of import duties and the doubling of the excise duty rate on petrol slightly reduce income inequality in Chile. They pointed out that between increasing the progressivity of a tax that is progressive in its collection, such as income tax, and increasing a regressive tax rate, such as VAT, the second option may end up being more beneficial for low-income sectors because the latter collects a greater proportion of income from high-income households. Direct taxes therefore have a smaller impact on income inequality in developing countries. Although income tax appears to be progressive in most developing countries, it is only progressive for certain types of income and often for certain income brackets. The extent of redistribution that can be achieved through personal income tax is small given the distribution of incomes and the nature of income tax.

Song (2013) examines the effects of China's tax system on regional income inequality using data for 28 provinces over the period 1978–2007 and ordinary least squares. He finds that China's expenditure-based tax distribution has contributed to increase income inequality over the past three decades. Unlike the work above which found a significant effect of taxation on income inequality, Domeij and Heathcote (2004) shows that taxation does not affect it. In a case study on Guatemala, they assess the impact of taxes on income inequality using survey data covering the period 2009–2010. They find that taxation does not contribute to reduce income inequality in the country. Conducting a descriptive analysis, Jellema et Tassot (2018) find that in Togo, direct taxes and non-monetary transfers are the tax instruments that have the greatest influence on reducing income inequality. Cabrera et al. (2015) find that in the Guatemalan case over the period 2009–2011, although direct taxes are progressive, their redistributive effect is negligible, due to their weakness. Indirect taxes, especially those on consumption, are rather regressive. In total, the regressivity of indirect taxes outweighs the progressivity of direct taxes, so that tax policy as such does not affect income inequality.

The existing literature shows no consensus view on the effects of taxation on income inequality. Our paper adds new insights to the growing literature on the effects of taxation on income inequality, focusing on SSA. Given that the amount of tax collected by countries determines their capacity to finance social spending for the benefit of the poor, vulnerable and marginalized people (Odusola 2017), we hypothesize that taxation reduces income inequality in SSA (Hypothesis 1). In addition, taxation may have different effects on different parts of the distribution of income. When income disparities are small, it seems easier for the government to use tax policy to reduce them further. We therefore assume that taxation reduces income inequality in SSA all the more, as income inequality is already low (Hypothesis 2). Similarly, different taxes can have differentiated effects on income inequality. Direct taxes are progressive and indirect taxes regressive (Benhabib et al. 2011; Martínez-Vázquez et al. 2011). We investigate the effects of different taxes on income inequality and postulate that direct taxes decrease income inequality, while indirect taxes increase it (Hypothesis 3).



## Data and Methodology

This section presents and describes the data and the methodology.

### Data

We use annual data based on an unbalanced panel of 45 SSA countries<sup>4</sup> over the period 1980–2018. The choice of the sample size and the study period is dictated by data availability.

We use the Gini coefficient of market income as a measure of inequality (pre-tax and transfer Gini coefficient)<sup>5</sup> from the World Income Inequality Database (WIID) version 2021 (UNU-WIDER 2021a). Atkinson (1970) highlighted the limitations of the Gini coefficient. It does not consider income differences between individuals in the same income category. He noted that the Gini index is more sensitive to changes in the middle of income distribution and less sensitive to changes at the top and the bottom of income distribution. In other words, it attaches more weight to transfers to income near the mode of the distribution than at the tails. However, Gini coefficient remains the most widely measure of income inequality in the literature (Alves and Silva 2021; Ciminelli et al. 2018; Clement et al. 2015; Engel et al. 1999; Milanovic 2016; Odusola 2017). This is because the Gini coefficient of income inequality is more available on an internationally comparable basis (Christopoulos and McAdam 2017). They also allow a relatively easier comparison of income inequality between countries (Bergh and Nilsson 2010) and across time. Gini coefficients are theoretically bounded between 0 (meaning that each reference unit receives an equal share of income) and 100 (meaning that a single reference unit receives all income while all the others receive nothing)<sup>6</sup>.

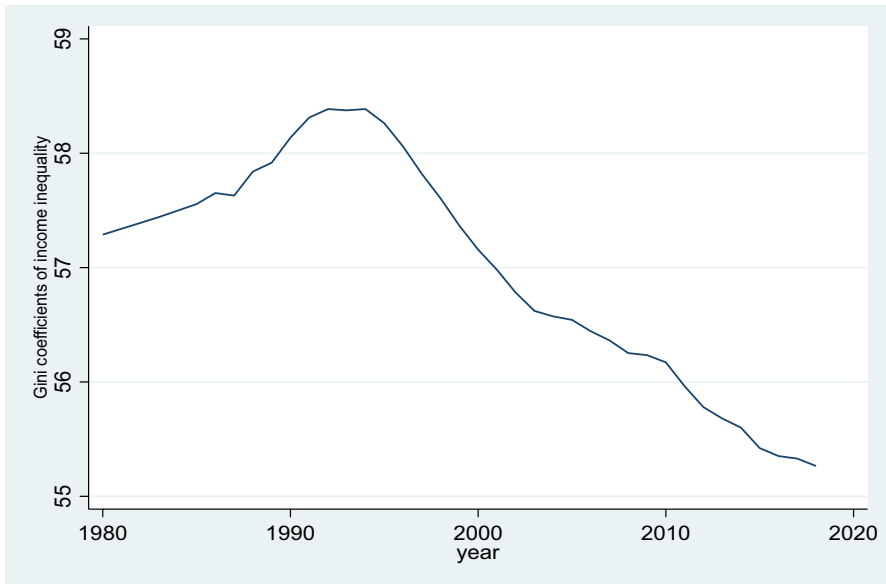
Figure 1 presents the income inequality trends in SSA over the period 1980–2018. The evolution of the Gini coefficient suggests two major trends. On the one hand, between 1980 and 1995, an upward trend in the Gini coefficient is observed, reflecting an exacerbation of income inequality. On the other hand, over the period 1996–2018, the Gini index has been declining over time. Between 1980 and 2018, the average Gini for the 45 SSA countries declined by 3.52%. This decline reflects a reduction in income inequality over this period. Although income inequality measured by Gini coefficient has been declining, on average,

<sup>4</sup> The list of countries in the sample are Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic (CAR), Chad, Comoros, Democratic Republic of Congo (DRC), Congo, Ivory Coast, Djibouti, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Uganda, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Zambia, and Zimbabwe.

<sup>5</sup> This decision somewhat mitigates the problem of reverse causality since post-tax and transfer Gini coefficient vary "mechanically" and "economically" with the tax system while pre-tax and transfer Gini coefficient vary only through the endogenous responses of labour supply or the equilibrium effect on factor prices (Poterba 2007). We thank one anonymous reviewer for this suggestion.

<sup>6</sup> See UNU-WIDER (2021a) and McNabb et al. (2021) for details on the content and the methodology.





**Fig. 1** Trends of income inequality measured by Gini coefficient in SSA, 1980–2018 Source: Authors' construction using data from UNU-WIDER (2021a)

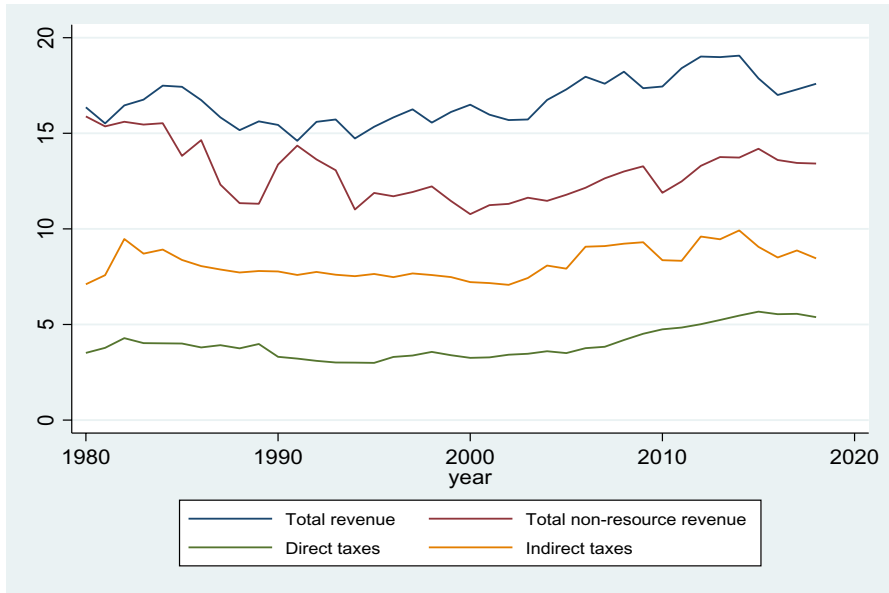
its level is still high in SSA with a mean value estimated at 57 (Table 5 in the Appendix 1). Over the period 1980–2018, the Gini coefficient of income inequality varied from 41.80 (Djibouti) to 72.47 (Burkina Faso), which means that Burkina Faso has the greatest income inequality of the countries in our sample.

For robustness checks, we use an alternative indicator of income inequality: the Palma ratio. The Palma ratio is the share of the top 10 per cent income divided by the share of the bottom 40 per cent income. This measure of income inequality has become popular as more income inequality research focuses on the growing divide between the richest and poorest in society. The trends portrayed by the income inequality measured by the Gini coefficient are confirmed with the Palma ratio (Figure 4 in the Appendix). Over the period 1980–2018, the Palma ratio varied from 2.06 (Djibouti) to 15.88 (Burkina Faso), confirming the one obtained with the Gini index that Burkina Faso has the greatest income inequality in our sample.

Data on taxes are taken from the Government Revenue Dataset (GRD), version 2021. GRD provides the most complete, high quality, and transparent cross-country dataset on public revenues available in developing countries (UNU-WIDER 2021b). GRD is updated annually, collating data from major international databases, and draws on data compiled from the public archive of IMF Article IV Staff Reports. Data on taxes are on total revenue, total non-resource revenue, direct taxes, and indirect taxes. All variables on taxes are in percentage of GDP.







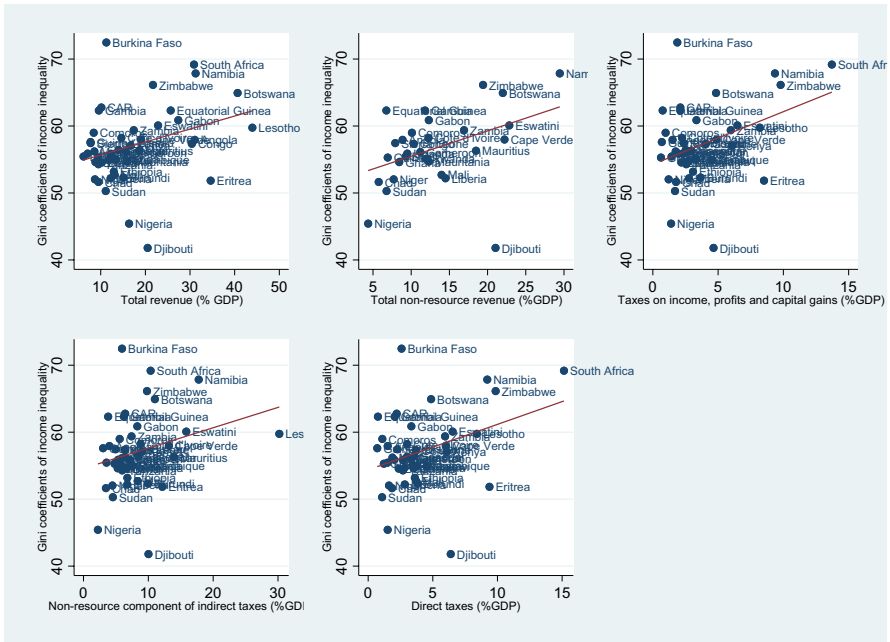
**Fig. 2** Taxes trends in Sub-Saharan Africa over time, 1980–2018 Source: Authors’ construction based on data from UNU-WIDER (2021b)

Figure 2 presents taxes trends in SSA over the period 1980–2018. From 1980 to 1990, total revenue, total non-resource-revenue, direct taxes, and indirect taxes have slightly decreased. However, from the early 1990s there have been reforms to tax policy which have also slightly increased these taxes.

Over the period 1980–2018, total revenue, total non-resource tax revenue, direct taxes, and indirect taxes respectively represent 16.68 per cent, 12.73 per cent, 3.95 per cent, and 8.16 per cent of GDP (Table 5 in the Appendix 1). In addition, these taxes are strongly correlated with one another (Table 6 in the Appendix 1). In the econometric analysis, using these variables simultaneously in the same regression can generate multicollinearity problems. Therefore, tax variables are introduced individually into the regressions in the next sections (3.2 and 4).

Figure 3 presents the correlation between taxes and income inequality in SSA over the period 1980–2018. Overall, the correlation analysis shows that taxes are positively correlated with income inequality: tax policy is potentially not redistributive. Countries in SSA which have higher taxation tend to have high income inequality. This positive correlation between taxation and income inequality in SSA may be linked to the preponderance of indirect taxes (8.16 per cent of GDP), which are non-progressive relative to direct taxes (3.95 per cent of GDP): indirect taxes are more than twice as high as direct taxes. Econometric regression enables us to analyse this further.





**Fig. 3** Correlation between taxes and income inequality in sub-Saharan Africa, 1980–2018. *Note* Data are average values per country over the period 1980–2020. Income inequality is measured by Gini coefficient Source: authors' construction based on data from UNU-WIDER (2021a, 2021b)

We include many variables to control for potential important determinants of income inequality. These variables include primary net enrolment rates<sup>7</sup>, nets flow of foreign direct investment in percentage of GDP (FDI), trade openness, total natural resources rent in percentage of GDP, urbanization rate, inflation rate, domestic credit to private sector in percentage of GDP, employment rates, public expenditure on education in percentage of GDP, remittances, real GDP per capita, real GDP per capita squared. Following Durham (1999), Pryor (2014), real GDP per capita squared is introduced to account for Kuznets (1955) effects. This allows us to check whether there is an inverted U-Shaped relationship between income inequality and economic development in SSA. These variables are from the World Development Indicators database (World Bank 2022).

Access to education is an important determinant of income inequality, not least because wages are the main source of income in modern societies. Indeed, according to Becker and Chiswick (1966) and Mincer (1974), income inequality can be influenced by the level and inequality of education in a society: they argue

<sup>7</sup> This variable is used to approximate human capital. It better reflects the quality of human capital relative to the gross rate. Also, data are more available for this variable compared to the secondary and tertiary enrollment rates. In the choice of variables, we prioritize variables which have more observations than others while considering their relevancy in the literature and the context.



that educated populations influence income inequality in a society, through their supply and demand. According to Schultz (1963), increasing human capital is one way to lower income inequality and increasing support for public education might be one way to accomplish this. Education lowers inequality, by allowing access to better jobs, enabling one to get out of poverty, and displays more equal societies promoting the populations' access to education (Vale and Camões 2023).

FDI captures the extent of each country's financial globalization (Vale and Camões 2023). They can increase income inequality in a country when there are disparities in its geographic distribution (Yu et al. 2011). FDI flows can increase income inequality insofar as they offer relatively higher incomes to skilled workers than to unskilled workers (Wu and Hsu 2012). As for trade openness, following Stolper and Samuelson (1941) trade openness reduces income inequality in developing countries where trade openness increases the incomes of holders of labour inputs and reduces those of holders of capital inputs.

Inflation tends to increase income inequality by reducing the real value of income, and by reducing the share of the bottom quintile and the real minimum wage (Alves and Silva 2021; Easterly and Fischer 2001). Financial development widens income inequality because the poor are unable to access financial services and are therefore excluded from its benefits (Rajan and Zingales 2003). This is because the poor are not able to provide collateral and are unlikely to be able to repay loans from financial markets.

Urbanisation increases income inequality. Economic development is being accompanied by a process of urbanisation, with a proportion of the rural population migrating to urban centres to work in industry. Incomes in the industrial sector are higher than those in the agricultural sector, due to differences in productivity (Kuznets 1955).

Natural resources increase income inequality through the mechanisms of the natural resource curse (Gylfason and Zoega 2002; Sala-i-Martin and Subramanian 2012). As for remittances, Kindleberger (1965) argues that they can provide the means for the poor and financially excluded households to address liquidity constraints, which can go a long way to promote entrepreneurship, innovation, and jobs creation, providing concrete grounds to reduce income inequality.

We also control for employment rate. For Hacibedel et al. (2019), a period of economic prosperity, marked by high employment rates, leads to a reduction in inequality. This increase in the employment rate will have to go hand in hand with a better quality of jobs created, to reduce wage and income inequality. Conversely, a slowdown in growth resulting in job losses and rising unemployment rates leads to an increase in inequality. The unemployed, having no income, spend their savings, which contributes to exacerbating income inequality.

We also control for political system using polity2 variable from the Centre for Systemic Peace (CSP). It is a proxy for democracy. Following Rodrik (2000), democracy is a meta institution, an institution from which other institutions in a country are born or strengthened. Democracy reduces income inequality through a consistent allocation of resources to the health and education sectors (Meltzer and Richard 1981).



Table 6 (in the Appendix 1) shows that multicollinearity problem is not a concern because overall correlation between independent variables is relatively low. In addition, the variables are stationary over the period 1980–2018<sup>8</sup>.

## Methodology

To investigate the effects of taxation in SSA, we use ordinary least squares (OLS), two-stages least squares (IV-2SLS), and instrumental variable quantile regression (IVQR).

We start with a simple model or a naive approach that does not consider the possible endogeneity between some variables in the econometric model: the OLS. Next, we use IV-2SLS to address the issue of the identification strategy to deal with the endogeneity problem related to taxes, democracy (polity2) and education. Taxation is endogenous, due to reverse causality from income inequality to taxes and vice versa (Adam et al. 2015). For example, economies characterized by greater income inequality choose to rely more on taxation of capital than labour. In countries with higher income inequality, policy makers may also choose to rely more on direct or indirect taxation (Martínez-Vázquez et al. 2012).

Endogeneity can also stem from measurement errors of democracy variable and reverse causality between education and inequality. The variable for democracy is derived from expert opinions and survey data and is therefore potentially subject to measurement errors: this variable is not observed but, instead, is estimated. Regarding the endogeneity of education, any observed relationship between education outcomes and income inequality may reflect reverse causation: current income inequality also affects current educational attainment and its dispersion. Therefore, any unobserved factors that affect income inequality and education outcomes can bias the estimated relationship between education outcomes and income inequality (Coady and Dizioli 2017). Children of affluent parents get more and better schooling than children of poor parents, which seems to imply that reducing income inequality would reduce inequality in schooling.

Two types of instruments are generally used in the empirical literature: internal and external instruments. Internal instruments are the endogenous variables taxation, democracy and education lagged at order 1 and order 2. We choose those lags to limit issues of degrees of freedom. External instrument is legal origin of a country

<sup>8</sup> Because our period of study covers a relatively a long one (1980–2018, 38 years), our estimations should rely on the assumption that explanatory variables are stationary. We use the Fisher-type unit-root test based on augmented Dickey-Fuller tests. This is because `xtunitroot fisher` does not require strongly balanced data, and the individual series can have gaps. It fits well with the structure and the characteristics of our data: panel data with individual series having gaps. The results are presented in Table 7 in the Appendix 1. Total revenue, Total non-resource revenue, direct taxes, indirect taxes, trade openness, foreign direct investment, total natural resources rents, urbanization rate, inflation rate, public expenditure on education, remittances are statistically and significantly stationary at level at 1%. Gini coefficient, democracy, financial development, primary education, employment rate, GDP per capita are statistically and significantly stationary at first differences at 1%. We thank two anonymous referees for suggesting this test.



