Working paper

Personal income tax reforms and income inequality in African countries

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Abstract

This study sheds light on the potential of personal income tax (PIT) to address inequality in African countries. We employ new data on PIT design and reforms from the TaxDev Employment Income Taxes Dataset (EITD) alongside data on pre-tax income distributions from the World Inequality Database (WID) to model the redistributive capacity of PIT regimes in African countries, and the extent to which reforms to these regimes between 1995 and 2020 have affected this potential. We find that, on average across the study period, PIT could reduce inequality by around 4.1 Gini points in African countries if applied to the entire income distribution. However, after adjusting for informal incomes, this potential increases to around 4.7 Gini points. Focusing specifically on policy design, cross-country regressions show that the level of the top marginal PIT rate, and the point at which it is applied, matter most for its potential effects on inequality. Crucially, we find that PIT reforms over the period in question have, on average, lessened the redistributive capacity of PIT.

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Acronyms

CEQ	Commitment to Equity Institute
CV	Coefficient of Variation
EITD	Employment Income Taxes Dataset
GDP	gross domestic product
IED	Informal Economy Database
IMF	International Monetary Fund
LIC	low-income country
LMIC	lower-middle-income country
MIC	middle-income country
NNI	net national income
OECD	Organisation for Economic Co-operation and Development
PIT	personal income tax
RS	Reynolds-Smolensky index
WID	World Inequality Database

Executive summary

Policy-makers seeking to tackle rising inequality in low-income countries (LICs) and middle-income countries (MICs) often have a more limited suite of tools at their disposal than their counterparts in, for example, Organisation for Economic Co-operation and Development (OECD) countries. Among other things, this is due to their small tax bases and under-financed or under-developed social transfer mechanisms. While almost all countries worldwide have some form of personal income tax (PIT), the capacity to achieve income redistribution via PIT in LICs and MICs – and how this capacity has been affected by reform – is not well researched or understood. Specifically, we know little about how policy design features – such as the structural progressivity or level at which marginal rates are set – affect labour market incentives on the intensive and extensive margins, which in turn influence the effectiveness of PIT as a redistributive tool.

This working paper presents the findings of research looking at the capacity of PIT to affect inequality outcomes in African countries. One of the primary barriers to cross-country research in this area is the paucity of data. However, we harness new data on PIT design and reforms from the TaxDev Employment Income Taxes Dataset (EITD) alongside data on pre-tax income distributions from the World Inequality Database (WID) to model the redistributive capacity of PIT regimes in African countries, and the extent to which reforms to these regimes between 1995 and 2020 have influenced this.

We focus on a simple measure of redistributive capacity, namely the Reynolds-Smolensky index (RS), which compares pre- and post-tax inequality across the income distribution. We consider both the Gini Coefficient and Palma Ratio as outcomes of interest. We find that, when applied to the entire income distribution, PIT could reduce inequality by around 4.1 Gini points on average in African countries across the study period. After adjusting for informal incomes, this potential increases to around 4.7 Gini points. However, this average figure masks a range of experiences across the continent; in some countries, the application of PIT reduces the Gini by as much as 10.5 points.

Our analysis of reforms to PIT in African countries since the 1990s paints an interesting picture: on average, reforms – broadly defined as any change in the policy design of PIT, such as rates, number of bands, tax-free allowances or thresholds – have lessened its redistributive capacity. One potential explanation for this finding is

that countries in our sample have, historically, preferred not to use PIT as a redistributive tool, instead focusing on administering it as efficiently as possible in order to raise sufficient revenues to allow for redistribution via the spending side of the budget, should government desire. However, if we are to better understand the role of PIT in mediating inequality in lower-middle-income countries (LMICs) as processes of development, industrialisation and structural transformation bring more of the workforce into formal employment, findings such as those contained herein are crucial.

Our main focus is on the policy design of PIT, i.e. how the features of the tax – the existence of a tax-free threshold, number of rates and bands, at what level the top marginal rate is set – affect redistributive potential. However, by combining the EITD and WID data, the analysis moves closer to understanding effective progressivity (how progressive the tax is in practice) rather than structural progressivity (how progressive it is in principle). Yet, given the features of labour markets in many LMICs, namely that many individuals earn low incomes – often informally and outside the purview of the tax authorities – we do not claim that the findings presented here show the 'true' effective progressivity; rather, they contribute to an emerging literature that estimates the redistributive potential or 'capacity' of PIT.

Regarding specific design features, the results of cross-country regressions show that the level of the top marginal PIT rate, and the point at which it is applied, have the strongest influence on redistributive capacity. We find that a dummy variable identifying reform years is statistically significantly associated with a reduction in redistributive potential; reforms to the top marginal rate – and the point in the income distribution at which it is applied – are associated with the largest changes in redistributive potential over our study period.