(La Porta et al. 1999; La Porta et al. 2008). Legal origin identifies the legal origin of the Company law or commercial code of each country. There are five possible origins: (i) English common law, (ii) French commercial code; (iii) German commercial code; (iv) Scandinavian commercial code; and (v) social/communist laws (La Porta et al. 1999; Djankov et al. 2008). It is a dummy variable coded 0 or 1: 1 indicates that a country was colonized by France and French legal code was transferred; 0 indicates that a country inherited English, German, Scandinavian or social/communist laws<sup>9</sup>.

OLS and IV-2SLS estimate the parameters of the econometric model only at the mean of the conditional distribution of the dependent variable. They do not allow to analyse the distributional effects of taxation across the conditional distribution of income (for example 10th, 25th, 50th, 75th and 90th quantiles of the distribution of income inequality). However, taxes effects on income inequality could be different in countries with different levels of income inequality (low, moderate, or high inequality). In addition, Epanechnikov kernel density estimates show that the distribution one of the income inequality measures used (Palma ratio) is not normal<sup>10</sup>.

We employ instrumental variable quantile regressions (hereafter IVQR) to account for those limitations. IVQR not only accounts for the endogeneity issues highlighted above, but also estimates the effects of taxation across different parts of the distribution of income. The quantile regression is robust to distributional assumptions, produces non-sensitive estimates, properties that are absent in the linear-regression model (Hao and Naiman 2007). It is robust to outliers and does not require independence or a weak degree of dependence (Kudryavtsev 2009). IVQR is also used in previous studies on the determinants of wage inequality (Bargain and Kwenda 2014; Chletsos and Roupakias 2020; Martins and Pereira 2004), across the mortality distribution (Yang et al. 2012) and income inequality (Altunbaş and Thornton 2018; Demir et al. 2020). IVQR has been introduced by Chernozhukov and Hansen (2005). It implements the smoothed instrumental variables quantile regression estimator of Kaplan (2021, 2022) and Kaplan and Sun (2017), who show that smoothing improves both computation time and statistical accuracy. Moreover, this estimator can handle models with multiple endogenous terms, as well as allowing simultaneity and reverse causality. The quantile estimator is obtained by solving the following optimization problem for the  $\theta$ th quantile, ( $0 < \theta < 1$ ):

<sup>9</sup> This variable has been used in previous literature as an instrument of institutional quality (Acemoglu et al. 2014) or finance (Beck et al. 2000). Legal origin variable can affect income inequality through social and political institutions rather than directly; for example, the rich elites who are adopting “extractive strategies” are in most countries with French legal origin. For example, La Porta et al. (1999) link the quality of government institutions to legal origins, with French legal origin having a negative effect on institutions.

<sup>10</sup> See Figs. 5., and 6 for the Epanechnikov Kernel density estimate of the Gini coefficient and the Palma ratio, respectively, in the Appendix 2.



$$\min_{\beta \in R^k} \left[ \sum_{i \in \{i: y_i \geq x_i' \beta\}} \theta |y_i - x_i' \beta| + \sum_{i \in \{i: y_i < x_i' \beta\}} (1 - \theta) |y_i - x_i' \beta| \right] \quad (1)$$

In equation (1)  $y_i$  is the dependent variable, and  $x_i$  a vector  $k$  by 1 of explanatory variables. Quantile regressions minimise the weighted sum of the absolute deviations, obtaining for example the 10th or 90th quantiles by weighting the residuals appropriately. The conditional quantile of  $y_i$  given  $x_i$  is given by equation 2 below:

$$Q_y(\theta | x_i) = x_i' \beta_\theta \quad (2)$$

IVQR is used for the baseline results. However, for comparison and robustness check purposes, OLS and IV-2SLS are also used<sup>11</sup>. In IVQR, the 50th quantile is the median effects, while estimates from OLS and IV-2SLS are the mean.

Equation (3) presents the econometric model that is used for the regressions:

$$\begin{aligned} INEQ_{it} = & \beta_0 + \beta_1 T_{it} + \beta_2 EDUC_{it} + \beta_3 DEMOC_{it} + \beta_4 FDI_{it} + \beta_5 OPEN_{it} + \beta_6 NRR_{it} + \beta_7 URB_{it} \\ & + \beta_8 INF_{it} + \beta_9 FD_{it} + \beta_{10} ER_{it} + \beta_{11} GEE_{it} + \beta_{12} \ln(REM)_{it} + \beta_{13} \ln(GDPpc)_{it} + \beta_{14} \ln(GDPpc)_{it}^2 + \mu_{it} \end{aligned} \quad (3)$$

With  $i$ , a country;  $t$ , the year;  $\mu_{it}$  is the error term; and  $\beta_0, \beta_1, \dots, \beta_{14}$  are the parameters of the model. INEQ is the income inequality measure.  $T$  is a tax measure. Taxes variables include, total revenue, total non-resource revenue, direct taxes, and indirect taxes. EDUC is the primary net enrolment rates, a proxy for human capital in SSA. FDI is the net flow of foreign direct investment (percentage of GDP). Open is trade openness (percentage of GDP). NRR is total natural resources rents (percentage of GDP). URB is urbanization rate. DEMOC (polity2) is a proxy of democracy. INF is inflation rate, a measure of macroeconomic stability. FD is financial development measured by domestic credit to private sector (percentage of GDP). ER is the employment rate. GEE is the total public expenditure on education (percentage of GDP). REM stands for remittances. RGDPpc is real GDP per capita, a proxy of economic development.

## Results and Discussions on the Effects of Taxation on Income Inequality in SSA

The estimated effects of taxes on income inequality using the OLS, IV-2SLS and the IVQR are presented in Tables 1, 2, 3 and 4. The results of the diagnostic tests show that all the models are well specified. The key statistics of interest are the Hansen J statistics test for over-identification which has  $p$ -values higher than 0.10, and the Cragg-Donald Wald F statistic of weak exogeneity which is also well above 10. These statistics indicate that the instruments are valid and relevant, providing confidence that they are sufficiently strong.

<sup>11</sup> For additional robustness checks, OLS with time fixed effects, cluster for years and cluster for countries, quantile regression, and instrumental variables with internal instruments are used.



**Table 1** Total revenue and income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                         |                         |                         |                        |                        |                         |
|---------------------------------|--|-------------------------|-------------------------|-------------------------|------------------------|------------------------|-------------------------|
|                                 | (1)  | (2)                     | (3)                     | (4)                     | (5)                    | (6)                    | (7)                     |
| OLS                             | IV-2SLS  | IVQR 0.10               | IVQR 0.25               | IVQR 0.50               | IVQR 0.75              | IVQR 0.90              |                         |
| Total revenue                   | 0.192***<br>(0.0242)                           | 0.183***<br>(0.0335)    | 0.195***<br>(0.0367)    | 0.226***<br>(0.0225)    | 0.188***<br>(0.0341)   | 0.236***<br>(0.0497)   | 0.313***<br>(0.0627)    |
| Democracy (polity2)             | -0.245***<br>(0.0534)                          | -0.346***<br>(0.0709)   | -0.197***<br>(0.0701)   | -0.163***<br>(0.0424)   | -0.179***<br>(0.0677)  | -0.212***<br>(0.0956)  | -0.249*<br>(0.140)      |
| Trade openness                  | -0.0772***<br>(0.00594)                        | -0.0752***<br>(0.00686) | -0.0818***<br>(0.00521) | -0.0791***<br>(0.00651) | -0.0704***<br>(0.0189) | -0.0643***<br>(0.0165) | -0.0767***<br>(0.00826) |
| Foreign direct investment       | 0.00357<br>(0.0368)                            | 0.00660<br>(0.0434)     | 0.120***<br>(0.0331)    | 0.109***<br>(0.0274)    | 0.0263<br>(0.0441)     | 0.00161<br>(0.0499)    | -0.128**<br>(0.0572)    |
| Total natural resources rents   | 0.00810<br>(0.0243)                            | 0.00864<br>(0.0327)     | -0.0366<br>(0.0261)     | -0.0304<br>(0.0244)     | -0.0132<br>(0.0330)    | 0.0236<br>(0.0675)     | 0.167**<br>(0.0807)     |
| Urbanization rate               | 0.00663<br>(0.0186)                            | 0.00526<br>(0.0215)     | 0.0269<br>(0.0210)      | 0.0411**<br>(0.0197)    | 0.0447*<br>(0.0247)    | 0.0205<br>(0.0394)     | -0.105***<br>(0.0414)   |
| Inflation rate                  | 0.107**<br>(0.0460)                            | 0.112**<br>(0.0535)     | 0.140***<br>(0.0296)    | 0.111***<br>(0.0296)    | 0.0955***<br>(0.0300)  | 0.0466<br>(0.0404)     | 0.0301<br>(0.0646)      |
| Financial development           | 0.0474***<br>(0.0156)                          | 0.0628***<br>(0.0216)   | 0.0205<br>(0.0163)      | 0.0275**<br>(0.0136)    | 0.0295*<br>(0.0175)    | 0.0425<br>(0.0325)     | 0.0960***<br>(0.0254)   |
| Public expenditure on education | 0.707***<br>(0.143)                            | 0.913***<br>(0.174)     | 0.678***<br>(0.167)     | 0.575***<br>(0.137)     | 0.779***<br>(0.145)    | 0.516**<br>(0.209)     | 0.531<br>(0.382)        |
| Primary education               | -0.00205<br>(0.0241)                           | -0.0196<br>(0.0289)     | 0.0551*<br>(0.0308)     | 0.0116<br>(0.0159)      | 0.0184<br>(0.0206)     | -0.0339<br>(0.0266)    | -0.145***<br>(0.0358)   |
| Employment rate                 | -0.0561*<br>(0.0293)                           | -0.0411<br>(0.0373)     | -0.0640**<br>(0.0295)   | -0.0332**<br>(0.0163)   | -0.0412<br>(0.0300)    | -0.0532<br>(0.0476)    | 0.00930<br>(0.0530)     |



Table 1 (continued)

| Independent variables           | Dependent variable: Gini coefficient of income |                     |                      |                      |                     |                     |                    |
|---------------------------------|--|---------------------|----------------------|----------------------|---------------------|---------------------|--------------------|
|                                 | (1)  | (2)                 | (3)                  | (4)                  | (5)                 | (6)                 | (7)                |
|                                 | OLS  | IV-2SLS             | IVQR 0.10            | IVQR 0.25            | IVQR 0.50           | IVQR 0.75           | IVQR 0.90          |
| Ln(GDP per capita)              | -7.122<br>(6.691)                              | -5.221<br>(6.858)   | 1.319<br>(4.433)     | 5.012<br>(3.999)     | -10.22<br>(6.373)   | -6.467<br>(7.864)   | -3.907<br>(13.03)  |
| Ln(GDP per capita squared)      | 0.511<br>(0.465)                               | 0.394<br>(0.477)    | -0.00873<br>(0.314)  | -0.245<br>(0.299)    | 0.709<br>(0.477)    | 0.461<br>(0.528)    | 0.307<br>(0.989)   |
| Ln(Remittances)                 | -0.276<br>(0.225)                              | -0.265<br>(0.251)   | -0.366***<br>(0.125) | -0.314***<br>(0.103) | -0.214<br>(0.146)   | -0.200<br>(0.273)   | -0.167<br>(0.301)  |
| Constant                        | 82.70***<br>(23.62)                            | 74.70***<br>(24.04) | 39.66**<br>(15.65)   | 29.53**<br>(14.58)   | 89.62***<br>(24.76) | 83.20***<br>(29.84) | 83.84**<br>(40.07) |
| Number of countries             | 45   | 45                  | 45                   | 45                   | 45                  | 45                  | 45                 |
| Observations                    | 322  | 272                 | 272                  | 272                  | 272                 | 272                 | 272                |
| Prob > F                        | 0.0000   |                     |                      |                      |                     |                     |                    |
| Kleibergen-Paap rk LM statistic |  | 0.0000              |                      |                      |                     |                     |                    |
| Cragg-Donald Wald F statistic   |  | 274.383             |                      |                      |                     |                     |                    |
| Hansen test $p$ -value          |  | 0.761               |                      |                      |                     |                     |                    |

Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .



**Table 2** Total non-resource revenue and income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                        |                       |                        |                         |                        |                         |
|---------------------------------|--|------------------------|-----------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                 | (1)  | (2)                    | (3)                   | (4)                    | (5)                     | (6)                    | (7)                     |
| OLS                             | IV-2SLS  | IVQR 0.10              | IVQR 0.25             | IVQR 0.50              | IVQR 0.75               | IVQR 0.90              |                         |
| Total non-resource revenue      | 0.162**<br>(0.0665)                            | 0.184*<br>(0.0986)     | -0.0324<br>(0.201)    | 0.0776<br>(0.134)      | 0.213**<br>(0.0843)     | 0.338**<br>(0.136)     | 0.363***<br>(0.138)     |
| Democracy (polity2)             | 0.0249<br>(0.0480)                             | 0.0482<br>(0.0602)     | -0.0167<br>(0.0725)   | -0.0735<br>(0.0746)    | 0.00393<br>(0.0781)     | 0.00814<br>(0.0894)    | 0.0740<br>(0.0687)      |
| Trade openness                  | -0.0574***<br>(0.00984)                        | -0.0453***<br>(0.0126) | -0.0317<br>(0.0203)   | -0.0488***<br>(0.0178) | -0.0629***<br>(0.00834) | -0.0627***<br>(0.0127) | -0.0544***<br>(0.00723) |
| Foreign direct investments      | -0.0148<br>(0.0582)                            | -0.0249<br>(0.0787)    | -0.00759<br>(0.0576)  | -0.0258<br>(0.0527)    | -0.126**<br>(0.0501)    | -0.185***<br>(0.0711)  | -0.171**<br>(0.0698)    |
| Total natural resources rents   | 0.0983***<br>(0.0204)                          | 0.123***<br>(0.0326)   | 0.000574<br>(0.0640)  | 0.0414<br>(0.0521)     | 0.0834***<br>(0.0308)   | 0.0989***<br>(0.0284)  | 0.105***<br>(0.0228)    |
| Urbanization rate               | -0.0776**<br>(0.0321)                          | -0.111***<br>(0.0371)  | -0.0777**<br>(0.0348) | -0.0117<br>(0.0400)    | -0.0364<br>(0.0357)     | -0.127***<br>(0.0458)  | -0.168***<br>(0.0450)   |
| Inflation rate                  | 0.0710***<br>(0.0256)                          | 0.0702**<br>(0.0281)   | 0.148***<br>(0.0317)  | 0.110***<br>(0.0356)   | 0.0629*<br>(0.0346)     | 0.0357<br>(0.0284)     | 0.0343<br>(0.0209)      |
| Financial development           | -0.148***<br>(0.0342)                          | -0.169***<br>(0.0454)  | -0.297***<br>(0.0959) | -0.170**<br>(0.0719)   | -0.107***<br>(0.0374)   | -0.0915***<br>(0.0263) | -0.0973***<br>(0.0212)  |
| Public expenditure on education | 0.621***<br>(0.149)                            | 0.519***<br>(0.193)    | 0.483***<br>(0.139)   | 0.579***<br>(0.171)    | 0.541***<br>(0.156)     | 0.721***<br>(0.235)    | 0.770***<br>(0.178)     |
| Primary education               | 0.0278<br>(0.0183)                             | 0.0217<br>(0.0199)     | 0.112***<br>(0.0397)  | 0.0318<br>(0.0305)     | 0.0105<br>(0.0219)      | -0.00610<br>(0.0166)   | 1.90e-05<br>(0.0133)    |
| Employment rate                 | 0.0794**<br>(0.0383)                           | 0.137**<br>(0.0545)    | 0.170**<br>(0.0701)   | 0.134*<br>(0.0807)     | 0.0637<br>(0.0567)      | 0.0292<br>(0.0632)     | 0.0629<br>(0.0465)      |



Table 2 (continued)

| Independent variables                           | Dependent variable: Gini coefficient of income |                     |                     |                    |                    |                   |                     |
|---|--|---------------------|---------------------|--------------------|--------------------|-------------------|---------------------|
|   | (1)  | (2)                 | (3)                 | (4)                | (5)                | (6)               | (7)                 |
|   | OLS  | IV-2SLS             | IVQR 0.10           | IVQR 0.25          | IVQR 0.50          | IVQR 0.75         | IVQR 0.90           |
| Ln(GDP per capita)                              | -4.762<br>(7.782)                              | -1.811<br>(8.926)   | -28.04*<br>(15.83)  | -20.97*<br>(11.41) | -7.839<br>(7.438)  | 10.11<br>(11.73)  | 20.36*<br>(11.11)   |
| Ln(GDP per capita squared)                      | 0.749<br>(0.553)                               | 0.628<br>(0.649)    | 2.486**<br>(1.241)  | 1.872**<br>(0.861) | 0.877<br>(0.583)   | -0.367<br>(0.833) | -1.049<br>(0.780)   |
| Ln(Remittances)                                 | -0.493***<br>(0.176)                           | -0.441**<br>(0.205) | -0.576**<br>(0.247) | -0.405<br>(0.275)  | -0.152<br>(0.200)  | -0.240<br>(0.198) | -0.461**<br>(0.201) |
| Constant  | 47.36*<br>(26.95)                              | 29.76<br>(30.11)    | 113.5*<br>(60.34)   | 98.91**<br>(42.43) | 63.50**<br>(31.04) | 5.701<br>(42.14)  | -33.75<br>(39.61)   |
| Number of countries                             | 45   | 45                  | 45                  | 45                 | 45                 | 45                | 45                  |
| Observations                                    | 133  | 115                 | 115                 | 115                | 115                | 115               | 115                 |
| Prob > F  | 0.0000   |                     |                     |                    |                    |                   |                     |
| Kleibergen-Paap rk LM statistic <i>p</i> -value |  | 0.0001              |                     |                    |                    |                   |                     |
| Cragg-Donald Wald F statistic                   |  | 51.780              |                     |                    |                    |                   |                     |
| Hansen test <i>p</i> -value                     |  | 0.4867              |                     |                    |                    |                   |                     |

Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

**Table 3** Direct taxes and income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                         |                        |                         |                        |                        |                         |
|---------------------------------|--|-------------------------|------------------------|-------------------------|------------------------|------------------------|-------------------------|
|                                 | (1)  | (2)                     | (3)                    | (4)                     | (5)                    | (6)                    | (7)                     |
| OLS                             | IV-2SLS  | IVQR 0.10               | IVQR 0.25              | IVQR 0.50               | IVQR 0.75              | IVQR 0.90              |                         |
| Direct taxes                    | 0.578***<br>(0.124)                            | 0.596***<br>(0.143)     | 0.418*<br>(0.223)      | 0.537***<br>(0.182)     | 0.736***<br>(0.186)    | 0.905***<br>(0.158)    | 0.917***<br>(0.180)     |
| Democracy (polity2)             | -0.201***<br>(0.0533)                          | -0.248***<br>(0.0705)   | -0.124*<br>(0.0719)    | -0.0925<br>(0.0576)     | -0.154<br>(0.103)      | -0.220*<br>(0.114)     | -0.104<br>(0.0811)      |
| Trade openness                  | -0.0751***<br>(0.00717)                        | -0.0752***<br>(0.00724) | -0.0894***<br>(0.0104) | -0.0765***<br>(0.00894) | -0.0707***<br>(0.0174) | -0.0813***<br>(0.0103) | -0.0835***<br>(0.00636) |
| Foreign direct investments      | 0.00719<br>(0.0368)                            | 0.00410<br>(0.0423)     | 0.153***<br>(0.0554)   | 0.0971**<br>(0.0416)    | -0.0287<br>(0.0352)    | -0.0499<br>(0.0585)    | -0.168***<br>(0.0450)   |
| Total natural resources rents   | 0.0396<br>(0.0309)                             | 0.0102<br>(0.0384)      | 0.00767<br>(0.0393)    | -0.0167<br>(0.0359)     | 0.0188<br>(0.0353)     | 0.0753<br>(0.0625)     | 0.158***<br>(0.0544)    |
| Urbanization rate               | -0.00599<br>(0.0201)                           | -0.0161<br>(0.0232)     | 0.0410***<br>(0.0195)  | 0.0191<br>(0.0215)      | 0.0177<br>(0.0286)     | -0.0774<br>(0.0597)    | -0.111***<br>(0.0370)   |
| Inflation rate                  | 0.0539<br>(0.0484)                             | 0.0475<br>(0.0561)      | 0.0756<br>(0.0750)     | 0.0461<br>(0.0483)      | 0.0281<br>(0.0457)     | 0.0168<br>(0.0540)     | 0.0270<br>(0.0587)      |
| Financial development           | -0.0191<br>(0.0251)                            | -0.00476<br>(0.0295)    | -0.0124<br>(0.0355)    | 0.00185<br>(0.0272)     | -0.0420<br>(0.0297)    | -0.0346<br>(0.0228)    | -0.0206<br>(0.0393)     |
| Public expenditure on education | 0.719***<br>(0.168)                            | 0.807***<br>(0.204)     | 0.498***<br>(0.168)    | 0.342<br>(0.239)        | 0.631***<br>(0.244)    | 0.564***<br>(0.213)    | 0.633**<br>(0.311)      |
| Primary education               | -0.0298<br>(0.0296)                            | -0.0426<br>(0.0334)     | 0.0263<br>(0.0483)     | -0.00739<br>(0.0192)    | -0.0144<br>(0.0200)    | -0.101*<br>(0.0560)    | -0.171***<br>(0.0345)   |
| Employment rate                 | -0.0264<br>(0.0347)                            | -0.00629<br>(0.0421)    | -0.0416<br>(0.0445)    | 0.000782<br>(0.0242)    | -0.00743<br>(0.0213)   | 0.0213<br>(0.0424)     | 0.0305<br>(0.0466)      |



Table 3 (continued)

| Independent variables           | Dependent variable: Gini coefficient of income |                      |                   |                    |                      |                      |                      |
|---------------------------------|--|----------------------|-------------------|--------------------|----------------------|----------------------|----------------------|
|                                 | (1)  | (2)                  | (3)               | (4)                | (5)                  | (6)                  | (7)                  |
|                                 | OLS  | IV-2SLS              | IVQR 0.10         | IVQR 0.25          | IVQR 0.50            | IVQR 0.75            | IVQR 0.90            |
| Ln(GDP per capita)              | -28.38***<br>(10.04)                           | -27.31***<br>(10.18) | -3.443<br>(14.37) | -1.468<br>(12.56)  | -34.91***<br>(6.472) | -42.83***<br>(11.91) | -39.37***<br>(9.598) |
| Ln(GDP per capita squared)      | 2.105***<br>(0.712)                            | 2.042***<br>(0.721)  | 0.445<br>(1.011)  | 0.296<br>(0.882)   | 2.568***<br>(0.489)  | 3.197***<br>(0.846)  | 2.914***<br>(0.735)  |
| Ln(Remittances)                 | 0.0547<br>(0.305)                              | 0.162<br>(0.336)     | -0.276<br>(0.279) | -0.0399<br>(0.219) | 0.152<br>(0.289)     | 0.448<br>(0.288)     | 0.200<br>(0.327)     |
| Constant                        | 155.1***<br>(34.99)                            | 150.6***<br>(35.12)  | 56.20<br>(45.12)  | 51.03<br>(42.62)   | 174.5***<br>(22.07)  | 209.8***<br>(44.17)  | 207.3***<br>(31.34)  |
| Number of countries             | 45   | 45                   | 45                | 45                 | 45                   | 45                   | 45                   |
| Observations                    | 271  | 233                  | 233               | 233                | 233                  | 233                  | 233                  |
| Prob > F                        | 0.0000   |                      |                   |                    |                      |                      |                      |
| Kleibergen-Paap rk LM statistic |  | 0.0000               |                   |                    |                      |                      |                      |
| Cragg-Donald Wald F statistic   |  | 269.305              |                   |                    |                      |                      |                      |
| Hansen test $p$ -value          |  | 0.4125               |                   |                    |                      |                      |                      |

Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

**Table 4** Indirect taxes and income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                         |                        |                        |                        |                        |                         |
|---------------------------------|--|-------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|
|                                 | (1)  | (2)                     | (3)                    | (4)                    | (5)                    | (6)                    | (7)                     |
| OLS                             | IV-2SLS  | IVQR 0.10               | IVQR 0.25              | IVQR 0.50              | IVQR 0.75              | IVQR 0.90              |                         |
| Indirect taxes                  | 0.196***<br>(0.0487)                           | 0.153**<br>(0.0641)     | 0.237**<br>(0.102)     | 0.209***<br>(0.0615)   | 0.109**<br>(0.0463)    | 0.0789<br>(0.0756)     | 0.0902<br>(0.101)       |
| Democracy (polity2)             | -0.213***<br>(0.0703)                          | -0.147*<br>(0.0841)     | -0.0156<br>(0.0744)    | -0.0598<br>(0.0474)    | -0.0414<br>(0.0662)    | -0.000521<br>(0.103)   | -0.105<br>(0.110)       |
| Trade openness                  | -0.0891***<br>(0.00759)                        | -0.0925***<br>(0.00777) | -0.0893***<br>(0.0176) | -0.0881***<br>(0.0101) | -0.0932***<br>(0.0103) | -0.102***<br>(0.00961) | -0.0978***<br>(0.00808) |
| Foreign direct investments      | 0.0933***<br>(0.0339)                          | 0.115***<br>(0.0382)    | 0.140***<br>(0.0418)   | 0.139***<br>(0.0424)   | 0.119**<br>(0.0466)    | 0.143***<br>(0.0332)   | 0.0883**<br>(0.0415)    |
| Total natural resources rents   | -0.00260<br>(0.0321)                           | -0.0528<br>(0.0413)     | -0.0633<br>(0.0443)    | -0.0938**<br>(0.0434)  | -0.0861**<br>(0.0406)  | -0.0516<br>(0.0337)    | 0.0181<br>(0.0654)      |
| Urbanization rate               | 0.0316<br>(0.0231)                             | 0.00660<br>(0.0285)     | -0.000479<br>(0.0315)  | 0.0184<br>(0.0231)     | 0.0114<br>(0.0286)     | -0.0468<br>(0.0397)    | -0.0591<br>(0.0661)     |
| Inflation rate                  | 0.121**<br>(0.0505)                            | 0.138**<br>(0.0540)     | 0.104**<br>(0.0431)    | 0.0876***<br>(0.0287)  | 0.0903***<br>(0.0269)  | 0.0965***<br>(0.0276)  | 0.0663<br>(0.0497)      |
| Financial development           | 0.0230<br>(0.0166)                             | 0.0258<br>(0.0178)      | 0.0283<br>(0.0206)     | 0.0380<br>(0.0240)     | 0.0184<br>(0.0250)     | 0.00165<br>(0.0248)    | 0.0225<br>(0.0213)      |
| Public expenditure on education | 0.860***<br>(0.130)                            | 0.887***<br>(0.136)     | 0.605**<br>(0.243)     | 0.685***<br>(0.187)    | 0.899***<br>(0.149)    | 0.913***<br>(0.137)    | 1.014***<br>(0.169)     |
| Primary education               | -0.0196<br>(0.0294)                            | -0.0233<br>(0.0306)     | 0.0294<br>(0.0346)     | 0.00156<br>(0.0154)    | -0.0162<br>(0.0198)    | -0.0107<br>(0.0201)    | -0.0749<br>(0.0823)     |
| Employment rate                 | -0.0719<br>(0.0440)                            | -0.0983**<br>(0.0484)   | -0.0784***<br>(0.0299) | -0.0979***<br>(0.0347) | -0.122***<br>(0.0360)  | -0.212***<br>(0.0725)  | -0.154***<br>(0.0584)   |



Table 4 (continued)

| Independent variables           | Dependent variable: Gini coefficient of income |                     |                   |                   |                     |                     |                     |
|---------------------------------|--|---------------------|-------------------|-------------------|---------------------|---------------------|---------------------|
|                                 | (1)  | (2)                 | (3)               | (4)               | (5)                 | (6)                 | (7)                 |
| Ln(GDP per capita)              | OLS  | IV-2SLS             | IVQR 0.10         | IVQR 0.25         | IVQR 0.50           | IVQR 0.75           | IVQR 0.90           |
|                                 | -17.00*<br>(10.08)                             | -17.31<br>(10.50)   | 10.10<br>(10.05)  | 5.216<br>(10.68)  | -19.23**<br>(9.632) | -14.90*<br>(8.921)  | -22.36<br>(16.79)   |
| Ln(GDP per capita squared)      | 1.282*<br>(0.715)                              | 1.294*<br>(0.744)   | -0.582<br>(0.675) | -0.298<br>(0.744) | 1.388**<br>(0.626)  | 1.107<br>(0.682)    | 1.653<br>(1.257)    |
| Ln(Remittances)                 | -0.00378<br>(0.332)                            | 0.111<br>(0.371)    | -0.151<br>(0.203) | -0.129<br>(0.257) | 0.272<br>(0.208)    | -0.0467<br>(0.389)  | 0.0211<br>(0.431)   |
| Constant                        | 116.5***<br>(34.37)                            | 121.3***<br>(35.52) | 14.63<br>(30.45)  | 38.72<br>(36.96)  | 131.5***<br>(35.32) | 124.9***<br>(27.20) | 155.1***<br>(62.22) |
| Number of countries             | 45   | 45                  | 45                | 45                | 45                  | 45                  | 45                  |
| Observations                    | 230  | 210                 | 210               | 210               | 210                 | 210                 | 210                 |
| Prob > F                        | 0.0000   |                     |                   |                   |                     |                     |                     |
| Kleibergen-Paap rk LM statistic |  | 0.0000              |                   |                   |                     |                     |                     |
| Cragg-Donald Wald F statistic   |  | 113.493             |                   |                   |                     |                     |                     |
| Hansen test $p$ -value          |  | 0.1155              |                   |                   |                     |                     |                     |

Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Table 1 presents the distributional effect of government total revenue in SSA. This table shows that government total revenue increases income inequality in SSA. Their increasing effects are greater in countries with higher income inequality: this increasing effect is greater in the most unequal countries (the 75th and 90th quantiles) than in the least unequal countries (the 10th and 25th quantiles). This rising effect is lower at the median distribution of income compared to those of the two previous groups. At the mean distribution of income inequality (IV-2SLS), total government revenue has an increasing effect although this effect is lower than that of the median one (IVQR 0.50).

This result is linked to the level and the structure of taxes in SSA. As suggested by Clements et al. (2015), the effect of taxation on income inequality in developing countries is limited. This limited, modest, and regressive effect of taxation is linked to low revenue collection and the preponderance of indirect taxes (Bastagli et al. 2012; Feger 2014; Goñi et al. 2011). Tax revenues in SSA are low compared to other regions (IMF, 2023; Modica et al. 2018; UNECA 2019). Low tax revenues limit the resources available to implement social programs benefiting the poorest members of society. Low fiscal capacity is linked to narrow tax base due to the size of middle class, the size of shadow economy and tax evasions in the region. A sizeable middle class, through its contribution via taxes, broadens the tax base and fosters taxation capacity (Baskaran and Bigsten 2013). However, in SSA, the middle class represents 11.26% of the population, compared with 19.6% in East Asia and the Pacific, 13.73% in Latin America and the Caribbean, and 22% in the Middle East and North Africa (Bhorat et al. 2021). A large proportion of households do not contribute to tax, especially income tax, because they have no or only have a modest income (Avom 2011).

In SSA, the shadow economy accounts for 40 to 62 % of GDP while informal employment represents for more than 90 percent of total employment (Medina and Schneider 2018; Okunogbe and Santoro 2023). The tax authorities are finding it difficult to identify all the income generated in the sector and to tax it appropriately. As a result, the size of the informal sector limits tax collection in SSA (Gupta et al. 2022). According to De Freitas (2012), the presence of this sector allows wealthy tax evasion and undermines redistribution, particularly in countries where income inequality is already glaring.

Similarly, the wealthiest escape taxation through tax avoidance practices, by placing their wealth in tax havens. Zucman (2014) reports that in Africa, offshore wealth is established at \$500 billion annually. This amount represents 30% of financial wealth and generates \$15 billion of tax revenue loss due to the evasion of personal income taxes on investment income earned offshore and evasion of wealth, inheritance, and estate taxes. Henley and Partners (2023) highlights that between 2012 and 2022, 18,500 high-net-worth individuals<sup>12</sup> have left Africa.

Furthermore, according to Odusola (2017), tax system in Africa is regressive. The tax system in SSA is based on indirect taxes, as the structural, institutional, and political characteristics of these countries do not allow for substantial direct tax

<sup>12</sup> individuals with wealth of USD 1 million or more.



collection (Feger 2014). In this vein, Gupta et al. (2022) reveal that the increase in the tax revenue in SSA between 2000 and 2017 is driven by increasing tax on goods and services collections which constitutes 40 % of total tax. Given that the average propensity to consume is generally higher among the poor than the rich, a tax system in which indirect taxation is preponderant exacerbates income inequality as shown in the correlational analysis in section "Data". Tax reforms implemented in SSA do not consider the redistributive dimension of taxation and are not able to substantially increase tax revenues as a proportion of GDP (Gupta and Jalles 2022).

These results are in line with the findings of Martorano (2018) and Goñi et al. (2011) that the equalizing effect of taxation is limited in Latin America due to low tax revenue. They are also in line with the results of Odusola (2017) that low tax collection in Africa undermines the distributional effect of taxation on income inequality.

Table 2 presents the effects of total non-resource tax revenue on income inequality in SSA over the period 1980–2018. The results show that the non-resource component of total income does not affect income inequality in SSA countries with low-income inequality (the 10th and 25th quantiles). In contrast, in countries with high income inequality (in the 75th and 90th quantiles), this component increases income inequality. It also increases income inequality at the median (the 50th quantile). This median effect is greater than the mean effect, which is also positive and statistically significant. These significant positive results (50th, 75th and 90th quantiles) are broadly consistent with those obtained with total revenue. Total non-resource revenue constitutes a significant share of total revenue. Non-resource taxes represent 12.73 per cent of GDP compared to 16.68 per cent for total revenue (Table 5 in the Appendix 1). In countries with an ineffective tax system, taxation tends to increase income inequality, especially when inequality is higher in these countries.

Table 3 below presents the effects of direct taxes on income inequality in SSA. The results show that direct taxes increase income inequality, and their increasing effects are greater in countries with higher income inequality. In addition, the effect at the median distribution of income is positive and higher than that at the mean in the regression with total direct taxes. This result implies that in SSA, direct taxes do not necessarily favour progressivity of the tax system. This is contrary to the theoretical prediction that direct taxes are progressive and that they reduce income inequality. They do not reduce the concentration of wealth in the top end of the distribution and are not equalizing. Rather, they widen income inequality in the region.

The positive effect of direct taxes on income inequality in SSA can be explained by the narrowness of the tax base as well as the small size of these taxes. In addition, the appropriateness of direct taxes depends on the ability of the government to target pro-poor spending. This result contrasts with those established by Cornia et al. (2011) and Goñi et al. (2011) that direct taxes reduce income inequality in the Latin American contexts.

Table 4 presents the results of the effect of indirect taxes on income inequality. From this table, it emerges that while indirect taxes increase income inequality in the least unequal countries (10th, 25th quantiles), they have no significant effect in the most unequal countries (75th, 90th quantiles). The amplifying effect of indirect taxes at the median distribution is smaller than at the mean distribution. In general,





our results are in line with previous studies that indirect taxes increase income inequality (Bachas et al. 2020; Ciminelli et al. 2018; Ramos and Roca-Sagales 2008). However, they disagree with the result established by Cornia et al. (2011) that indirect taxes reduce income inequality in the Latin American context.

To sum up, we find that total revenue and its direct and indirect component widen income inequality over the period 1980–2018 in SSA. Globally, the increasing effects of taxation are higher in the most unequal countries of the region compared to the least unequal ones, that is income inequality feeds on itself. These results are robust to the different estimates (OLS, IV-2SLS, IVQR)<sup>13</sup>. Furthermore, they are also robust to the use of Palma ratio as an alternative measure of income inequality (Tables 8, 9, 10, 11 in the Appendix 1). However, when the Palma ratio is used as the dependent variable, the amplitude of the estimated coefficients is smaller. This is due to the difference in the magnitude of the Gini index and the Palma ratio themselves: the mean value of the Gini index is 57 whereas the one of the Palma ratio is 5.62. In addition to taxation in the econometric model (Eq. 3), we include a set of control variables which may affect the evolution of income inequality in SSA. Cross-tabulating the effects of the control variables in all the four tables (Tables 1, 2, 3 and 4) shows that globally three of these variables are statistically significant. These are trade openness, democracy, and public expenditure on education (Table 12 in the Appendix 1).

The results indicate that trade openness reduces income inequality in SSA. Countries in SSA are small and import dependent. Greater trade openness of a country therefore leads to increased imports which contribute to lower prices at the national level, leading to gains for the consumer. This result is in accordance with Stolper-Samuelson theorem (Stolper and Samuelson 1941) which predicts that trade openness decreases inequality in developing countries.

Public expenditure on education increases income inequality in SSA. As Jimenez (1986) posits it, the poor do not always benefit from public spending on education, so it does not always help to reduce income inequality. Moreover, in many countries, the increase of expenditure in education does not translate into a reduction of income inequality (Fields 1980). In SSA countries, weak institutions mean that a large share of public spending on education is not actually spent on education. This raises the issue of the use of public resources to reach the poorest in the region, where governance is poor. In such an environment, increased public spending on education hardly means improved access or quality of education for the poorest.

Democracy favours income distribution in SSA. Democratic institutions are a major source of responsiveness and accountability in the political economy literature, providing electoral incentives to redistribute income. Leaders in democratic countries need widespread support to achieve and sustain power and are, therefore, more likely to move beyond their narrow set of personal interests by appealing to a wider public through public policies (Meltzer and Richard 1981). Widespread enfranchisement in democracies is likely to result in higher public goods provision,

<sup>13</sup> OLS with time fixed effects, cluster for years and cluster for countries, quantile regression and instrumental variables with internal instruments produce qualitatively similar results.



which may help the poor to benefit from economic growth via investments in human capital. These policies are expected to produce more equal income distribution over time.

In a third robustness analysis, we add two control variables: financial openness measured by the Chinn and Ito (2008) index and foreign aid (see Tables 13, 14, 15 and 16). Foreign aid is the net official development assistance and official aid received (constant 2020 US\$) from the WDI of the World Bank (2022). The results show that financial openness has no significant effect on income inequality in SSA over the period 1980–2018. In contrast, foreign aid reduces income inequality in the region over the same period<sup>14</sup>. Foreign aid is an injection of capital into the economy and, if used economically, can help governments alleviate income inequality and poverty. In most SSA countries, annual budgets are largely supplemented by foreign aid. Hence, foreign aid serves as a significant component of government finances and expenditures. Our baseline results (Tables 1, 2, 3 and 4) are robust to the inclusion of these two variables.

Finally, since panel data is unbalanced, due to the missing data in some variables, we use bi-annual data to mitigate the potential effect of missing data and to analyze the robustness of our basic results (Fourth robustness check) The results obtained are presented in Tables 17, 18, 19 and 20. They are broadly like the baseline results (Tables 1, 2, 3 and 4).

## Conclusion

Sub-Saharan Africa is one of the regions where income inequality is the most pronounced. One of the instruments available to governments to reduce income inequality is taxation. Building on these elements, we have investigated the effects of taxation on income inequality in Sub-Saharan Africa. We have used ordinary least squared, two-stage least squared and instrumental variable quantile regression for the estimates. We show that taxation widens income inequality in SSA over the period 1980–2018. Total revenue, total non-resource tax revenue, direct taxes, and indirect taxes, increase income inequality in the region. Therefore, total revenue and its direct and indirect component widen income inequality in SSA. In addition, globally, the increasing effects of taxation on income inequality are higher in the most unequal countries of the region compared to the least unequal ones.

These results imply that tax system in SSA should be reformed to make it more progressive to reduce income inequality. Direct taxes represent only 3.95% of GDP, while indirect taxes are set at 8.16% of GDP. The weakness of direct taxes is linked to the size of the informal sector, tax evasion and the failure of tax reforms to consider the redistributive effects of taxation: policymakers in the region are generally

<sup>14</sup> Remittances do not significantly affect income inequality in SSA over the period 1980-2018.



more focused on the amount of tax revenue collected rather than its capacity to reduce inequality or both.

As we have shown, the tax system is regressive in SSA. This system increases inequality, as a larger proportion of the income of the poorest is taxed than that of the richest. Moreover, in a context where social programmes (education, health, social protection, housing, etc.) for the poor are weak, poorly targeted, or even absent, taxation is a source of exacerbation of inequalities. This means that when taxation is not accompanied by redistribution mechanisms, it exacerbates inequalities. The finding that taxation increases income inequality, particularly in countries that are already highly unequal, has important implications in terms of overhauling the tax system. Strengthening the administrative capacity of tax authorities could help to uncover hidden taxpayers in the informal sector and bring them under the progressive income tax system. In the same way, drastically curbing tax evasion by the most affluent to increase tax revenues and the preponderance of direct taxation is important. While increasing tax resources is important for financing economic development, making them more and sufficiently progressive is necessary to curb income inequality as it feeds and can generate political instability and violence in the region. Our results suggest making the tax system more progressive and redistributive mechanisms that are both effective and fair as fiscal policy goal in the region.

## **Appendix**

### **Appendix 1: The tables**

See Tables [5](#), [6](#), [7](#), [8](#), [9](#), [10](#), [11](#), [12](#), [13](#), [14](#), [15](#), [16](#), [17](#), [18](#), [19](#) and [20](#)



**Table 5** Variables, definitions, sources, and description Source: Authors

| Variables                              | Variables names | Definitions  | Sources                    | Mean   | S.D.   |
|--|-----------------|--|----------------------------|--------|--------|
| Gini coefficient                       | Gini            | The measure of income inequality comprises between 0 and 100 with 0 the most equal distribution and 100 the most unequal distribution.   | WIID, UNU-WIDER (2021a, b) | 56.994 | 6.380  |
| Total Revenue (% GDP)                  | TR              | Total revenue is revenue excluding grants and excluding social contributions. It is taxes plus non-tax revenue.  | GRD, UNU-WIDER (2021a, b)  | 16.678 | 10.135 |
| Total Non-Resource Tax Revenue (% GDP) | TNRR            | It is non-resource tax excluding social contributions. Total non-resource tax revenue are taxes minus resource taxes.  | GRD, UNU-WIDER (2021a, b)  | 12.725 | 7.058  |
| Direct Taxes (% GDP)                   | DT              | Direct taxes excluding social contributions and resource revenue. They are total direct tax minus resource-taxes.  | GRD, UNU-WIDER (2021a, b)  | 3.946  | 3.240  |
| Indirect taxes (% GDP)                 | NTCIT           | They include tax on goods and services, tax on international trade and other taxes, net of any resource component.   | GRD, UNU-WIDER (2021a, b)  | 8.155  | 5.484  |
| Primary net school enrolment (%)       | EDUC            | Net enrollment rate is the ratio of children of official school age who are enrolled in school to the population of the corresponding official school age. Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music. | WDI, World Bank (2022)     | 67.714 | 20.950 |



Table 5 (continued)

| Variables   | Variables names | Definitions  | Sources                | Mean   | S.D.    |
|---|-----------------|--|------------------------|--------|---------|
| Net inflows of foreign direct investments (% GDP) | FDI             | Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP. | WDI, World Bank (2022) | 3.005  | 7.979   |
| Trade openness (%)                                | OPEN            | It is the sum of exports and imports of goods and services measured as a share of gross domestic product.  | WDI, World Bank (2022) | 65.028 | 34.671  |
| Total natural resources rents (% GDP)             | NRR             | Total natural resources rents are the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents.  | WDI, World Bank (2022) | 11.229 | 10.834  |
| Urban population (% of total population)          | URB             | Urban population refers to people living in urban areas.   | WDI, World Bank (2022) | 34.683 | 16.539  |
| Inflation rate (%)                                | INF             | Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. It is a measure of macroeconomic stability.   | WDI, World Bank (2022) | 42.141 | 657.952 |



Table 5 (continued)

| Variables                                     | Variables names | Definitions   | Sources                | Mean   | S.D.   |
|---|-----------------|---|------------------------|--------|--------|
| Polity2                                       | DEMOC           | It is a measure of political regime authority spectrum on a 21-point scale ranging from -10 (hereditary monarchy) to +10 (consolidated democracy). The highest score reflects the best situation  | CSP, Polity IV         | -0.456 | 5.984  |
| Domestic credit to private sector (% GDP)     | FD              | Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. It is a measure of financial development.  | WDI, World Bank (2022) | 17.659 | 19.290 |
| Total employment to population ratio, 15+ (%) | ER              | Employment to population ratio is the proportion of a country's population that is employed. Employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangements. Ages 15 and older are generally considered the working-age population. | WDI, World Bank (2022) | 61.932 | 14.861 |



Table 5 (continued)

| Variables                                    | Variables names | Definitions  | Sources                | Mean  | S.D.   |
|--|-----------------|--|------------------------|-------|--------|
| Government expenditure in education (% GDP)  | GEE             | General government expenditure on education expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government. General government usually refers to local, regional, and central governments.   | WDI, World Bank (2022) | 4.106 | 2.765  |
| Personal received remittances (current US\$) | REM             | Personal remittances comprise personal transfers and compensation of employees. Personal transfers consist of all current transfers in cash or in kind made or received by resident households to or from nonresident households. Personal transfers thus include all current transfers between resident and nonresident individuals. Compensation of employees refers to the income of border, seasonal, and other short-term workers who are employed in an economy where they are not resident and of residents employed by nonresident entities. Data are the sum of two items defined in the sixth edition of the IMF's Balance of Payments Manual: personal transfers and compensation of employees. Data are in current U.S. dollars. | WDI, World Bank (2022) | 4.854 | 19.324 |



Table 5 (continued)

| Variables                           | Variables names | Definitions   | Sources                | Mean     | S.D.     |
|-------------------------------------|-----------------|---|------------------------|----------|----------|
| GDP per capita (constant 2010 US\$) | RGDP            | GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus, any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars. | WDI, World Bank (2022) | 1638.868 | 2047.847 |

WIID, World Income Inequality Database from UNU-WIDER (201a); GRD, Government Revenue Dataset from UNU-WIDER (2021b); WDI, World development indicators from the World Bank (2022); CSP, Centre for Systemic Peace (CSP). S.D., Standard deviation





**Table 6** Correlation between variables Source: Authors

|       | TR        | TNRR       | DT        | NTCT      | INEQ     | DEMOC     | OPEN      | FDI      | NRR       | URB       | INF     | FD        | GEE       | EDUC     | ER        | RGDP      | REM |
|-------|-----------|------------|-----------|-----------|----------|-----------|-----------|----------|-----------|-----------|---------|-----------|-----------|----------|-----------|-----------|-----|
| TR    | 1         |            |           |           |          |           |           |          |           |           |         |           |           |          |           |           |     |
| TNRR  | 0.515***  | 1          |           |           |          |           |           |          |           |           |         |           |           |          |           |           |     |
| DT    | 0.609***  | 0.861***   | 1         |           |          |           |           |          |           |           |         |           |           |          |           |           |     |
| NTCT  | 0.681***  | 0.939***   | 0.566***  | 1         |          |           |           |          |           |           |         |           |           |          |           |           |     |
| INEQ  | 0.289***  | 0.472***   | 0.296***  | 0.203***  | 1        |           |           |          |           |           |         |           |           |          |           |           |     |
| DEMOC | 0.120***  | 0.263***   | 0.264***  | 0.220***  | 0.062**  | 1         |           |          |           |           |         |           |           |          |           |           |     |
| OPEN  | 0.550***  | 0.453***   | 0.248***  | 0.437***  | 0.126*** | 0.107***  | 1         |          |           |           |         |           |           |          |           |           |     |
| FDI   | 0.086***  | -0.021     | -0.009    | -0.021    | -0.037   | 0.064***  | 0.311***  | 1        |           |           |         |           |           |          |           |           |     |
| NRR   | 0.096***  | -0.461***  | -0.265*** | -0.315*** | -0.003   | -0.149*** | 0.184***  | 0.238*** | 1         |           |         |           |           |          |           |           |     |
| URB   | 0.330***  | -0.016     | 0.167***  | -0.024    | -0.001   | 0.198***  | 0.392***  | 0.150*** | 0.230***  | 1         |         |           |           |          |           |           |     |
| INF   | -0.043    | -0.117***  | -0.066**  | -0.072**  | -0.007   | -0.014    | -0.022    | -0.012   | 0.061**   | -0.004    | 1       |           |           |          |           |           |     |
| FD    | 0.353***  | 0.562***   | 0.667***  | 0.282***  | 0.201*** | 0.281***  | 0.171***  | -0.034   | -0.195*** | 0.311***  | -0.035  | 1         |           |          |           |           |     |
| GEE   | 0.490***  | 0.730***   | 0.488***  | 0.487***  | 0.272*** | 0.103***  | 0.231***  | -0.026   | -0.140*** | -0.012    | -0.060* | 0.198***  | 1         |          |           |           |     |
| EDUC  | 0.331***  | 0.614***   | 0.355***  | 0.314***  | 0.156*** | 0.438***  | 0.318***  | 0.092*** | -0.030    | 0.196***  | -0.024  | 0.279***  | 0.225***  | 1        |           |           |     |
| ER    | -0.381*** | -0.3798*** | -0.228*** | -0.294*** | -0.058** | -0.069**  | -0.397*** | -0.023   | 0.109***  | -0.548*** | 0.037   | -0.297*** | -0.162*** | -0.095** | 1         |           |     |
| RGDP  | 0.485***  | 0.146***   | 0.249***  | 0.125***  | 0.274*** | 0.112***  | 0.387***  | 0.033    | 0.163***  | 0.620***  | -0.023  | 0.420***  | 0.175***  | 0.326*** | -0.504*** | 1         |     |
| REM   | 0.290***  | 0.174***   | 0.028     | 0.550***  | 0.048*   | -0.034    | 0.222***  | 0.016    | -0.052*   | -0.152*** | -0.006  | -0.019    | 0.218***  | -0.003   | -0.153*** | -0.096*** | 1   |

\*, \*\*, and \*\*\* represent significance at 10%, 5%, and 1%



**Table 7** Fisher-type unit-root test statistics of explanatory variables Source: Authors

| Variables                       | <i>p</i> -Statistic | <i>z</i> -Statistic | <i>L</i> *        | <i>P</i> <sub>m</sub> | Order of Integration | Decision   |
|---------------------------------|---------------------|---------------------|-------------------|-----------------------|----------------------|------------|
| Total revenue                   | 151.0624 (0.0001)   | -3.2723 (0.0005)    | -3.5676 (0.0002)  | 4.5513 (0.0000)       | I(0)                 | Stationary |
| Total non-resource revenue      | 162.3509 (0.0000)   | -4.4257 (0.0000)    | -7.0061 (0.0000)  | 10.0492 (0.0000)      | I(0)                 | Stationary |
| Direct taxes                    | 153.6760 (0.0000)   | -1.7096 (0.0437)    | -2.3284 (0.0104)  | 4.7461 (0.0000)       | I(0)                 | Stationary |
| Indirect taxes                  | 153.2148 (0.0000)   | -3.5472 (0.0002)    | -3.7538 (0.0001)  | 4.9157 (0.0000)       | I(0)                 | Stationary |
| Gini coefficient                | 209.9337 (0.0000)   | -5.3270 (0.0000)    | -6.8068 (0.0000)  | 8.9393 (0.0000)       | I(1)                 | Stationary |
| Democracy                       | 1289.1789 (0.0000)  | -32.0010 (0.0000)   | -53.6944 (0.0000) | 89.3815 (0.0000)      | I(1)                 | Stationary |
| Trade Openness                  | 136.0984 (0.0005)   | -3.1957 (0.0007)    | -3.4139 (0.0004)  | 3.8200 (0.0001)       | I(0)                 | Stationary |
| Foreign direct investment       | 396.6702 (0.0000)   | -13.0253 (0.0000)   | -15.6401 (0.0000) | 22.8578 (0.0000)      | I(0)                 | Stationary |
| Total natural resources rents   | 256.0358 (0.0000)   | -8.9156 (0.0000)    | -9.6628 (0.0000)  | 12.3756 (0.0000)      | I(0)                 | Stationary |
| Urbanization rate               | 661.2919 (0.0000)   | -12.5669 (0.0000)   | -27.3090 (0.0000) | 42.5816 (0.0000)      | I(0)                 | Stationary |
| Inflation rate                  | 602.6264 (0.0000)   | -17.4462 (0.0000)   | -24.4367 (0.0000) | 38.7914 (0.0000)      | I(0)                 | Stationary |
| Financial development           | 1162.6107 (0.0000)  | -29.4289 (0.0000)   | -48.9367 (0.0000) | 79.9477 (0.0000)      | I(1)                 | Stationary |
| Public expenditure on education | 147.6149 (0.0000)   | -2.1708 (0.0150)    | -2.8565 (0.0024)  | 4.6981 (0.0000)       | I(0)                 | Stationary |
| Primary education               | 497.8601 (0.0000)   | -15.6207 (0.0000)   | -21.4333 (0.0000) | 32.4732 (0.0000)      | I(1)                 | Stationary |
| Employment rate                 | 386.3385 (0.0000)   | -11.0542 (0.0000)   | -14.6262 (0.0000) | 22.0878 (0.0000)      | I(1)                 | Stationary |
| GDP per capita                  | 907.4036 (0.0000)   | -23.8629 (0.0000)   | -37.0697 (0.0000) | 60.9257 (0.0000)      | I(1)                 | Stationary |
| Remittances                     | 187.0345 (0.0000)   | -2.4655 (0.0068)    | -3.7230 (0.0001)  | 7.2325 (0.0000)       | I(0)                 | Stationary |

The Fisher-type unit-root test based on augmented Dickey-Fuller tests was used. Values in parenthesis are *p*-values



**Table 8** Total revenue and income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Palma ratio of income |                         |                         |                         |                         |                         |                         |
|---------------------------------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                 | (1)                                       | (2)                     | (3)                     | (4)                     | (5)                     | (6)                     | (7)                     |
|                                 | OLS                                       | IV-2SLS                 | IVQR 0.10               | IVQR 0.25               | IVQR 0.50               | IVQR 0.75               | IVQR 0.90               |
| Total revenue                   | 0.101***<br>(0.0124)                      | 0.102***<br>(0.0161)    | 0.0623***<br>(0.0103)   | 0.0613***<br>(0.0129)   | 0.0754***<br>(0.0183)   | 0.109***<br>(0.0195)    | 0.162***<br>(0.0254)    |
| Democracy (polity2)             | -0.116***<br>(0.0333)                     | -0.159***<br>(0.0420)   | -0.0496***<br>(0.0185)  | -0.0609***<br>(0.0126)  | -0.0665***<br>(0.0159)  | -0.0850***<br>(0.0350)  | -0.0661<br>(0.0419)     |
| Trade openness                  | -0.0257***<br>(0.00289)                   | -0.0232***<br>(0.00341) | -0.0188***<br>(0.00337) | -0.0164***<br>(0.00257) | -0.0191***<br>(0.00262) | -0.0247***<br>(0.00330) | -0.0258***<br>(0.00388) |
| Foreign direct investments      | -0.0204<br>(0.0161)                       | -0.0270<br>(0.0202)     | 0.0301**<br>(0.0142)    | 0.0173**<br>(0.00706)   | 0.00215<br>(0.00988)    | -0.0129<br>(0.0167)     | -0.0587*<br>(0.0339)    |
| Total natural resources rents   | -0.00539<br>(0.0105)                      | 0.00143<br>(0.0152)     | -0.00863<br>(0.00707)   | -0.00794<br>(0.00567)   | -0.00803<br>(0.0117)    | -0.00282<br>(0.0192)    | 0.0130<br>(0.0280)      |
| Urbanization rate               | 0.0256***<br>(0.00810)                    | 0.0272***<br>(0.00937)  | 0.0141**<br>(0.00709)   | 0.0134*<br>(0.00721)    | 0.0242**<br>(0.0109)    | 0.0224<br>(0.0156)      | -0.0153<br>(0.0152)     |
| Inflation rate                  | 0.0631**<br>(0.0304)                      | 0.0649*<br>(0.0360)     | 0.0281***<br>(0.00929)  | 0.0263***<br>(0.00477)  | 0.0253***<br>(0.00950)  | 0.0227**<br>(0.0112)    | 0.0228<br>(0.0419)      |
| Financial development           | 0.0330***<br>(0.00793)                    | 0.0399***<br>(0.0119)   | -0.00444<br>(0.00748)   | 0.00494<br>(0.00747)    | 0.00401<br>(0.0146)     | 0.0185<br>(0.0123)      | 0.0529***<br>(0.0176)   |
| Public expenditure on education | 0.266***<br>(0.0616)                      | 0.325***<br>(0.0719)    | 0.186***<br>(0.0479)    | 0.182***<br>(0.0361)    | 0.236***<br>(0.0695)    | 0.239***<br>(0.0753)    | 0.268**<br>(0.120)      |
| Primary education               | -0.0266*<br>(0.0144)                      | -0.0393**<br>(0.0176)   | 0.00883<br>(0.00841)    | 0.00146<br>(0.00545)    | -0.00364<br>(0.00578)   | -0.0173**<br>(0.00686)  | -0.0640**<br>(0.0317)   |
| Employment rate                 | -0.0130<br>(0.0168)                       | 0.000906<br>(0.0214)    | -0.0123**<br>(0.00579)  | -0.00799<br>(0.00522)   | -0.00993*<br>(0.00602)  | -0.0256<br>(0.0160)     | -0.0337<br>(0.0314)     |
| Ln(GDP per capita)              | -5.271                                    | -4.410                  | 0.0173                  | 0.484                   | -3.681                  | -3.290                  | 3.577                   |