1 Introduction

Globally, income inequality has risen in recent decades (see Gradín and Oppel, 2021). One important tool for tackling income inequality and supporting redistributive aims is PIT. Yet, in LICs and MICs, PIT often applies to only a small share of the labour force, and thus its redistributive capacity is constrained (e.g. Benedek et al., 2022; Jensen, 2022). While this can be attributed to large informal sectors (e.g. Sabirianova Peter et al., 2010), low average incomes or poor administrative capacity (Ardanaz and Scartascini, 2013) and the policy design of PIT can also play an important role in influencing its redistributive capacity. For example, a PIT that is designed without a tax-free allowance creates significant extensive margin disincentives, while one that features marginal rates that climb too steeply (given the underlying distribution of employment income) might affect incentives on the intensive margin. Recent findings show that, in one in four African countries, an individual earning a (formal) wage equal to the $1.90 per day poverty line would be taxed on income and that, as of 2019, seven countries have no tax-free allowance in place (McNabb and Granger, 2023). McNabb and Granger (2023) have also shown that the average African PIT is reformed only every five or six years.[1] This naturally leads to concerns over the extent of fiscal drag, which can exacerbate disincentives linked to the lack of tax-free allowance over time. Recent research has even shown that perceptions of progressivity – which can be influenced by the existence of progressive tax schedules – affect people's willingness to pay tax in LMICs (Hoy, 2022). We argue that, amid growing interest in studying effective tax burdens in LMICs, there is also significant scope to better understand the potential for PIT design to minimise incentive effects and more strongly influence inequality outcomes in practice in such contexts.

The main contribution of this study is a cross-country analysis combining two novel data sources to provide rich, descriptive analysis on how the redistributive capacity of PIT has evolved over time in African countries. The primary limitation with attempting to answer this question lies in the difficulty in observing – or approximating – the underlying pre-tax income distribution for a panel of countries over a long timeframe. Related studies have taken various approaches to understanding PIT progressivity across countries, often driven by data availability. Sabirianova Peter et al. (2010) and McNabb and Granger (2023) examine the structural

[1] The average in OECD countries is every 1.5 years.

progressivity of PIT systems, namely how progressive the tax system is by design, without accounting for underlying income.[2] Studies examining effective progressivity seek to understand how progressive a PIT system is in practice by applying the tax rules to the observed underlying income distribution (see Commitment to Equity Institute (CEQ) studies). Gerber et al. (2020) and Vellutini and Benitez (2021) have attempted to understand the structural progressivity of a PIT system across countries, computed on some estimate of the underlying income distribution. The present study belongs to this latter stream of work. While our analysis faces some of the same challenges as previous studies with respect to approximating the employment income tax base, we suggest a new approach to exploring the redistributive capacity of PIT by combining detailed data on statutory PIT design from the EITD with annual data on pre-tax income distributions for African countries from the WID.[3] Studies following this rationale point out that, while PIT may be progressive by design in LMICs, it might fail to achieve redistribution in practice, often due to its limited reach (e.g. Benedek et al., 2022).

We find that, on average between 1995 and 2020, PIT displays fairly significant redistributive capacity across income distributions, as measured by the RS (i.e. the change between pre- and post-tax Ginis; Reynolds and Smolensky, 1977). This redistributive capacity has however declined over the period in question and varies quite starkly across countries. Regarding the design elements of PIT, fixed effects regressions show that the position in the income distribution – and the magnitude – of the top marginal PIT rate matter most for the redistributive capacity of a PIT system. Detailed data from the EITD also enables us to focus on PIT reforms. Our results suggest that reforms to PIT policy in African countries between 1995 and 2020 have not, on average, improved its redistributive capacity. Indeed, the inverse is often true. Specifically, reforms to top marginal rates (which reforms have, more often than not, reduced) have had a negative effect in this regard. This confirms the analysis of Gupta and Jalles (2022), who find that recent reforms to PIT design have worsened inequality in sub-Saharan Africa.[4]

Our findings are subject to a number of limitations. We do not attempt a holistic analysis of the effect of the entire tax and transfer system on inequality. For such analysis, we would refer the reader to, for example, work by the CEQ (Lustig, 2018) or tax-benefit microsimulation under the SOUTHMOD project (Decoster et al., 2019). However, by focusing solely on the role of PIT in a consistent manner over time, we contribute to a deeper understanding of its

[2] See also the OECD's *Taxing Wages* publications.

[3] The analysis might best be referred to as 'partial static fiscal incidence', as we do not simulate the effects of other taxes or transfers beyond that of PIT, or the behavioural effects induced by taxes.

[4] At the same time, revenue from PIT in African countries has been growing over recent decades, but there is evidence that this is attributable more to underlying economic developments than to policy design of PIT (Benedek et al., 2022).

redistributive capacity in LMICs and, specifically, how reforms have influenced this.

The paper is structured as follows. 12 reviews relevant literature. 15 introduces the two datasets utilised in this study, including some first descriptive statistics on variables of interest. It also outlines our methodology and empirical approach. In 27, we present and discuss our findings, before introducing further adjustments to our income measure in 34. 40 concludes with a discussion of key findings and policy implications.

2 Literature review

The role of taxation in influencing inequality and redistributive outcomes has received considerable attention, ranging from theoretical considerations regarding the optimal rate (Hemming and Kay, 1980) to voter preferences (Meltzer and Richard, 1981). It is well understood that taxation – particularly direct taxation –applied in the 'right' way can act as a powerful redistributive tool. However, in practice this may often be difficult to achieve. This is especially true in LMICs, where informality is often high and enforcement capability lacking. In the following, we discuss research focusing on PIT and its redistributive capacity.