Table 8 (continued)

| Independent variables                           | Dependent variable: Palma ratio of income |                             |                              |                                |                             |                             |                              |
|---|---|-----------------------------|------------------------------|--------------------------------|-----------------------------|-----------------------------|------------------------------|
|   | (1)                                       | (2)                         | (3)                          | (4)                            | (5)                         | (6)                         | (7)                          |
|   | OLS                                       | IV-2SLS                     | IVQR 0.10                    | IVQR 0.25                      | IVQR 0.50                   | IVQR 0.75                   | IVQR 0.90                    |
| Ln(GDP per capita squared)                      | (4.136)<br>0.336<br>(0.290)               | (3.923)<br>0.286<br>(0.276) | (1.939)<br>0.0285<br>(0.120) | (1.458)<br>-0.0152<br>(0.0992) | (3.057)<br>0.258<br>(0.228) | (2.760)<br>0.214<br>(0.181) | (9.106)<br>-0.296<br>(0.644) |
| Ln(Remittances)                                 | -0.0697<br>(0.137)                        | -0.0459<br>(0.150)          | -0.104***<br>(0.0313)        | -0.0675**<br>(0.0307)          | -0.0656<br>(0.0587)         | -0.132<br>(0.0956)          | -0.276*<br>(0.167)           |
| Constant  | 25.63*<br>(14.38)                         | 21.63<br>(13.42)            | 1.420<br>(5.569)             | 0.761<br>(5.099)               | 16.79<br>(10.52)            | 18.75**<br>(8.232)          | 1.350<br>(32.77)             |
| Number of countries                             | 45  | 45                          | 45                           | 45                             | 45                          | 45                          | 45                           |
| Observations                                    | 322                                       | 272                         | 272                          | 272                            | 272                         | 272                         | 272                          |
| R-squared                                       | 0.429                                     | 0.375                       |                              |                                |                             |                             |                              |
| Prob > F  | 0.0000                                    |                             |                              |                                |                             |                             |                              |
| Kleibergen-Paap rk LM statistic <i>p</i> -value |   | 0.0000                      |                              |                                |                             |                             |                              |
| Cragg-Donald Wald F statistic                   |   | 274.383                     |                              |                                |                             |                             |                              |
| Hansen test <i>p</i> -value                     |   | 0.5888                      |                              |                                |                             |                             |                              |

Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

**Table 9** Total non-resource revenue and income inequality in Sub-Saharan Africa, 1980–2018

| Independent variables           | Dependent variable: Palma ratio of income |                         |                         |                         |                         |                         |                         |
|---------------------------------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                 | (1)                                       | (2)                     | (3)                     | (4)                     | (5)                     | (6)                     | (7)                     |
|                                 | OLS                                       | IV-2SLS                 | IVQR 0.10               | IVQR 0.25               | IVQR 0.50               | IVQR 0.75               | IVQR 0.90               |
| Total non-resource revenue      | 0.106***<br>(0.0238)                      | 0.106***<br>(0.0352)    | 0.0462<br>(0.0472)      | 0.0861**<br>(0.0395)    | 0.118***<br>(0.0294)    | 0.111**<br>(0.0446)     | 0.147***<br>(0.0496)    |
| Democracy (polity2)             | 0.00550<br>(0.0159)                       | 0.00464<br>(0.0194)     | -0.0256<br>(0.0294)     | -0.0156<br>(0.0181)     | -0.00935<br>(0.0189)    | -0.0250<br>(0.0339)     | 0.00796<br>(0.0158)     |
| Trade openness                  | -0.0163***<br>(0.00287)                   | -0.0133***<br>(0.00362) | -0.0134***<br>(0.00339) | -0.0134***<br>(0.00404) | -0.0168***<br>(0.00396) | -0.0172***<br>(0.00416) | -0.0150***<br>(0.00330) |
| Foreign direct investments      | -0.00729<br>(0.0131)                      | -0.0107<br>(0.0169)     | -0.00721<br>(0.0103)    | -0.00544<br>(0.0122)    | -0.0183<br>(0.0143)     | -0.0301<br>(0.0220)     | -0.0618<br>(0.0387)     |
| Total natural resources rents   | 0.0202***<br>(0.00529)                    | 0.0231***<br>(0.00743)  | 0.00592<br>(0.0134)     | 0.0151<br>(0.0103)      | 0.0208**<br>(0.00971)   | 0.0181*<br>(0.0105)     | 0.0211***<br>(0.00670)  |
| Urbanization rate               | -0.000678<br>(0.00961)                    | -0.00538<br>(0.0122)    | 0.0141<br>(0.0159)      | 0.0181<br>(0.0125)      | 0.00990<br>(0.0190)     | -0.0162<br>(0.0135)     | -0.0290<br>(0.0177)     |
| Inflation rate                  | 0.0166**<br>(0.00697)                     | 0.0147*<br>(0.00815)    | 0.0333***<br>(0.0127)   | 0.0285***<br>(0.0100)   | 0.0186**<br>(0.00870)   | 0.00787<br>(0.0126)     | 0.00841<br>(0.00892)    |
| Financial development           | -0.0533***<br>(0.00834)                   | -0.0577***<br>(0.0105)  | -0.0704***<br>(0.0122)  | -0.0678***<br>(0.0160)  | -0.0536***<br>(0.0120)  | -0.0448***<br>(0.0103)  | -0.0468***<br>(0.0106)  |
| Public expenditure on education | 0.277***<br>(0.0592)                      | 0.267***<br>(0.0721)    | 0.210***<br>(0.0417)    | 0.197***<br>(0.0519)    | 0.217***<br>(0.0621)    | 0.378***<br>(0.117)     | 0.408***<br>(0.0945)    |
| Primary education               | 0.00262<br>(0.00399)                      | 0.00288<br>(0.00467)    | 0.0108**<br>(0.00536)   | 0.00426<br>(0.00598)    | -0.00322<br>(0.00576)   | -0.00188<br>(0.00480)   | 0.00290<br>(0.00406)    |
| Employment rate                 | 0.0117<br>(0.0109)                        | 0.0237*<br>(0.0142)     | 0.0354***<br>(0.0132)   | 0.0348**<br>(0.0156)    | 0.0158<br>(0.0188)      | -0.00539<br>(0.0188)    | -0.000447<br>(0.0212)   |
| Ln(GDP per capita)              | -5.016**                                  | -5.416*                 | -13.00**                | -13.08***               | -8.259**                | -3.010                  | 0.240                   |



Table 9 (continued)

| Independent variables           | Dependent variable: Palma ratio of income |                               |                                |                                |                                |                             |                              |
|---------------------------------|---|-------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|------------------------------|
|                                 | (1)                                       | (2)                           | (3)                            | (4)                            | (5)                            | (6)                         | (7)                          |
| OLS                             |   | IV-2SLS                       | IVQR 0.10                      | IVQR 0.25                      | IVQR 0.50                      | IVQR 0.75                   | IVQR 0.90                    |
| Ln(GDP per capita squared)      | (2.307)<br>0.433***<br>(0.162)            | (2.825)<br>0.475**<br>(0.196) | (5.306)<br>1.006***<br>(0.376) | (4.355)<br>1.006***<br>(0.310) | (3.472)<br>0.659***<br>(0.255) | (3.817)<br>0.290<br>(0.281) | (4.296)<br>0.0558<br>(0.317) |
| Ln(Remittances)                 | -0.170***<br>(0.0590)                     | -0.140**<br>(0.0675)          | -0.117<br>(0.0835)             | -0.0913<br>(0.0614)            | -0.0860<br>(0.0564)            | -0.103<br>(0.0798)          | -0.201**<br>(0.0853)         |
| Constant                        | 16.55**<br>(8.198)                        | 16.55<br>(10.22)              | 41.73**<br>(20.80)             | 42.38***<br>(14.13)            | 27.97**<br>(12.61)             | 11.86<br>(13.82)            | 0.260<br>(15.34)             |
| Number of countries             | 45  | 45                            | 45                             | 45                             | 45                             | 45                          | 45                           |
| Observations                    | 133                                       | 115                           | 115                            | 115                            | 115                            | 115                         | 115                          |
| R-squared                       | 0.796                                     | 0.798                         |                                |                                |                                |                             |                              |
| Prob > F                        | 0.0000                                    |                               |                                |                                |                                |                             |                              |
| Kleibergen-Paap rk LM statistic | <i>p</i> -value                           | 0.0001                        |                                |                                |                                |                             |                              |
| Cragg-Donald Wald F statistic   |   | 51.780                        |                                |                                |                                |                             |                              |
| Hansen test <i>p</i> -value     |   | 0.7577                        |                                |                                |                                |                             |                              |

Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Source: Authors

**Table 10** Direct Taxes and Income Inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Palma ratio of income |                         |                         |                         |                         |                         |                         |
|---------------------------------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                 | (1)                                       | (2)                     | (3)                     | (4)                     | (5)                     | (6)                     | (7)                     |
|                                 | OLS                                       | IV-2SLS                 | IVQR 0.10               | IVQR 0.25               | IVQR 0.50               | IVQR 0.75               | IVQR 0.90               |
| Direct taxes                    | 0.343***<br>(0.0614)                      | 0.352***<br>(0.0692)    | 0.233***<br>(0.0605)    | 0.261***<br>(0.0701)    | 0.310***<br>(0.0692)    | 0.424***<br>(0.0485)    | 0.618***<br>(0.0950)    |
| Democracy (polity2)             | -0.0912***<br>(0.0305)                    | -0.114***<br>(0.0382)   | -0.0424**<br>(0.0203)   | -0.0359**<br>(0.0154)   | -0.0530*<br>(0.0286)    | -0.0723*<br>(0.0369)    | -0.0115<br>(0.0551)     |
| Trade openness                  | -0.0228***<br>(0.00260)                   | -0.0220***<br>(0.00310) | -0.0189***<br>(0.00402) | -0.0169***<br>(0.00275) | -0.0200***<br>(0.00314) | -0.0252***<br>(0.00293) | -0.0260***<br>(0.00370) |
| Foreign direct investments      | -0.0347**<br>(0.0154)                     | -0.0453**<br>(0.0193)   | 0.00817<br>(0.0182)     | -0.000297<br>(0.00870)  | -0.0220*<br>(0.0116)    | -0.0381**<br>(0.0162)   | -0.113***<br>(0.0294)   |
| Total natural resources rents   | 0.0118<br>(0.0125)                        | 0.00151<br>(0.0168)     | -0.000569<br>(0.00856)  | -0.00517<br>(0.00816)   | 0.00345<br>(0.0107)     | 0.0111<br>(0.0135)      | 0.0313<br>(0.0250)      |
| Urbanization rate               | 0.0223***<br>(0.00858)                    | 0.0206*<br>(0.0104)     | 0.0166<br>(0.0108)      | 0.0133*<br>(0.00754)    | 0.0188**<br>(0.00946)   | 0.00279<br>(0.0134)     | -0.0147<br>(0.0187)     |
| Inflation rate                  | 0.0334<br>(0.0279)                        | 0.0353<br>(0.0335)      | 0.0348*<br>(0.0187)     | 0.0211<br>(0.0151)      | 0.0162<br>(0.0130)      | 0.0101<br>(0.0131)      | -0.00508<br>(0.0365)    |
| Financial development           | -0.00639<br>(0.0105)                      | 0.00213<br>(0.0133)     | -0.00202<br>(0.0131)    | -0.00277<br>(0.00827)   | -0.0151<br>(0.0129)     | -0.0259***<br>(0.00853) | -0.0239<br>(0.0214)     |
| Public expenditure on education | 0.242***<br>(0.0805)                      | 0.292***<br>(0.0969)    | 0.125*<br>(0.0703)      | 0.0898<br>(0.0769)      | 0.173*<br>(0.103)       | 0.242***<br>(0.0900)    | 0.260*<br>(0.135)       |
| Primary education               | -0.0403**<br>(0.0183)                     | -0.0486**<br>(0.0207)   | 0.00563<br>(0.00900)    | -0.00548<br>(0.00609)   | -0.0103*<br>(0.00545)   | -0.0304<br>(0.0185)     | -0.0805**<br>(0.0318)   |
| Employment rate                 | 0.00751<br>(0.0212)                       | 0.0206<br>(0.0261)      | -0.0109<br>(0.00854)    | -0.00217<br>(0.00747)   | -0.00458<br>(0.00747)   | -0.00950<br>(0.0219)    | 0.0116<br>(0.0438)      |
| Ln(GDP per capita)              | -17.91***<br>(1.850)                      | -17.06***<br>(1.850)    | 0.249                   | -1.850                  | -11.04**                | -17.88***               | -22.09**                |



Table 10 (continued)

| Independent variables           | Dependent variable: Palma ratio of income |                                |                              |                             |                               |                                |                               |
|---------------------------------|---|--------------------------------|------------------------------|-----------------------------|-------------------------------|--------------------------------|-------------------------------|
|                                 | (1)                                       | (2)                            | (3)                          | (4)                         | (5)                           | (6)                            | (7)                           |
|                                 | OLS                                       | IV-2SLS                        | IVQR 0.10                    | IVQR 0.25                   | IVQR 0.50                     | IVQR 0.75                      | IVQR 0.90                     |
| Ln(GDP per capita squared)      | (6.659)<br>1.276***<br>(0.475)            | (6.467)<br>1.221***<br>(0.463) | (7.750)<br>0.0209<br>(0.538) | (3.271)<br>0.166<br>(0.227) | (5.042)<br>0.801**<br>(0.362) | (4.620)<br>1.299***<br>(0.311) | (8.717)<br>1.576**<br>(0.628) |
| Ln(Remittances)                 | 0.134<br>(0.194)                          | 0.181<br>(0.211)               | -0.1000<br>(0.0915)          | -0.0329<br>(0.0706)         | 0.00453<br>(0.0815)           | 0.0508<br>(0.107)              | 0.0778<br>(0.247)             |
| Constant                        | 68.33***<br>(23.14)                       | 64.74***<br>(22.20)            | 0.379<br>(24.73)             | 8.778<br>(11.67)            | 42.57**<br>(17.42)            | 68.97***<br>(15.07)            | 88.53***<br>(28.35)           |
| Number of countries             | 45  | 45                             | 45                           | 45                          | 45                            | 45                             | 45                            |
| Observations                    | 271                                       | 233                            | 233                          | 233                         | 233                           | 233                            | 233                           |
| R-squared                       | 0.429                                     | 0.408                          |                              |                             |                               |                                |                               |
| Prob > F                        | 0.0000                                    |                                |                              |                             |                               |                                |                               |
| Kleibergen-Paap rk LM statistic |   | 0.0000                         |                              |                             |                               |                                |                               |
| Cragg-Donald Wald F statistic   |   | 269.305                        |                              |                             |                               |                                |                               |
| Hansen test <i>p</i> -value     |   | 0.2608                         |                              |                             |                               |                                |                               |

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



**Table 11** Indirect taxes and income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Independent variables           | Dependent variable: Palma ratio of income |                         |                         |                         |                         |                         |                         |
|---------------------------------|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                 | (1)                                       | (2)                     | (3)                     | (4)                     | (5)                     | (6)                     | (7)                     |
|                                 | OLS                                       | IV-2SLS                 | IVQR 0.10               | IVQR 0.25               | IVQR 0.50               | IVQR 0.75               | IVQR 0.90               |
| Indirect taxes                  | 0.0561**<br>(0.0244)                      | 0.0279<br>(0.0334)      | 0.0525***<br>(0.0202)   | 0.0369***<br>(0.00956)  | 0.0276*<br>(0.0143)     | 0.00448<br>(0.0383)     | 0.0257<br>(0.0383)      |
| Democracy (polity2)             | -0.101**<br>(0.0430)                      | -0.104*<br>(0.0575)     | -0.0316**<br>(0.0146)   | -0.0271<br>(0.0177)     | -0.0233<br>(0.0268)     | -0.0262<br>(0.0311)     | -0.102**<br>(0.0416)    |
| Trade openness                  | -0.0282***<br>(0.00459)                   | -0.0273***<br>(0.00578) | -0.0196***<br>(0.00471) | -0.0176***<br>(0.00271) | -0.0217***<br>(0.00402) | -0.0289***<br>(0.00310) | -0.0269***<br>(0.00362) |
| Foreign direct investments      | 0.0150<br>(0.0140)                        | 0.0131<br>(0.0189)      | 0.0341***<br>(0.00911)  | 0.0292***<br>(0.00960)  | 0.0323***<br>(0.00949)  | 0.0387***<br>(0.0139)   | 0.0120<br>(0.0139)      |
| Total natural resources rents   | -0.00391<br>(0.0139)                      | -0.0189<br>(0.0187)     | -0.0134<br>(0.0103)     | -0.0175**<br>(0.00791)  | -0.0218<br>(0.0138)     | -0.0390**<br>(0.0197)   | -0.0199<br>(0.0184)     |
| Urbanization rate               | 0.0254**<br>(0.0110)                      | 0.0178<br>(0.0142)      | 0.00415<br>(0.00767)    | 0.000867<br>(0.00578)   | 0.00544<br>(0.00996)    | -0.00733<br>(0.0143)    | 0.0168<br>(0.0133)      |
| Inflation rate                  | 0.0612*<br>(0.0340)                       | 0.0704*<br>(0.0424)     | 0.0223*<br>(0.0115)     | 0.0170**<br>(0.00865)   | 0.0143<br>(0.0109)      | 0.0249*<br>(0.0147)     | 0.0687**<br>(0.0347)    |
| Financial development           | 0.0225**<br>(0.00988)                     | 0.0294**<br>(0.0144)    | 0.00442<br>(0.00964)    | 0.00658<br>(0.00765)    | -0.000244<br>(0.0154)   | 0.00661<br>(0.0108)     | 0.0305**<br>(0.0122)    |
| Public expenditure on education | 0.394***<br>(0.0691)                      | 0.475***<br>(0.0747)    | 0.221**<br>(0.0927)     | 0.220***<br>(0.0369)    | 0.288***<br>(0.0812)    | 0.409**<br>(0.164)      | 0.470***<br>(0.0869)    |
| Primary education               | -0.0346*<br>(0.0197)                      | -0.0422*<br>(0.0223)    | 0.00175<br>(0.00426)    | -0.00153<br>(0.00443)   | -0.00683<br>(0.00646)   | -0.00780<br>(0.00937)   | -0.0435***<br>(0.0146)  |
| Employment rate                 | -0.0227<br>(0.0300)                       | -0.0245<br>(0.0399)     | -0.0243<br>(0.0161)     | -0.0281***<br>(0.00717) | -0.0367***<br>(0.0128)  | -0.0696***<br>(0.0223)  | -0.0214<br>(0.0285)     |
| Ln(GDP per capita)              | -11.01                                    | -10.03                  | 1.717                   | 1.096                   | -2.936                  | -7.782                  | -10.45*                 |



Table 11 (continued)

| Independent variables           | Dependent variable: Palma ratio of income |                             |                               |                               |                             |                             |                              |
|---------------------------------|---|-----------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|------------------------------|
|                                 | (1)                                       | (2)                         | (3)                           | (4)                           | (5)                         | (6)                         | (7)                          |
|                                 | OLS                                       | IV-2SLS                     | IVQR 0.10                     | IVQR 0.25                     | IVQR 0.50                   | IVQR 0.75                   | IVQR 0.90                    |
| Ln(GDP per capita squared)      | (6.990)<br>0.778<br>(0.498)               | (6.951)<br>0.709<br>(0.496) | (2.600)<br>-0.0954<br>(0.180) | (1.783)<br>-0.0597<br>(0.119) | (4.218)<br>0.225<br>(0.305) | (5.430)<br>0.582<br>(0.414) | (5.493)<br>0.740*<br>(0.385) |
| Ln(Remittances)                 | 0.0998<br>(0.217)                         | 0.139<br>(0.242)            | -0.0431<br>(0.0572)           | -0.00610<br>(0.0585)          | 0.0322<br>(0.0825)          | -0.0337<br>(0.124)          | 0.170<br>(0.215)             |
| Constant                        | 45.90*<br>(23.67)                         | 43.25*<br>(22.81)           | -2.429<br>(9.194)             | 1.242<br>(6.059)              | 16.85<br>(13.88)            | 36.62**<br>(17.85)          | 54.51***<br>(17.86)          |
| Number of countries             | 45  | 45                          | 45                            | 45                            | 45                          | 45                          | 45                           |
| Observations                    | 230                                       | 196                         | 196                           | 196                           | 196                         | 196                         | 196                          |
| R-squared                       | 0.401                                     | 0.387                       |                               |                               |                             |                             |                              |
| Prob > F                        | 0.0000                                    |                             |                               |                               |                             |                             |                              |
| Kleibergen-Paap rk LM statistic |   | 0.0000                      |                               |                               |                             |                             |                              |
| Cragg-Donald Wald F statistic   |   | 96.814                      |                               |                               |                             |                             |                              |
| Hansen test <i>p</i> -value     |   | 0.1501                      |                               |                               |                             |                             |                              |

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

**Table 12** Effects of control variables on income inequality in Sub-Saharan Africa, 1980–2018 Source: Authors

| Control variables               | Total revenue | Direct taxes | Indirect taxes | Non-resource revenue |
|---------------------------------|---------------|--------------|----------------|----------------------|
| Democracy (polity2)             | Yes           | Yes          | Yes            | No                   |
| Trade openness                  | Yes           | Yes          | Yes            | Yes                  |
| Foreign Direct Investments      | No            | No           | Yes            | No                   |
| Total natural resources rents   | No            | No           | No             | Yes                  |
| Urbanization rate               | No            | No           | No             | Yes                  |
| Inflation rate                  | Yes           | No           | Yes            | Yes                  |
| Financial development           | Yes           | No           | No             | Yes                  |
| Public expenditure on education | Yes           | Yes          | Yes            | Yes                  |
| Primary education               | No            | No           | No             | No                   |
| Employment rate                 | No            | No           | Yes            | Yes                  |
| Ln(GDP per capita)              | No            | Yes          | No             | No                   |
| Ln(GDP per capita squared)      | No            | Yes          | Yes            | No                   |
| Ln(Remittances)                 | No            | No           | No             | Yes                  |

Yes, means generally statistically significant; No means not generally statistically significant



**Table 13** Total revenue and income inequality in Sub-Saharan Africa, 1980–2018 (with additional variables) Source: Authors

| Variables                       | Dependent variable: Gini coefficient of income |                         |                       |                         |                         |                        |                         |
|---------------------------------|--|-------------------------|-----------------------|-------------------------|-------------------------|------------------------|-------------------------|
|                                 | (1)  | (2)                     | (3)                   | (4)                     | (5)                     | (6)                    | (7)                     |
| Independent variables           | OLS  | IV-2SLS                 | IVQR 0.10             | IVQR 0.25               | IVQR 0.50               | IVQR 0.75              | IVQR 0.90               |
| Total revenue                   | 0.198***<br>(0.0243)                           | 0.189***<br>(0.0316)    | 0.179***<br>(0.0562)  | 0.161***<br>(0.0420)    | 0.187***<br>(0.0311)    | 0.240***<br>(0.0442)   | 0.253***<br>(0.0373)    |
| Democracy (polity2)             | -0.226***<br>(0.0544)                          | -0.312***<br>(0.0723)   | -0.0228<br>(0.0661)   | -0.120**<br>(0.0483)    | -0.142***<br>(0.0514)   | -0.182*<br>(0.0945)    | -0.219***<br>(0.0743)   |
| Trade openness                  | -0.0826***<br>(0.00654)                        | -0.0810***<br>(0.00749) | -0.112***<br>(0.0145) | -0.0849***<br>(0.00684) | -0.0787***<br>(0.00691) | -0.0694***<br>(0.0133) | -0.0777***<br>(0.00727) |
| Foreign direct investment       | 0.0297<br>(0.0419)                             | 0.0286<br>(0.0498)      | 0.215***<br>(0.0487)  | 0.150***<br>(0.0559)    | 0.0975**<br>(0.0403)    | -0.000737<br>(0.0510)  | -0.137**<br>(0.0568)    |
| Total natural resources rents   | 0.0158<br>(0.0261)                             | 0.0127<br>(0.0367)      | -0.0187<br>(0.0441)   | -0.0627<br>(0.0481)     | -0.0388<br>(0.0255)     | 0.0242<br>(0.0592)     | 0.112<br>(0.0879)       |
| Urbanisation rate               | 0.00543<br>(0.0184)                            | 0.00129<br>(0.0211)     | 0.000572<br>(0.0324)  | 0.0280<br>(0.0290)      | 0.0426<br>(0.0325)      | 0.0208<br>(0.0441)     | -0.132**<br>(0.0593)    |
| Inflation rate                  | 0.106**<br>(0.0469)                            | 0.112**<br>(0.0543)     | 0.0615<br>(0.0412)    | 0.112***<br>(0.0307)    | 0.105***<br>(0.0283)    | 0.0510<br>(0.0396)     | -0.00768<br>(0.0638)    |
| Financial development           | 0.0605***<br>(0.0140)                          | 0.0752***<br>(0.0202)   | -0.00543<br>(0.0347)  | 0.0221<br>(0.0297)      | 0.0465**<br>(0.0204)    | 0.0554*<br>(0.0291)    | 0.114***<br>(0.0242)    |
| Public expenditure on education | 0.757***<br>(0.142)                            | 0.953***<br>(0.167)     | 0.605***<br>(0.178)   | 0.711***<br>(0.142)     | 0.731***<br>(0.112)     | 0.616***<br>(0.183)    | 0.784***<br>(0.245)     |
| Primary education               | -0.00751<br>(0.0233)                           | -0.0231<br>(0.0283)     | 0.0855**<br>(0.0362)  | 0.0292<br>(0.0214)      | 0.0111<br>(0.0189)      | -0.0307<br>(0.0226)    | -0.124***<br>(0.0341)   |
| Employment rate                 | -0.0361<br>(0.0273)                            | -0.0204<br>(0.0341)     | -0.0260<br>(0.0288)   | -0.0132<br>(0.0209)     | -0.0107<br>(0.0229)     | -0.0152<br>(0.0523)    | -0.00854<br>(0.0502)    |
| Ln(GDP per capita)              | 2.900  | 5.429                   | 23.54***              | 14.75***                | 7.860                   | 1.094                  | 3.971                   |



Table 13 (continued)

| Variables                                       | Dependent variable: Gini coefficient of income |                              |                                 |                                 |                              |                               |                              |
|---|--|------------------------------|---------------------------------|---------------------------------|------------------------------|-------------------------------|------------------------------|
|   | (1)  | (2)                          | (3)                             | (4)                             | (5)                          | (6)                           | (7)                          |
| Independent variables                           | OLS  | IV-2SLS                      | IVQR 0.10                       | IVQR 0.25                       | IVQR 0.50                    | IVQR 0.75                     | IVQR 0.90                    |
| Ln(GDP per capita squared)                      | (7.558)<br>-0.202<br>(0.523)                   | (7.695)<br>-0.362<br>(0.535) | (6.432)<br>-1.500***<br>(0.453) | (4.861)<br>-0.929***<br>(0.294) | (9.080)<br>-0.526<br>(0.623) | (10.53)<br>-0.0836<br>(0.668) | (13.09)<br>-0.250<br>(0.930) |
| Ln (Remittances)                                | -0.383<br>(0.245)                              | -0.358<br>(0.270)            | -0.510***<br>(0.125)            | -0.361***<br>(0.105)            | -0.306*<br>(0.170)           | -0.237<br>(0.238)             | -0.00723<br>(0.271)          |
| Financial openness (Chinn and Ito)              | 0.197<br>(0.158)                               | 0.225<br>(0.192)             | 0.172<br>(0.187)                | -0.0341<br>(0.144)              | -0.116<br>(0.263)            | 0.235<br>(0.242)              | 0.637**<br>(0.284)           |
| Ln(Foreign aid)                                 | -0.684**<br>(0.276)                            | -0.674**<br>(0.322)          | -1.523***<br>(0.370)            | -1.149***<br>(0.253)            | -1.140***<br>(0.269)         | -0.483<br>(0.443)             | 0.388<br>(0.450)             |
| Constant  | 60.48**<br>(24.83)                             | 50.08**<br>(25.19)           | -10.25<br>(18.20)               | 17.18<br>(15.45)                | 45.73<br>(31.28)             | 63.85**<br>(31.22)            | 49.72<br>(42.16)             |
| Number of countries                             | 45   | 45                           | 45                              | 45                              | 45                           | 45                            | 45                           |
| Observations                                    | 320  | 272                          | 272                             | 272                             | 272                          | 272                           | 272                          |
| Prob > F  | 0.0000   |                              |                                 |                                 |                              |                               |                              |
| Kleibergen-Paap rk LM statistic <i>p</i> -value |  | 0.0000                       |                                 |                                 |                              |                               |                              |
| Cragg-Donald Wald F statistic                   |  | 316.295                      |                                 |                                 |                              |                               |                              |
| Hansen test <i>p</i> -value                     |  | 0.5655                       |                                 |                                 |                              |                               |                              |

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



**Table 14** Total non-resource revenue and income inequality in Sub-Saharan Africa, 1980-2018 (with additional control variables) Source: Authors

| Variables                       | Dependent variable : Gini coefficient of income |                         |                        |                         |                         |                        |                         |
|---------------------------------|---|-------------------------|------------------------|-------------------------|-------------------------|------------------------|-------------------------|
|                                 | (1)   | (2)                     | (3)                    | (4)                     | (5)                     | (6)                    | (7)                     |
| Independent variables           | OLS   | IV-2SLS                 | IVQR                   | IVQR                    | IVQR                    | IVQR                   | IVQR                    |
| Total non-resource revenue      | 0.250***<br>(0.0426)                            | 0.249***<br>(0.0475)    | 0.185***<br>(0.0403)   | 0.138***<br>(0.0380)    | 0.210***<br>(0.0321)    | 0.302***<br>(0.0880)   | 0.303***<br>(0.0681)    |
| Democracy(polity2)              | -0.222***<br>(0.0680)                           | -0.232**<br>(0.0912)    | -0.0948**<br>(0.0468)  | -0.139***<br>(0.0451)   | -0.113**<br>(0.0461)    | -0.140<br>(0.109)      | -0.204***<br>(0.0882)   |
| Trade openness                  | -0.0851***<br>(0.00750)                         | -0.0850***<br>(0.00965) | -0.1000***<br>(0.0127) | -0.0804***<br>(0.00667) | -0.0852***<br>(0.00620) | -0.0907***<br>(0.0126) | -0.0546***<br>(0.00916) |
| Foreign direct investment       | 0.0774**<br>(0.0376)                            | 0.0810*<br>(0.0467)     | 0.205***<br>(0.0409)   | 0.130***<br>(0.0251)    | 0.100**<br>(0.0490)     | 0.0662**<br>(0.0329)   | -0.0328<br>(0.0437)     |
| Total natural resources rents   | 0.0253<br>(0.0325)                              | -0.0316<br>(0.0416)     | -0.0690*<br>(0.0410)   | -0.0935***<br>(0.0280)  | -0.0847***<br>(0.0274)  | -0.0183<br>(0.0461)    | 0.0142<br>(0.0554)      |
| Urbanisation rate               | 0.0660***<br>(0.0191)                           | 0.0640***<br>(0.0243)   | 0.0492**<br>(0.0233)   | 0.0580***<br>(0.0190)   | 0.0919***<br>(0.0301)   | 0.0515<br>(0.0335)     | -0.0195<br>(0.0252)     |
| Inflation rate                  | 0.130**<br>(0.0513)                             | 0.155**<br>(0.0607)     | 0.142***<br>(0.0333)   | 0.105***<br>(0.0214)    | 0.0904***<br>(0.0335)   | 0.0903**<br>(0.0413)   | 0.0509<br>(0.0626)      |
| Financial development           | 0.0254<br>(0.0156)                              | 0.0360*<br>(0.0216)     | 0.0280<br>(0.0493)     | 0.0691**<br>(0.0295)    | 0.0252<br>(0.0182)      | 0.0136<br>(0.0292)     | 0.0463*<br>(0.0262)     |
| Public expenditure on education | 0.703***<br>(0.125)                             | 0.822***<br>(0.125)     | 0.813***<br>(0.120)    | 0.850***<br>(0.163)     | 0.918***<br>(0.104)     | 0.729***<br>(0.154)    | 0.301*<br>(0.170)       |
| Primary education               | -0.0217<br>(0.0272)                             | -0.0279<br>(0.0315)     | 0.0394<br>(0.0243)     | 0.00557<br>(0.0173)     | -0.0167<br>(0.0200)     | -0.0232<br>(0.0173)    | -0.0131<br>(0.0298)     |
| Employment rate                 | 0.00859<br>(0.0415)                             | 0.0360<br>(0.0601)      | 0.0551<br>(0.0380)     | 0.00157<br>(0.0322)     | 0.0172<br>(0.0327)      | -0.0552<br>(0.0616)    | 0.0199<br>(0.0667)      |
| Ln(GDP per capita)              | -10.95  | -8.508                  | 19.45**                | 15.12**                 | -8.928                  | -16.13                 | -19.86*                 |

Table 14 (continued)

| Variables                          | Dependent variable : Gini coefficient of income |                             |                               |                                |                             |                             |                              |
|------------------------------------|---|-----------------------------|-------------------------------|--------------------------------|-----------------------------|-----------------------------|------------------------------|
|                                    | (1)   | (2)                         | (3)                           | (4)                            | (5)                         | (6)                         | (7)                          |
| Independent variables              | OLS   | IV-2SLS                     | IVQR                          | IVQR                           | IVQR                        | IVQR                        | IVQR                         |
| Ln(GDP per capita squared)         | (10.26)<br>0.848<br>(0.724)                     | (10.37)<br>0.678<br>(0.734) | (8.842)<br>-1.232*<br>(0.641) | (6.450)<br>-0.998**<br>(0.438) | (10.69)<br>0.664<br>(0.737) | (10.62)<br>1.152<br>(0.715) | (11.36)<br>1.534*<br>(0.816) |
| Ln(Remittances)                    | -0.105<br>(0.317)                               | -0.0242<br>(0.369)          | -0.286**<br>(0.116)           | -0.227*<br>(0.130)             | 0.0612<br>(0.185)           | -0.0651<br>(0.370)          | -0.338<br>(0.354)            |
| Financial openness (Chinn and Ito) | 0.137<br>(0.182)                                | 0.0947<br>(0.240)           | -0.203<br>(0.375)             | -0.430*<br>(0.232)             | -0.185<br>(0.348)           | 0.257<br>(0.339)            | 0.831***<br>(0.256)          |
| Ln(Foreign aid)                    | -0.764**<br>(0.306)                             | -0.975***<br>(0.365)        | -1.899***<br>(0.369)          | -1.297***<br>(0.304)           | -1.198***<br>(0.324)        | -0.439*<br>(0.259)          | -0.175<br>(0.353)            |
| Constant                           | 103.2***<br>(32.95)                             | 97.09***<br>(32.65)         | 7.280<br>(27.45)              | 19.93<br>(22.28)               | 104.8***<br>(36.84)         | 124.3***<br>(35.93)         | 124.8***<br>(31.95)          |
| Number of countries                | 45  | 45                          | 45                            | 45                             | 45                          | 45                          | 45                           |
| Observations                       | 245   | 207                         | 207                           | 207                            | 207                         | 207                         | 207                          |
| Prob > F                           | 0.0000  |                             |                               |                                |                             |                             |                              |
| Kleibergen-Paap rk LM statistic    | <i>p</i> -value                                 | 0.0000                      |                               |                                |                             |                             |                              |
| Cragg-Donald Wald F statistic      |   | 267.036                     |                               |                                |                             |                             |                              |
| Hansen test <i>p</i> -value        |   | 0.4343                      |                               |                                |                             |                             |                              |

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



**Table 15** Direct taxes and income inequality in Sub-Saharan Africa, 1980–2018 (with additional variables) Source: Authors

| Variables                       | Dependent variable: Gini coefficient of income |                         |                       |                         |                         |                         |                         |
|---------------------------------|--|-------------------------|-----------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                 | (1)  | (2)                     | (3)                   | (4)                     | (5)                     | (6)                     | (7)                     |
|                                 | OLS  | IV-2SLS                 | IVQR                  | IVQR                    | IVQR                    | IVQR                    | IVQR                    |
| Direct taxes                    | 0.660***<br>(0.135)                            | 0.686***<br>(0.145)     | 0.682***<br>(0.198)   | 0.626***<br>(0.121)     | 0.765***<br>(0.130)     | 0.944***<br>(0.152)     | 0.647***<br>(0.230)     |
| Democracy (polity2)             | -0.172***<br>(0.0555)                          | -0.204***<br>(0.0726)   | -0.0103<br>(0.0471)   | -0.0418<br>(0.0468)     | -0.0775<br>(0.0731)     | -0.145<br>(0.0892)      | -0.178**<br>(0.0884)    |
| Trade openness                  | -0.0809***<br>(0.00751)                        | -0.0826***<br>(0.00771) | -0.106***<br>(0.0163) | -0.0811***<br>(0.00495) | -0.0835***<br>(0.00633) | -0.0817***<br>(0.00755) | -0.0809***<br>(0.00703) |
| Foreign direct investment       | 0.0235<br>(0.0392)                             | 0.0217<br>(0.0443)      | 0.168***<br>(0.0393)  | 0.119***<br>(0.0333)    | 0.0345<br>(0.0458)      | -0.0414<br>(0.0469)     | -0.160***<br>(0.0606)   |
| Total natural resource rents    | 0.0525<br>(0.0334)                             | 0.0217<br>(0.0401)      | -0.0197<br>(0.0339)   | -0.0796**<br>(0.0394)   | -0.00406<br>(0.0363)    | 0.0632<br>(0.0493)      | 0.138***<br>(0.0387)    |
| Urbanisation rate               | -0.00461<br>(0.0200)                           | -0.0142<br>(0.0230)     | 0.00637<br>(0.0287)   | 0.0338<br>(0.0300)      | 0.0354<br>(0.0362)      | -0.0439<br>(0.0607)     | -0.135***<br>(0.0595)   |
| Inflation rate                  | 0.0502<br>(0.0489)                             | 0.0502<br>(0.0561)      | 0.101*<br>(0.0577)    | 0.0747<br>(0.0456)      | 0.0641**<br>(0.0285)    | 0.0241<br>(0.0602)      | -0.0213<br>(0.0411)     |
| Financial development           | -0.0124<br>(0.0241)                            | 0.00166<br>(0.0276)     | -0.00505<br>(0.0310)  | -0.00309<br>(0.0228)    | -0.0340<br>(0.0207)     | -0.0323<br>(0.0271)     | 0.0325<br>(0.0339)      |
| Public expenditure on education | 0.750***<br>(0.164)                            | 0.871***<br>(0.185)     | 0.362**<br>(0.156)    | 0.527***<br>(0.165)     | 0.667***<br>(0.131)     | 0.649***<br>(0.144)     | 0.916***<br>(0.261)     |
| Primary education               | -0.0359<br>(0.0286)                            | -0.0454<br>(0.0326)     | 0.0621<br>(0.0426)    | 0.00552<br>(0.0212)     | -0.0112<br>(0.0120)     | -0.0699<br>(0.0559)     | -0.145***<br>(0.0375)   |
| Employment rate                 | -0.00527<br>(0.0319)                           | 0.0183<br>(0.0374)      | -0.000221<br>(0.0215) | 0.0182<br>(0.0203)      | 0.0217<br>(0.0241)      | 0.0400<br>(0.0394)      | 0.0197<br>(0.0543)      |
| Ln(GDP per capita)              | -17.91   | -13.71                  | 20.10*                | 8.584                   | -16.11                  | -24.37                  | -30.01*                 |