PIT is one of the most common forms of direct taxation: Seelkopf et al. (2021) find that more than 90% of countries globally levy a PIT, while in the median country some form of PIT was introduced prior to the 1950s. The authors suggest that the implementation of a PIT was often a result of democratisation. For example, the development of party systems in contexts of low bureaucratic capacity (von Schiller, 2015) and an increase in so-called 'bureaucratic inquisition' imposed new reporting duties on income earners (Seligman, 2004). For many LMICs, a PIT was adopted from colonial regimes (Lieberman, 2002), and might retain features of colonial tax systems even today.

PIT has often been framed as the hallmark of progressive taxation (e.g. Ganghof, 2006; Aidt and Jensen, 2009). This may be true for advanced economies. However, numerous studies point to the fact that there is little to no progressivity in the PIT systems of LMICs. Sicat and Virmani (1988: 137) found that countries with high marginal rates often only applied those 'at extremely high income levels, at which level no taxpayers are likely to be subject to the tax'. More recent studies draw similar conclusions. Benedek et al. (2022) examined PIT in 157 'emerging and developing economies' between 2006 and 2018. They find an increase in PIT-to-gross domestic product (GDP) revenue during the 1990 to 2019 period, but this was driven more by economic development than changes in tax system design. LICs – which showed greater progressivity in comparison to more advanced economies – often relied on a broader set of tax instruments, and thus not exclusively on PIT. With the size of collections being considerably lower in LICs, Benedek et al conclude that PIT's redistributive capacity has remained limited.

Jensen (2022) studied 100 household surveys from countries at different income levels, including 20 LICs and 28 LMICs. He found that the share of the population subject to PIT increases with income,

but that this varies across development levels. In the poorest LICs, the employee tax share is practically zero aside from a steep increase in the top percentiles of the income distribution. In LMICs, the employee share is concentrated among the top three deciles; in comparison, in emerging economies this applies to the four middle deciles (four to seven). Overall, Jensen's study supports structural progressivity in LICs and LMICs by design, but due to its inefficient application and resulting small tax base it barely achieves any redistributive effect. In their study of over 100 countries from 2007 to 2018, Vellutini and Benitez (2021) find that the size of the PIT base – i.e. the number of individuals who were subject to it – was more of a constraint on redistribution than the structural design. At the same time, they did not find evidence of the so-called 'Robin Hood paradox', whereby there are a greater number of redistributive policies (or redistribution occurs to a greater extent) in countries with higher initial inequality.

Recent research sheds light on another important aspect of a progressive system: that it can actually increase people's willingness to pay tax. Hoy (2022) conducted a randomised survey of 30,000 individuals in 10 LMICs and found that individuals who received information that taxes were progressive in their country were more willing to pay tax. This was particularly the case where respondents received information that ran counter to their pre-existing beliefs about the progressivity of taxes in their country.

Some authors have suggested that PIT should not play a pivotal role in the pursuit of redistributive outcomes in LMICs. Bird and Zolt (2005) argue that PIT may be an inefficient tool due to its administrative or political costs, its lack of comprehensiveness and its minimal effect on inequality and poverty. Others argue that a primary factor may be legislative malapportionment, i.e. biased political representation, particularly at reform moments. Ardanaz and Scartascini (2013) found that, across 50 countries between 1990 and 2007, more unequal countries in terms of income and wealth show higher levels of malapportionment and, ultimately, lower PIT-to- GDP ratios (see also Ardanaz and Scartascini, 2011).

We contribute to this debate by providing a more granular analysis of the role PIT can play in LMIC contexts. We take country-specific income distributions as well as PIT systems and reforms into account. Generally, tax reforms have been associated with decreases in inequality in LMICs, although notably the reverse has been observed for sub-Saharan Africa (Gupta and Jalles, 2022). On a global level, observations of reform processes over time imply that governments have moved away from complex, progressive systems towards simpler, flatter PIT schedules (Sabirianova Peter et al., 2010). We build on such findings and use established indices and concepts to measure pre- and post-income tax inequality and effective progressivity to speak to this debate. Specifically, we expand current insights in terms of the timeframe of comparison as

well as the level of detail on PIT systems and design. A key focus is assessing the extent to which smaller tax bases due to informality in labour markets mediate the redistributive capacity of PIT. The following section introduces the data sources utilised and methods employed before presenting some summary statistics and exploring high-level trends in inequality and tax reform.

3 Data and methodology

3.1 Measuring income and inequality

The choice of income measure when studying PIT systems and burdens across countries and over time matters. There is a key trade-off between accuracy (i.e. closely approximating gross earned income from labour across the distribution) and data coverage. The relative weightings of these trade-offs will, naturally, differ according to the sample and exact outcomes being measured. An ideal scenario would be to observe panel data on *actual* wage distributions of employees across countries and over time.[5] While many African countries now capture such data electronically for recent years (by definition, only those who are tax compliant), the data is more suited to individual studies of reform episodes (e.g. Jouste et al., 2021, who examine the effects of a PIT reform in Uganda in 2012/13). This is due to the fact that administrative tax records contain sensitive information and are kept in secure locations, as well as the often relatively short time period covered.

Income (or consumption) data from household surveys (such as those used in CEQ and SOUTHMOD studies) are likely to capture the distribution of earnings more accurately at one point in time. However, depending on the frequency of surveys, they do not offer great coverage over time, and thus the likelihood that surveys would exist close to either side of a reform is low. Other measures of average incomes such as GDP per capita (which is readily available across countries and over time) have generally good data coverage and can be a useful anchor point for analysis (e.g. McNabb and Granger, 2022; Vellutini and Benitez, 2021). However, this is a fairly crude proxy of average earnings, especially in resource-rich LMICs. Labour Force Surveys can more accurately capture average *wage* earnings, but again – especially for LMICs – they suffer from the issue of infrequency. Such data can be found in the International Labour Organization (2023), but coverage for African countries is rather sparse. Labour Force Surveys are used as a measure of average earnings in the OECD's *Taxing Wages* publications.

The approach taken in this study has not, to the best of our knowledge, been applied elsewhere. Given our priority of obtaining annual data on the shape of *pre-tax* income distributions over time in African countries, we use data from the WID. This data includes

[5] This is at least true for the study of intensive margin effects of PIT reform. However, restricting the sample to taxpayers who currently file does not allow for any exploration of effects on the extensive margins.

average incomes and relative income shares at each percentile of the distribution, and has the advantage of a long and consistent coverage period that allows us to utilise the detailed information on tax systems contained within the EITD to its full potential. We focus on a variable that is constructed following a fiscal income notion; that is, income which is or should be reported on income tax declarations. This measure is thus broader than taxable employment income per se. More specifically, it is captured by net national income (NNI). In the WID, NNI represents a country's GDP minus the consumption of fixed capital (i.e. depreciation of capital stock) plus net foreign income (income generated abroad but accrued to domestic residents minus domestic income sent abroad). NNI can thus present a meaningful proxy that seeks to capture average individual income.[6][7] We further use the percentile distributions of per capita NNI based on an equal split across adult household members.[8] We examine the relative shares of pre-tax income held and average incomes earned in each percentile of a country's income distribution for the period 1995–2020 (the period covered by the EITD). The percentile distributions allow us to compute inequality measures – particularly the Gini Coefficient and Palma Ratio – which we compare across (i) pre- and post-tax and (ii) non-reform and reform years. The data as taken from the WID does not distinguish labour from capital income, and thus suffers the same drawbacks as Vellutini and Benitez (2021), for example.[9] Similarly, it does not distinguish between formal and informal incomes. Nevertheless, while this data has certain disadvantages, it goes further than studies which exogenously determine or simulate income distributions. We hence consider the results to be complementary to existing cross-country studies on the redistributive capacity of PIT. In 34, we attempt to adjust income data to take account of informality.

Looking at pre-tax income distributions for a sample of African countries, we can observe some initial trends. Within-country Gini Coefficients have, against global trends, been largely falling over the past three decades.[10] Figure 1 shows that the average pre-tax Gini in 1995 for African countries stood at 60.77; in 2020, the same figure was 58.82, and there has been an average increase in inequality since 2017. However, this average figure masks notable variations across the continent. Figure 2 plots the difference in pre-tax Ginis between 1995 and 2020 (our study period), highlighting significant heterogeneity in inequality outcomes.

[6] While NNI can be further decomposed into the income of households, corporations and governments, such detailed information is not available for African countries.

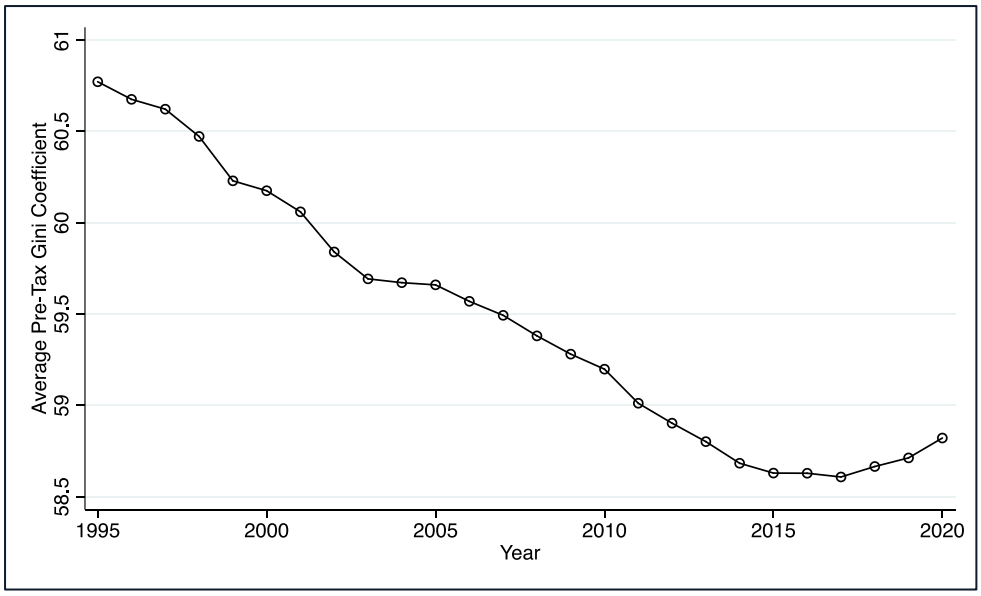
[7] Of the different income concepts captured in CEQ studies, our measure is closest in spirit to Market Income.