Table 15 (continued)

| Variables                                       | Dependent variable: Gini coefficient of income |                             |                              |                              |                              |                             |                               |
|---|--|-----------------------------|------------------------------|------------------------------|------------------------------|-----------------------------|-------------------------------|
|   | (1)  | (2)                         | (3)                          | (4)                          | (5)                          | (6)                         | (7)                           |
|   | OLS  | IV-2SLS                     | IVQR                         | IVQR                         | IVQR                         | IVQR                        | IVQR                          |
| Ln (GDP per capita squared)                     | (11.46)<br>1.363*<br>(0.810)                   | (11.65)<br>1.080<br>(0.826) | (10.64)<br>-1.221<br>(0.766) | (8.358)<br>-0.459<br>(0.562) | (9.950)<br>1.235*<br>(0.724) | (18.63)<br>1.863<br>(1.326) | (15.35)<br>2.235**<br>(1.136) |
| Ln(Remittances)                                 | -0.0769<br>(0.336)                             | -0.0191<br>(0.362)          | -0.396*<br>(0.239)           | -0.279*<br>(0.150)           | -0.0706<br>(0.245)           | 0.126<br>(0.345)            | 0.312<br>(0.318)              |
| Financial openness (Chinn and Ito)              | 0.220<br>(0.149)                               | 0.236<br>(0.184)            | 0.0592<br>(0.180)            | -0.232<br>(0.165)            | 0.00643<br>(0.332)           | 0.270<br>(0.362)            | 0.713**<br>(0.321)            |
| Ln(Foreign aid)                                 | -0.701**<br>(0.318)                            | -0.864**<br>(0.357)         | -1.618***<br>(0.379)         | -1.414***<br>(0.265)         | -1.240***<br>(0.313)         | -0.736<br>(0.576)           | 0.377<br>(0.612)              |
| Constant  | 131.4***<br>(37.74)                            | 118.5***<br>(38.02)         | 2.447<br>(33.93)             | 43.16<br>(28.95)             | 130.8***<br>(31.53)          | 155.5**<br>(62.56)          | 167.0***<br>(51.18)           |
| Number of countries                             | 45   | 45                          | 45                           | 45                           | 45                           | 45                          | 45                            |
| Observations                                    | 270  | 237                         | 237                          | 237                          | 237                          | 237                         | 237                           |
| Prob > F  | 0.0000   |                             |                              |                              |                              |                             |                               |
| Kleibergen-Paap rk LM statistic <i>p</i> -value |  | 0.0000                      |                              |                              |                              |                             |                               |
| Cragg-Donald Wald F statistic                   |  | 423.053                     |                              |                              |                              |                             |                               |
| Hansen test <i>p</i> -value                     |  | 0.3422                      |                              |                              |                              |                             |                               |

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



**Table 16** Indirect taxes and income inequality in Sub-Saharan Africa, 1980–2018 (with additional variables) Source: Authors

|                                 | Dependent variable : Gini coefficient of income |                         |                        |                        |                        |                       |                         |
|---------------------------------|---|-------------------------|------------------------|------------------------|------------------------|-----------------------|-------------------------|
|                                 | (1)   | (2)                     | (3)                    | (4)                    | (5)                    | (6)                   | (7)                     |
|                                 | OLS   | IVQR                    | IVQR                   | IVQR                   | IVQR                   | IVQR                  | IVQR                    |
| Indirect taxes                  | 0.186***<br>(0.0506)                            | 0.156***<br>(0.0586)    | 0.207***<br>(0.0500)   | 0.137***<br>(0.0450)   | 0.126**<br>(0.0567)    | 0.156*<br>(0.0804)    | 0.154***<br>(0.0618)    |
| Democracy (polity2)             | -0.215***<br>(0.0707)                           | -0.188*<br>(0.0957)     | -0.0876<br>(0.0716)    | -0.0922<br>(0.0621)    | -0.0775<br>(0.0873)    | -0.0730<br>(0.102)    | -0.154***<br>(0.0773)   |
| Trade Openness                  | -0.0900***<br>(0.00782)                         | -0.0924***<br>(0.00929) | -0.0997***<br>(0.0181) | -0.0858***<br>(0.0137) | -0.0882***<br>(0.0149) | -0.101***<br>(0.0114) | -0.0903***<br>(0.00832) |
| Foreign direct investment       | 0.102***<br>(0.0364)                            | 0.127***<br>(0.0424)    | 0.215***<br>(0.0522)   | 0.176***<br>(0.0382)   | 0.140**<br>(0.0625)    | 0.147***<br>(0.0415)  | 0.0919**<br>(0.0463)    |
| Total natural resource rents    | 0.00129<br>(0.0357)                             | -0.0456<br>(0.0438)     | -0.0581<br>(0.0461)    | -0.0977*<br>(0.0581)   | -0.0593<br>(0.0549)    | -0.0522<br>(0.0493)   | -0.0275<br>(0.0466)     |
| Urbanisation rate               | 0.0348<br>(0.0240)                              | 0.0188<br>(0.0306)      | 0.0314<br>(0.0274)     | 0.0246<br>(0.0274)     | 0.0260<br>(0.0387)     | -0.0224<br>(0.0348)   | 0.00372<br>(0.0320)     |
| Inflation rate                  | 0.125**<br>(0.0515)                             | 0.154**<br>(0.0642)     | 0.132**<br>(0.0588)    | 0.0928***<br>(0.0297)  | 0.0648*<br>(0.0332)    | 0.0830**<br>(0.0381)  | 0.105**<br>(0.0495)     |
| Financial development           | 0.0326**<br>(0.0155)                            | 0.0434**<br>(0.0204)    | 0.0139<br>(0.0391)     | 0.0300<br>(0.0363)     | 0.00238<br>(0.0370)    | 0.00538<br>(0.0302)   | 0.0408**<br>(0.0166)    |
| Public expenditure on education | 0.922***<br>(0.147)                             | 1.044***<br>(0.149)     | 0.935***<br>(0.212)    | 0.910***<br>(0.167)    | 0.918***<br>(0.178)    | 0.929***<br>(0.176)   | 0.985***<br>(0.127)     |
| Primary education               | -0.0200<br>(0.0293)                             | -0.0282<br>(0.0332)     | 0.0409<br>(0.0250)     | 0.0104<br>(0.0163)     | -0.0123<br>(0.0146)    | -0.0156<br>(0.0231)   | -0.0493<br>(0.0346)     |
| Employment rate                 | -0.0523<br>(0.0428)                             | -0.0517<br>(0.0580)     | 0.0410<br>(0.0596)     | -0.0384<br>(0.0377)    | -0.0526<br>(0.0717)    | -0.184**<br>(0.0774)  | -0.0773<br>(0.0470)     |
| Ln(GDP per capita)              | -11.13  | -7.516                  | 19.86**                | 12.03                  | -12.68                 | -14.22                | -15.15                  |

Table 16 (continued)

| Dependent variable : Gini coefficient of income |                             | (1)                         | (2)                           | (3)                          | (4)                         | (5)                         | (6)                         | (7)  |
|---|-----------------------------|-----------------------------|-------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|------|
|   | OLS                         | IVQR                        | IVQR                          | IVQR                         | IVQR                        | IVQR                        | IVQR                        | IVQR |
| Ln(GDP per capita squared)                      | (12.11)<br>0.866<br>(0.857) | (12.12)<br>0.607<br>(0.859) | (10.11)<br>-1.239*<br>(0.722) | (11.03)<br>-0.750<br>(0.751) | (13.66)<br>0.975<br>(0.954) | (11.91)<br>1.071<br>(0.884) | (10.86)<br>1.135<br>(0.755) |      |
| Ln(Remittances)                                 | -0.0818<br>(0.367)          | -0.0303<br>(0.408)          | -0.251<br>(0.202)             | -0.264<br>(0.169)            | 0.178<br>(0.305)            | -0.0645<br>(0.366)          | 0.168<br>(0.404)            |      |
| Financial Openness (Chinn and Ito)              | 0.0886<br>(0.187)           | 0.0643<br>(0.237)           | -0.0518<br>(0.315)            | -0.256<br>(0.324)            | -0.00900<br>(0.362)         | -0.103<br>(0.351)           | 0.108<br>(0.299)            |      |
| Ln (Foreign aid)                                | -0.409<br>(0.367)           | -0.689<br>(0.438)           | -1.779***<br>(0.459)          | -1.141***<br>(0.382)         | -0.661<br>(0.648)           | -0.111<br>(0.484)           | -0.163<br>(0.417)           |      |
| Constant  | 102.5***<br>(38.65)         | 96.41**<br>(38.00)          | 4.008<br>(33.97)              | 30.86<br>(35.72)             | 113.6***<br>(46.13)         | 121.0***<br>(40.80)         | 131.7***<br>(35.78)         |      |
| Observations                                    | 229                         | 197                         | 197                           | 197                          | 197                         | 197                         | 197                         |      |
| Prob > F  | 0.0000                      |                             |                               |                              |                             |                             |                             |      |
| Kleibergen-Paap rk LM statistic                 | <i>p</i> -value             | 0.0000                      |                               |                              |                             |                             |                             |      |
| Cragg-Donald Wald F statistic                   |                             | 266.418                     |                               |                              |                             |                             |                             |      |
| Hansen test <i>p</i> -value                     |                             | 0.1872                      |                               |                              |                             |                             |                             |      |

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



**Table 17** Total revenue and income inequality in Sub-Saharan Africa, 1980–2018 (with bi-annual data) Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                        |                        |                         |                        |                        |                        |
|---------------------------------|--|------------------------|------------------------|-------------------------|------------------------|------------------------|------------------------|
|                                 | (1)  | (2)                    | (3)                    | (4)                     | (5)                    | (6)                    | (7)                    |
|                                 | OLS  | IV-2SLS                | IVQR 0.10              | IVQR 0.25               | IVQR 0.50              | IVQR 0.75              | IVQR 0.90              |
| Total revenue                   | 0.194***<br>(0.0321)                           | 0.223***<br>(0.0414)   | 0.242***<br>(0.0324)   | 0.223***<br>(0.0283)    | 0.200***<br>(0.0462)   | 0.209***<br>(0.0521)   | 0.227***<br>(0.0425)   |
| Democracy (Polity2)             | -0.218***<br>(0.0618)                          | -0.198***<br>(0.0733)  | -0.102**<br>(0.0452)   | -0.108***<br>(0.0376)   | -0.0995<br>(0.0741)    | -0.0867<br>(0.111)     | -0.193***<br>(0.0762)  |
| Trade openness                  | -0.0766***<br>(0.00646)                        | -0.0734***<br>(0.0111) | -0.0922***<br>(0.0110) | -0.0801***<br>(0.00752) | -0.0818***<br>(0.0133) | -0.0728***<br>(0.0347) | -0.0724***<br>(0.0112) |
| Foreign direct investment       | -0.00511<br>(0.0560)                           | 0.0751<br>(0.0764)     | 0.175*<br>(0.0993)     | 0.0800<br>(0.106)       | 0.0266<br>(0.0633)     | -0.00429<br>(0.0731)   | 0.0501<br>(0.0736)     |
| Total natural resource rents    | 0.00350<br>(0.0338)                            | 0.0150<br>(0.0317)     | -0.0290<br>(0.0283)    | -0.0485*<br>(0.0255)    | -0.00366<br>(0.0372)   | 0.0231<br>(0.0576)     | 0.0124<br>(0.0271)     |
| Urbanisation rate               | -0.000742<br>(0.0226)                          | 0.0219<br>(0.0325)     | 0.0179<br>(0.0183)     | 0.0338<br>(0.0209)      | 0.0364<br>(0.0322)     | 0.00750<br>(0.0335)    | 0.0253<br>(0.0291)     |
| Inflation rate                  | 0.106*<br>(0.0620)                             | 0.131*<br>(0.0713)     | 0.172***<br>(0.0445)   | 0.0980**<br>(0.0386)    | 0.0758***<br>(0.0340)  | 0.0724<br>(0.0899)     | 0.110**<br>(0.0503)    |
| Financial development           | 0.0398**<br>(0.0187)                           | 0.0684**<br>(0.0315)   | 0.0225<br>(0.0228)     | 0.0246*<br>(0.0138)     | 0.0157<br>(0.0362)     | 0.0206<br>(0.0517)     | 0.0739**<br>(0.0295)   |
| Public expenditure on education | 0.672***<br>(0.188)                            | 0.827***<br>(0.285)    | 0.553**<br>(0.225)     | 0.570***<br>(0.170)     | 0.656***<br>(0.198)    | 0.500<br>(0.410)       | 0.774**<br>(0.312)     |
| Primary education               | 0.00515<br>(0.0279)                            | -0.166<br>(0.119)      | -0.0195<br>(0.0791)    | 0.0119<br>(0.0621)      | 0.00186<br>(0.113)     | 0.0206<br>(0.307)      | -0.151<br>(0.128)      |
| Employment rate                 | -0.0620*<br>(0.0363)                           | 0.00306<br>(0.0636)    | -0.0231<br>(0.0293)    | -0.0290<br>(0.0311)     | -0.0516<br>(0.0709)    | -0.105<br>(0.145)      | 0.00777<br>(0.0898)    |
| Ln(GDP per capita)              | -6.576   | -1.443                 | 7.721                  | 6.355                   | -12.02                 | -10.69                 | -0.585                 |



Table 17 (continued)

| Independent variables           | Dependent variable: Gini coefficient of income |                             |                              |                              |                             |                             |                             |
|---------------------------------|--|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                 | (1)  | (2)                         | (3)                          | (4)                          | (5)                         | (6)                         | (7)                         |
| OLS                             |  |                             | IVQR 0.10                    | IVQR 0.25                    | IVQR 0.50                   | IVQR 0.75                   | IVQR 0.90                   |
| Ln(GDP per capita squared)      | (7.923)<br>0.478<br>(0.551)                    | (8.211)<br>0.208<br>(0.551) | (5.528)<br>-0.359<br>(0.367) | (6.561)<br>-0.338<br>(0.436) | (8.477)<br>0.857<br>(0.536) | (12.20)<br>0.707<br>(0.745) | (7.174)<br>0.127<br>(0.494) |
| Ln(Remittances)                 | -0.342<br>(0.312)                              | -0.0385<br>(0.400)          | -0.317<br>(0.215)            | -0.343**<br>(0.162)          | -0.261<br>(0.365)           | -0.570<br>(0.468)           | 0.0125<br>(0.378)           |
| Constant                        | 80.96***<br>(27.99)                            | 63.88***<br>(29.38)         | 17.90<br>(18.46)             | 25.23<br>(24.77)             | 98.59***<br>(29.19)         | 101.3**<br>(42.89)          | 100.6***<br>(24.60)         |
| Number of countries             | 45   | 45                          | 45                           | 45                           | 45                          | 45                          | 45                          |
| Observations                    | 602  | 602                         | 602                          | 602                          | 602                         | 602                         | 602                         |
| R-squared                       | 0.464  | 0.272                       |                              |                              |                             |                             |                             |
| Prob > F                        | 0.0000   |                             |                              |                              |                             |                             |                             |
| Kleibergen-Paap rk LM statistic | 0.0000   |                             |                              |                              |                             |                             |                             |
| Cragg-Donald Wald F statistic   |  | 13.43                       |                              |                              |                             |                             |                             |
| Hansen test <i>p</i> -value     |  | 0.7429                      |                              |                              |                             |                             |                             |

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



**Table 18** Total non-resource revenue and income inequality in Sub-Saharan Africa, 1980–2018 (with bi-annual data) Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                        |                        |                        |                        |                        |                        |
|---------------------------------|--|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
|                                 | (1)  | (2)                    | (3)                    | (4)                    | (5)                    | (6)                    | (7)                    |
|                                 | OLS  | IV-2SLS                | IVQR 0.10              | IVQR 0.25              | IVQR 0.50              | IVQR 0.75              | IVQR 0.90              |
| Total non-resource revenue      | 0.224***<br>(0.0529)                           | 0.298***<br>(0.0916)   | 0.280***<br>(0.0839)   | 0.356***<br>(0.119)    | 0.210***<br>(0.0624)   | 0.234***<br>(0.0655)   | 0.281***<br>(0.0553)   |
| Democracy (polity2)             | -0.184**<br>(0.0763)                           | -0.126<br>(0.0903)     | -0.110<br>(0.0773)     | -0.0315<br>(0.0992)    | -0.104<br>(0.0820)     | -0.112*<br>(0.0669)    | -0.120*<br>(0.0660)    |
| Trade openness                  | -0.0841***<br>(0.00840)                        | -0.0865***<br>(0.0126) | -0.0871***<br>(0.0117) | -0.0964***<br>(0.0101) | -0.0801***<br>(0.0211) | -0.0816***<br>(0.0181) | -0.0856***<br>(0.0128) |
| Foreign direct investment       | 0.0467<br>(0.0536)                             | 0.139<br>(0.0926)      | 0.135<br>(0.0962)      | 0.175*<br>(0.101)      | 0.106<br>(0.0710)      | 0.0964<br>(0.101)      | 0.116<br>(0.0898)      |
| Total natural resource rents    | 0.0160<br>(0.0365)                             | 0.0378<br>(0.0364)     | 0.0323<br>(0.0482)     | 0.0376<br>(0.0540)     | 0.0123<br>(0.0607)     | 0.0316<br>(0.0511)     | 0.0359<br>(0.0410)     |
| Urbanisation rate               | 0.0421*<br>(0.0239)                            | 0.0567<br>(0.0354)     | 0.0519<br>(0.0362)     | 0.0874***<br>(0.0417)  | 0.0620*<br>(0.0356)    | 0.0445<br>(0.0352)     | 0.0554*<br>(0.0333)    |
| Inflation rate                  | 0.120*<br>(0.0655)                             | 0.0945<br>(0.0689)     | 0.0846<br>(0.0645)     | 0.0944*<br>(0.0572)    | 0.0128<br>(0.0708)     | 0.0215<br>(0.0475)     | 0.0749<br>(0.0489)     |
| Financial development           | -0.00825<br>(0.0211)                           | 0.00868<br>(0.0316)    | 0.00584<br>(0.0378)    | -0.0139<br>(0.0309)    | 0.0214<br>(0.0321)     | 0.0211<br>(0.0329)     | 0.0141<br>(0.0352)     |
| Public expenditure on education | 0.629***<br>(0.164)                            | 0.699***<br>(0.253)    | 0.698***<br>(0.226)    | 0.560**<br>(0.232)     | 0.794***<br>(0.188)    | 0.755***<br>(0.210)    | 0.695***<br>(0.242)    |
| Primary education               | -0.00347<br>(0.0324)                           | -0.199<br>(0.139)      | -0.167<br>(0.158)      | -0.158<br>(0.115)      | -0.131<br>(0.189)      | -0.172<br>(0.191)      | -0.179<br>(0.143)      |
| Employment rate                 | -0.0525<br>(0.0480)                            | 0.00265<br>(0.0744)    | -0.0155<br>(0.0901)    | 0.0148<br>(0.0806)     | -0.0314<br>(0.0996)    | -0.00684<br>(0.101)    | -0.000622<br>(0.0848)  |
| Ln(GDP per capita)              | -18.48*<br>(0.0480)                            | -17.23*<br>(0.0744)    | -14.43<br>(0.0901)     | -8.528<br>(0.0806)     | -11.87<br>(0.0996)     | -16.97<br>(0.101)      | -15.84<br>(0.0848)     |