[8] We convert constant into current local currency units for each country using a national income price index also included in the WID.

[9] In countries where income is subject to a comprehensive income tax (where both employment earnings and capital incomes are taxed together under one PIT), this weakness will not apply.

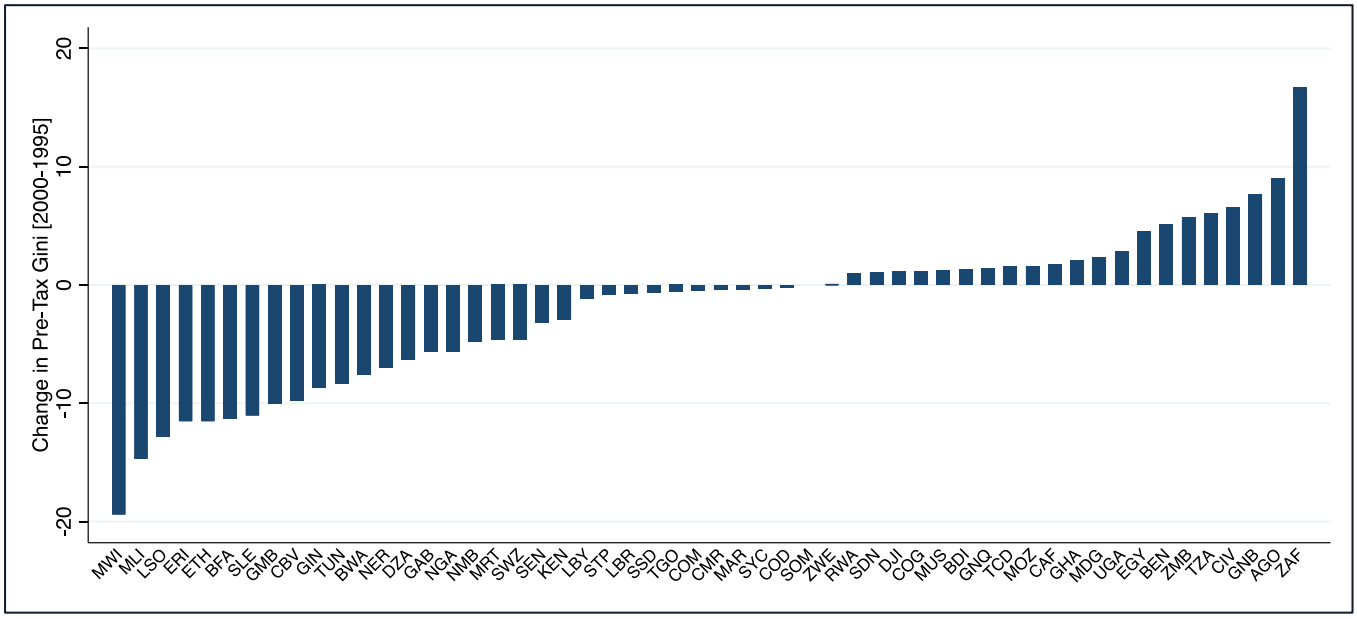
[10] This fits with recent evidence in Granger et al. (2022) that shows similar reductions in inequality in LICs and LMICs between 1980 and the present, whereas in upper-middle-income countries and high-income countries the reverse is true.

Figure 1 Average pre-tax Gini Coefficient in Africa, 1995–2020



Source: Authors' calculations from WID (2022)

Figure 2 Pre-tax Gini Coefficients, 1995–2020

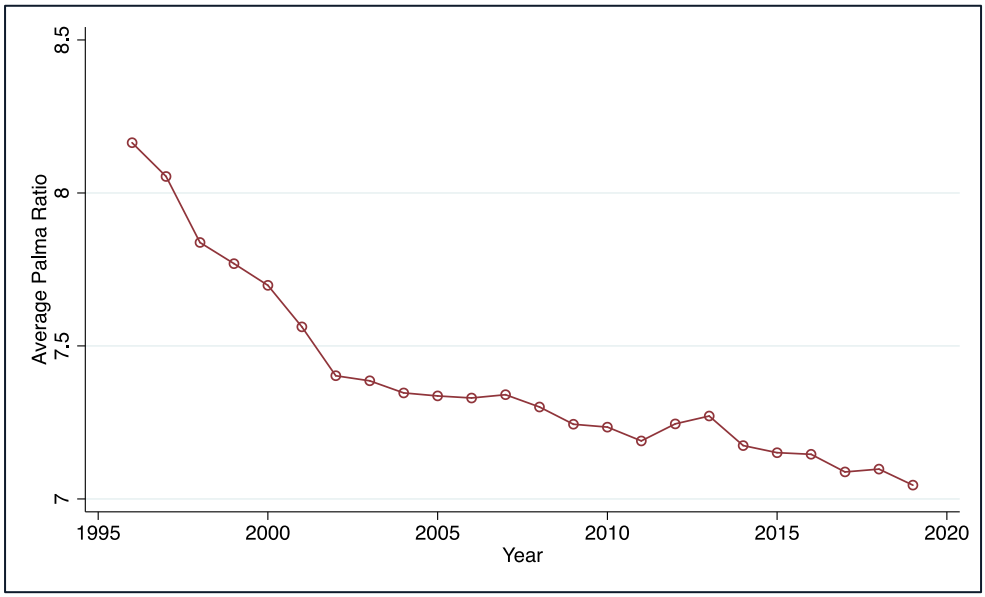


Source: Authors' calculations from WID (2022)

For a fuller picture, we also examine the Palma Ratio, which is computed as the share of income held by the top 10% of individuals divided by the share held by the bottom 40%. A higher ratio thus implies greater income inequality. The Palma Ratio not only yields a more accessible measure of inequality to policy-makers and the public, but is also arguably a more appropriate measure in contexts where the share of income held by the 'middle' of the distribution is broadly constant over time (as observed by Palma (2006); Cobham

and Sumner (2013)).[11] But when it is shares of income at the top and bottom of the distribution that are most frequently driving changes in income inequality, there is a strong case for refocusing attention on a measure such as the Palma. We replicate Figure 1 for the Palma Ratio in Figure 3.

Figure 3 Average pre-tax Palma Ratio in Africa, 1995–2020



Source: Authors' calculations from WID (2022)

Figure 3 shows a similar trend to that of the Gini Coefficient, namely that average inequality on the African continent has been decreasing over our sample period. However, the Palma tends to show that much of this decrease occurred in the late 1990s and early 2000s. After this period, the decline has been more modest. It suggests that, for our sample, there may have been more variation in the 'middle' (i.e. the 41st to 90th percentile (p)) than at the tails of the distribution (i.e. the bottom and top). We test for this by calculating the Coefficient of Variation (CV) as shown in Table 1. A key conceptual underpinning of the Palma Ratio is that there is little variation in the share of middle incomes over time. We would expect – as presented in Cobham and Sumner (2013), for example – that the 'middle 50%' or p41–p90 would show the smallest CV, and thus changes in income levels.[12] However, this is not the case for our sample. Instead, the smallest CV is observed for the top 10%. We do observe higher variation for the bottom 40% in terms of the CV. This suggests that focusing on the Palma Ratio might yield additional insights beyond the Gini Coefficient. In the results section below, we begin with the

[11] This is because the Gini is more sensitive to the middle part of an income distribution, and less sensitive to changes at the top or the bottom (Cobham and Sumner, 2013).

[12] The CV is calculated as $CV = \frac{\sigma}{\mu}$, where σ is the standard deviation and μ the mean of each percentile grouping (e.g. p91–p100) for a given country during our study period (1995–2020).

Gini Coefficient before analysing additional insights from the Palma Ratio.

Table 1 Coefficient of Variation over time: average, by country

Percentiles	Average Coefficient of Variation	Average share of income held
p91–p100	4.9%	53%
p1–p40	9.7%	8%
p41–p90	5.3%	39%

Source: Authors' calculations from WID (2022)