Table 18 (continued)

| Independent variables           | Dependent variable: Gini coefficient of income |                              |                             |                             |                             |                             |                             |
|---------------------------------|--|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                 | (1)  | (2)                          | (3)                         | (4)                         | (5)                         | (6)                         | (7)                         |
|                                 | OLS  | IV-2SLS                      | IVQR 0.10                   | IVQR 0.25                   | IVQR 0.50                   | IVQR 0.75                   | IVQR 0.90                   |
| Ln(GDP per capita squared)      | (10.57)<br>1.407*<br>(0.749)                   | (10.07)<br>1.414*<br>(0.728) | (12.71)<br>1.207<br>(0.855) | (8.596)<br>0.854<br>(0.525) | (12.93)<br>0.958<br>(0.826) | (13.80)<br>1.347<br>(1.080) | (11.82)<br>1.298<br>(0.807) |
| Ln(Remittances)                 | -0.130<br>(0.406)                              | 0.220<br>(0.518)             | 0.120<br>(0.535)            | -0.110<br>(0.339)           | 0.0779<br>(0.558)           | 0.261<br>(0.554)            | 0.252<br>(0.470)            |
| Constant                        | 117.8***<br>(35.85)                            | 117.8***<br>(35.37)          | 79.74*<br>(41.45)           | 77.46***<br>(33.16)         | 100.6***<br>(44.16)         | 123.4***<br>(54.22)         | 152.9***<br>(42.63)         |
| Number of countries             | 45   | 45                           | 45                          | 45                          | 45                          | 45                          | 45                          |
| Observations                    | 473  | 473                          | 473                         | 473                         | 473                         | 473                         | 473                         |
| R-squared                       | 0.569  | 0.308                        |                             |                             |                             |                             |                             |
| Prob > F                        | 0.0000   |                              |                             |                             |                             |                             |                             |
| Kleibergen-Paap rk LM statistic |  | 0.0000                       |                             |                             |                             |                             |                             |
| Cragg-Donald Wald F statistic   |  | 13.40                        |                             |                             |                             |                             |                             |
| Hansen test <i>p</i> -value     |  | 0.6464                       |                             |                             |                             |                             |                             |

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



**Table 19** Direct taxes and income inequality in Sub-Saharan Africa, 1980–2018 (with bi-annual data) Source: Authors

| Variables                       | Dependent variable: Gini coefficient of income |                        |                        |                        |                     |                     |                       |
|---------------------------------|--|------------------------|------------------------|------------------------|---------------------|---------------------|-----------------------|
|                                 | (1)  | (2)                    | (3)                    | (4)                    | (5)                 | (6)                 | (7)                   |
| Independent variables           | OLS  | IV-2SLS                | IVQR 0.10              | IVQR 0.25              | IVQR 0.50           | IVQR 0.75           | IVQR 0.90             |
| Direct taxes                    | 0.645***<br>(0.169)                            | 0.962***<br>(0.285)    | 0.774***<br>(0.232)    | 0.722***<br>(0.246)    | 0.871***<br>(0.220) | 1.023***<br>(0.324) | 0.988***<br>(0.285)   |
| Democracy (polity2)             | -0.162***<br>(0.0674)                          | -0.0834<br>(0.114)     | 0.241**<br>(0.110)     | -0.00578<br>(0.0746)   | -0.0922<br>(0.113)  | -0.0182<br>(0.108)  | -0.0159<br>(0.0948)   |
| Trade openness                  | -0.0778***<br>(0.00808)                        | -0.0753***<br>(0.0166) | -0.122***<br>(0.0156)  | -0.0911***<br>(0.0177) | -0.0557<br>(0.0395) | -0.0380<br>(0.0366) | -0.0387<br>(0.0262)   |
| Foreign direct investment       | -0.00705<br>(0.0561)                           | 0.202<br>(0.141)       | 0.473***<br>(0.145)    | 0.169<br>(0.130)       | 0.0693<br>(0.162)   | 0.0638<br>(0.177)   | 0.0634<br>(0.183)     |
| Total natural resource rents    | 0.0452<br>(0.0388)                             | 0.0763*<br>(0.0449)    | 0.117***<br>(0.0416)   | 0.0648*<br>(0.0368)    | 0.0570<br>(0.0564)  | 0.0846<br>(0.0565)  | 0.0856<br>(0.0602)    |
| Urbanisation rents              | -0.00587<br>(0.0253)                           | -0.00689<br>(0.0400)   | -0.0665*<br>(0.0388)   | 0.0372<br>(0.0282)     | 0.0106<br>(0.0399)  | -0.0277<br>(0.0481) | -0.0287<br>(0.0455)   |
| Inflation rate                  | 0.0325<br>(0.0651)                             | 0.00542<br>(0.0776)    | 0.222***<br>(0.0782)   | 0.0484<br>(0.0650)     | -0.0713<br>(0.103)  | -0.206*<br>(0.109)  | -0.207***<br>(0.0793) |
| Financial development           | -0.0441<br>(0.0319)                            | -0.0506<br>(0.0520)    | -0.0963***<br>(0.0411) | -0.0674***<br>(0.0255) | -0.0432<br>(0.0404) | -0.0459<br>(0.0464) | -0.0398<br>(0.0424)   |
| Public expenditure on education | 0.713***<br>(0.226)                            | 0.792**<br>(0.392)     | 0.447*<br>(0.230)      | 0.573**<br>(0.223)     | 0.599*<br>(0.347)   | 0.543<br>(0.383)    | 0.601<br>(0.369)      |
| Primary education               | -0.0201<br>(0.0359)                            | -0.346**<br>(0.155)    | -0.260**<br>(0.103)    | -0.123<br>(0.0802)     | -0.253<br>(0.207)   | -0.478**<br>(0.209) | -0.478***<br>(0.164)  |
| Employment rate                 | -0.0438<br>(0.0430)                            | 0.0950<br>(0.0874)     | -0.102<br>(0.0634)     | 0.000655<br>(0.0283)   | 0.0897<br>(0.117)   | 0.194*<br>(0.108)   | 0.192**<br>(0.0753)   |
| Ln(GDP per capita)              | -28.53**                                       | -35.74**               | -12.20                 | -21.01*                | -38.62***           | -38.95**            | -37.82**              |





Table 19 (continued)

| Variables                       | Dependent variable: Gini coefficient of income |                                |                               |                              |                                |                               |                                |
|---------------------------------|--|--------------------------------|-------------------------------|------------------------------|--------------------------------|-------------------------------|--------------------------------|
|                                 | (1)  | (2)                            | (3)                           | (4)                          | (5)                            | (6)                           | (7)                            |
| Independent variables           | OLS  | IV-2SLS                        | IVQR 0.10                     | IVQR 0.25                    | IVQR 0.50                      | IVQR 0.75                     | IVQR 0.90                      |
| Ln (GDP per capita squared)     | (11.95)<br>2.126**<br>(0.853)                  | (14.39)<br>2.872***<br>(1.056) | (9.328)<br>1.457**<br>(0.615) | (11.70)<br>1.772*<br>(0.951) | (14.39)<br>2.948***<br>(0.982) | (16.55)<br>3.098**<br>(1.310) | (16.39)<br>3.011***<br>(1.108) |
| Ln(Remittances)                 | -0.0930<br>(0.399)                             | 0.583<br>(0.606)               | 0.133<br>(0.520)              | -0.0799<br>(0.627)           | 0.418<br>(0.573)               | 0.584<br>(0.460)              | 0.579<br>(0.443)               |
| Constant                        | 156.0***<br>(41.44)                            | 182.7***<br>(50.98)            | 92.60***<br>(29.43)           | 122.2***<br>(43.07)          | 193.1***<br>(57.35)            | 204.1***<br>(61.15)           | 211.1***<br>(69.04)            |
| Number of countries             | 45   | 45                             | 45                            | 45                           | 45                             | 45                            | 45                             |
| Observations                    | 506  | 506                            | 506                           | 506                          | 506                            | 506                           | 506                            |
| Prob > F                        | 0.0000   |                                |                               |                              |                                |                               |                                |
| Kleibergen-Paap rk LM statistic |  | 0.0000                         |                               |                              |                                |                               |                                |
| Cragg-Donald Wald F statistic   |  | 13.45                          |                               |                              |                                |                               |                                |
| Hansen test <i>p</i> -value     |  | 0.7491                         |                               |                              |                                |                               |                                |

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



**Table 20** Indirect taxes and income inequality in Sub-Saharan Africa, 1980–2018 (with annual data) Source: Authors

| Independent variables           | Dependent variable: Gini coefficient of income |                        |                       |                       |                        |                        |                        |
|---------------------------------|--|------------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|
|                                 | (1)  | (2)                    | (3)                   | (4)                   | (5)                    | (6)                    | (7)                    |
| OLS                             | IV-2SLS  | IVQR 0.10              | IVQR 0.25             | IVQR 0.50             | IVQR 0.75              | IVQR 0.90              |                        |
| Indirect taxes                  | 0.175***<br>(0.0645)                           | 0.216***<br>(0.0907)   | 0.239***<br>(0.0937)  | 0.227**<br>(0.0931)   | 0.139<br>(0.0891)      | 0.160<br>(0.120)       | 0.165*<br>(0.0991)     |
| Democracy (polity2)             | -0.175*<br>(0.0940)                            | -0.0538<br>(0.110)     | 0.0478<br>(0.105)     | 0.171<br>(0.173)      | 0.00923<br>(0.128)     | -0.0660<br>(0.119)     | -0.0872<br>(0.126)     |
| Trade openness                  | -0.0903***<br>(0.00926)                        | -0.0956***<br>(0.0112) | -0.103***<br>(0.0157) | -0.109***<br>(0.0191) | -0.0956***<br>(0.0182) | -0.0942***<br>(0.0136) | -0.0987***<br>(0.0129) |
| Foreign direct investment       | 0.0778<br>(0.0573)                             | 0.198<br>(0.124)       | 0.241*<br>(0.128)     | 0.213<br>(0.154)      | 0.151<br>(0.0986)      | 0.0904<br>(0.100)      | 0.0701<br>(0.133)      |
| Total natural resource rents    | 0.00672<br>(0.0377)                            | 0.0307<br>(0.0420)     | -0.0106<br>(0.0603)   | -0.0178<br>(0.0571)   | -0.0230<br>(0.0802)    | 0.0273<br>(0.0576)     | 0.0600<br>(0.0447)     |
| Urbanisation rate               | 0.0305<br>(0.0307)                             | 0.0135<br>(0.0365)     | 0.0236<br>(0.0405)    | 0.0192<br>(0.0411)    | 0.0177<br>(0.0859)     | 0.0146<br>(0.0817)     | -0.0420<br>(0.0498)    |
| Inflation rate                  | 0.115<br>(0.0714)                              | 0.132<br>(0.0864)      | 0.118<br>(0.0775)     | 0.0973<br>(0.0835)    | -0.0153<br>(0.0983)    | 0.0368<br>(0.0682)     | 0.104<br>(0.0862)      |
| Financial development           | 0.00345<br>(0.0207)                            | 0.0120<br>(0.0284)     | -0.0277<br>(0.0420)   | -0.0246<br>(0.0393)   | 0.00604<br>(0.0312)    | 0.0108<br>(0.0352)     | -0.0187<br>(0.0339)    |
| Public expenditure on education | 0.877***<br>(0.169)                            | 0.911***<br>(0.213)    | 0.785***<br>(0.254)   | 0.749***<br>(0.255)   | 0.955***<br>(0.246)    | 0.955***<br>(0.264)    | 0.617***<br>(0.238)    |
| Primary education               | -0.00486<br>(0.0339)                           | -0.151<br>(0.154)      | -0.0808<br>(0.124)    | -0.114<br>(0.114)     | -0.137<br>(0.159)      | -0.0724<br>(0.212)     | 0.0525<br>(0.202)      |
| Employment rate                 | -0.0938*<br>(0.0555)                           | -0.0972<br>(0.0613)    | -0.0996<br>(0.0701)   | -0.153*<br>(0.0882)   | -0.0790<br>(0.0583)    | -0.119<br>(0.0884)     | -0.224***<br>(0.0745)  |

Table 20 (continued)

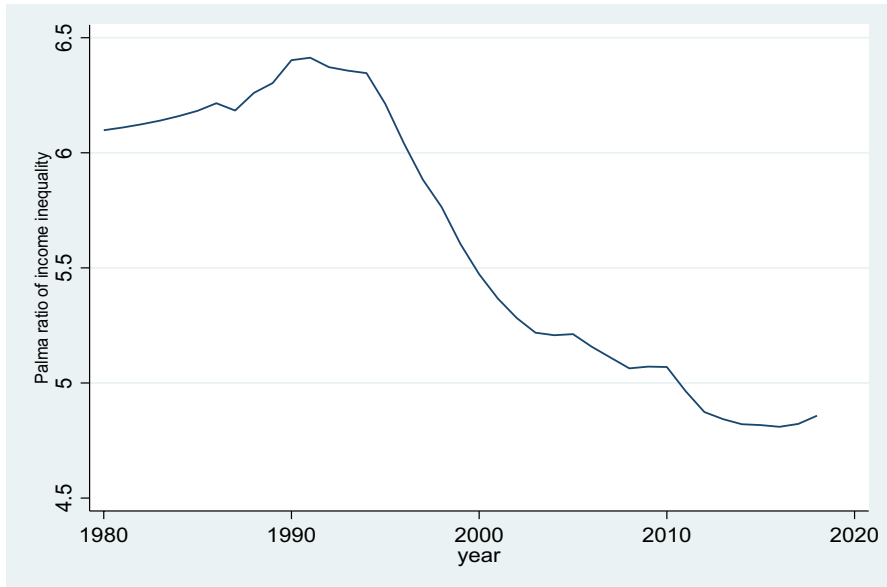
| Independent variables           | Dependent variable: Gini coefficient of income |                     |                    |                    |                     |                    |                     |
|---------------------------------|--|---------------------|--------------------|--------------------|---------------------|--------------------|---------------------|
|                                 | (1)  | (2)                 | (3)                | (4)                | (5)                 | (6)                | (7)                 |
| Ln(GDP per capita)              | OLS  | IV-2SLS             | IVQR 0.10          | IVQR 0.25          | IVQR 0.50           | IVQR 0.75          | IVQR 0.90           |
|                                 | -16.11<br>(11.83)                              | -17.99<br>(11.68)   | -9.382<br>(12.61)  | -11.80<br>(13.15)  | -30.60<br>(22.52)   | -15.36<br>(16.36)  | -23.36*<br>(13.79)  |
| Ln (GDP per capita squared)     | 1.232<br>(0.841)                               | 1.426*<br>(0.859)   | 0.875<br>(0.889)   | 1.025<br>(0.840)   | 2.249<br>(1.674)    | 1.171<br>(1.227)   | 1.687<br>(1.029)    |
| Ln (Remittances)                | -0.183<br>(0.441)                              | 0.121<br>(0.611)    | -0.153<br>(0.643)  | 0.0110<br>(0.497)  | 0.474<br>(0.971)    | -0.0653<br>(0.935) | -0.650<br>(1.004)   |
| Constant                        | 113.6***<br>(40.00)                            | 127.6***<br>(42.81) | 84.28**<br>(38.10) | 104.7**<br>(46.37) | 175.0***<br>(80.07) | 121.6*<br>(64.56)  | 155.5***<br>(49.82) |
| Number of countries             | 45   | 45                  | 45                 | 45                 | 45                  | 45                 | 45                  |
| Observations                    | 437  | 437                 | 437                | 437                | 437                 | 437                | 437                 |
| R-squared                       | 0.522  | 0.356               |                    |                    |                     |                    |                     |
| Kleibergen-Paap rk LM statistic |  | 0.0000              |                    |                    |                     |                    |                     |
| Cragg-Donald Wald F statistic   |  | 13.23               |                    |                    |                     |                    |                     |
| Hansen test <i>p</i> -value     |  | 0.6540              |                    |                    |                     |                    |                     |

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

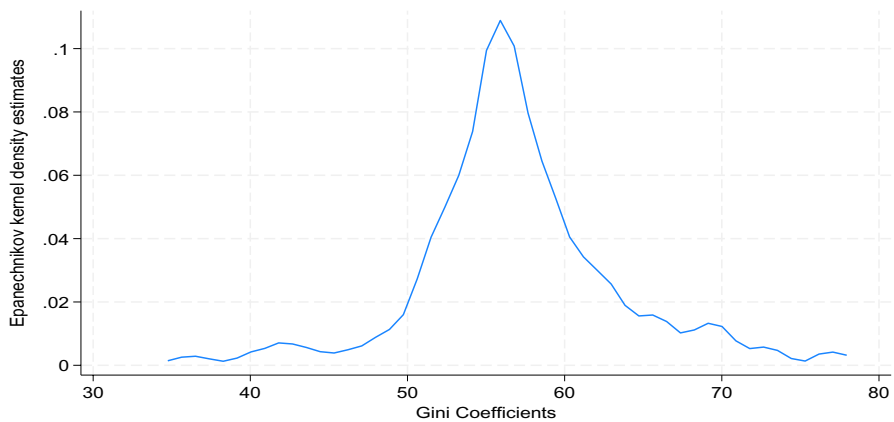


## Appendix 2: The figures

See Figs. 4, 5 and 6.

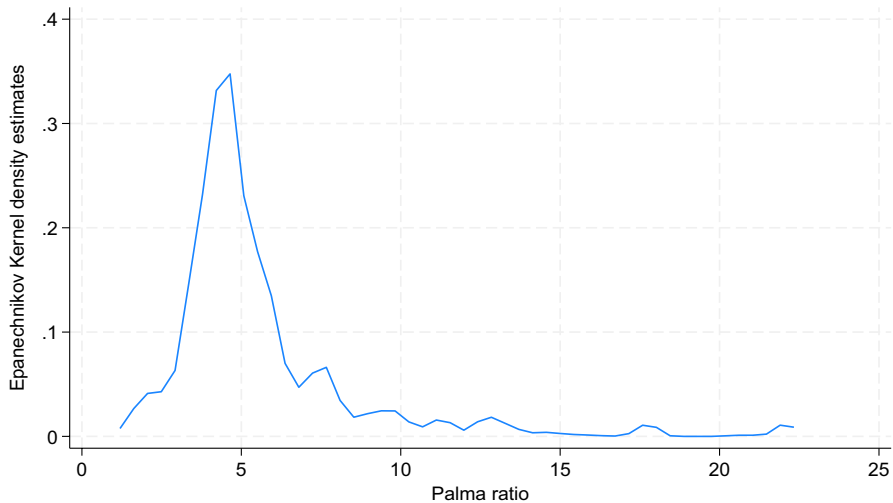


**Fig. 4** Trends of income inequality measured by Palma ratio in SSA, 1980–2018. Source: Authors' construction using data from UNU-WIDER (2021a)



**Fig. 5** Epanechnikov Kernel density estimate of the Gini coefficient. *Notes* This figure is created using the Epanechnikov kernel density estimation Source: Authors





**Fig. 6** Epanechnikov Kernel density estimate of the Palma ratio of income. *Notes* This figure is created using the Epanechnikov kernel density estimation Source: Authors

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