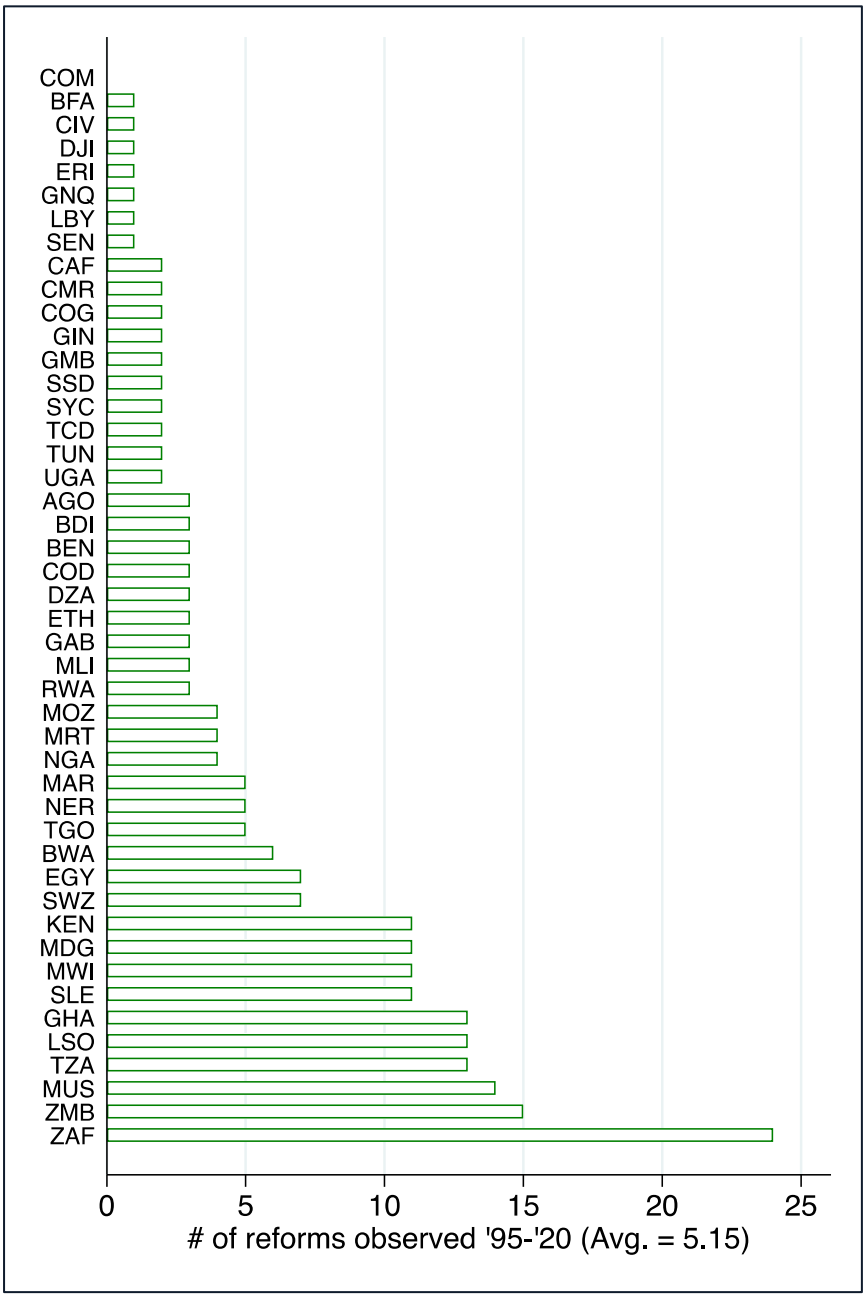
3.2 The Employment Income Taxes Dataset

The TaxDev EITD (McNabb, 2022) is a novel panel dataset capturing information on the statutory design of all taxes on employment income for 54 African countries since 1995. It consolidates information from publicly-available sources such as national tax laws, accounting guides and International Monetary Fund (IMF) country reports to provide detailed information on PIT thresholds, rates, allowances, credits etc. As such, it allows us to assess income tax burdens levied on representative individuals at each percentile of a country's income distribution. Crucially, the information contained within the EITD also identifies reforms to PIT systems. We define a tax reform as any adjustment to bands, rates, allowances, deductions or credits in any given country-year observation. In the sample of 1,120 country-years, we observe 237 PIT reforms, which equates to roughly one in every five years on average; some countries (e.g. South Africa) reformed their PIT systems on an almost annual basis (e.g. index thresholds and bands); others (e.g. the Comoros) made no reforms across the study period. Figure 4 highlights the frequency of reform across countries in our sample.

Concerning the features of PIT systems in Africa, we observe that the average top marginal rate fell from around 39% in 1995 to 31% in 2020 (which is also reflective of a global trend during recent decades). The average number of tax bands fell by around a third, from 7.5 to just over five in the same period.[13] Additional summary statistics are presented below after a brief overview of the methodology that brings together both data sources.

[13] See McNabb and Granger (2023) for a more thorough overview of such trends.

Figure 4 PIT reforms in African countries, 1995–2020



Source: Authors' calculations from EITD (2022)

3.3 Methodology and concepts

The main aims of our analysis are to explore inequality in pre- and post-tax incomes to understand the redistributive capacity of the PIT tax system of each country-year, and to understand whether – and how – PIT reforms have affected this capacity.

We refer to 'capacity', as we simulate the effect of statutory PIT incidence on a representative taxpayer in each income percentile. We thus assess to what extent the design of PIT is redistributive in nature rather than its actual effects, as this would also require consideration of which incomes PIT is levied on, and the ability of the tax administration to apply it. It is important to reiterate that we refer to PIT and not fiscal systems as a whole, as numerous other instruments on the collection and spending side affect the overall incidence of the fiscal system.

3.3.1 Pre- and post-tax income

To assess the redistributive capacity of PIT, we compute post-tax Gini Coefficients by applying tax liabilities of the PIT system of each country-year, which includes all tax thresholds, rates, credits, allowances and deductions, to a representative taxpayer in each income percentile. They are an unmarried resident and do not claim any deductions (for example family allowances, mortgage interest deductions or similar), beyond those which are universally available within the PIT system. The representatives' pre-tax income is equal to the average income of every individual of the same income percentile in the WID (2022). We account for the statutory incidence of PIT as set out in the law, and hence do not consider behavioural effects, nor do we take account of administrative capacity.

To compare pre- and post-tax income (Z_{pre} and Z_{post} respectively), we apply the tax liabilities L at each percentile j of every given country-year i to our pre-tax incomes. Thus, L_{ji} represents the tax liability for our representative taxpayer in percentile j in country-year i.

$$Z_{pre,ji} - L_{ji} = Z_{post,ji} \quad [1]$$

The tax-adjusted percentile distributions allow us to compare pre- and post-tax Gini Coefficients and Palma Ratios to elicit the redistributive capacity of PIT. Specifically, we compute the RS for each country-year *i* (RS_i) to analyse the difference in inequality measures of pre- and post-tax incomes. Below, G_{X_i} denotes the Gini Coefficient based on pre-tax income percentile distributions of a given country-year. $G_{N_i(X_i)}$ measures the Gini Coefficient after the PIT system in a given country-year has been applied. The RS shows the redistributive capacity of PIT by indicating whether it has an inequality-increasing or -decreasing effect on income distributions.

$$RS_i = G_{N_i(X_i)} - G_{(X_i)} \quad [2]$$

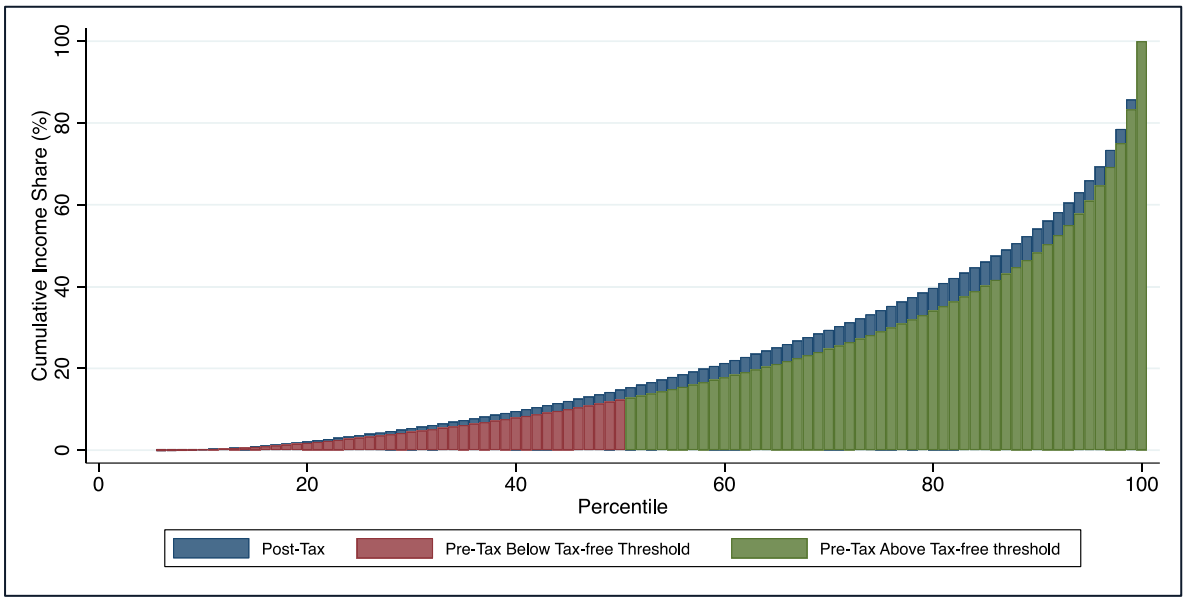
We also consider the change in the RS across time to tease out how the redistributive capacity of PIT has evolved. This specifically helps us to understand which type of reforms affected the redistributive

capacity of PIT. We thus compare the RS index of year i with the previous country-year, $i-1$. We define the difference D_i as:

$$D_i = RS_i - RS_{i-1} \quad [3]$$

In order to visualise our method, Figure 5 shows the shape of the pre-tax distribution of income for Uganda in 2015, according to whether or not individuals were subject to PIT (for this particular country-year, the 52nd percentile is the first in which average income is above the tax-free threshold), and the post-tax income distribution. The effects of applying PIT can be clearly seen on the shape of the income distribution.

Figure 5 Pre- and post-tax income shares in Uganda, 2015



Source: Authors' calculations from EITD (2022) and WID (2022)

3.3.2 Descriptive statistics

Summary statistics of our dependent and independent variables are shown in Table 2. The main dependent variable of interest, RS_i , is almost always negative, with an average reduction of 4.1 points (pp) for Gini Coefficients and -1.55 for the Palma Ratio. This suggests that, on average, PIT systems in African countries have some redistributive capacity. Yet, this appears to decline over our study period. While the average value of RS_i for the Gini Coefficient in 1995 stood at 4.2 points, it fell to 3.9 in 2020. There is also significant variation across countries; in 2020, for example, the value of RS_i ranged between -0.11 (Côte d'Ivoire) to -0.0001 (Somalia). Annual differences (D_i) for both the Gini and Palma Ratio are marginal on average. 47 shows the distribution of the RS (for the Gini Coefficient) for our study sample.

The average level of inequality captured by the pre-tax Gini Coefficient is high, at 59.7. In addition, the Palma Ratio shows us that the top 10% in African countries hold on average around 7.4 times as much as the bottom 40%. Regarding PIT systems, the average number of bands is just over six, but ranges from one to 20. The average top PIT rate was close to 35%, while in just 7% of country-years a ceiling was placed on the effective tax rate. For a majority of country-years (88%), PIT systems incorporate a personal deduction of some form.

We also look at which income levels PIT applies and hence a positive amount of tax is payable. Taxpayers subject to PIT typically earn 0.98 times median income. Yet this differs starkly across countries. Some PIT systems tax all earnings (no deduction exists), while others only tax incomes at 24 times the median income. The point at which taxpayers are subject to the top PIT rate ranges from all income (in the case of a flat rate with no deduction) to 600 times the median income of a given country-year. Concerning PIT reforms, we observe this for roughly one-quarter of country-years. We include a list of all countries in our empirical analysis in 48.

Table 2 Descriptive statistics

Variable	*Obs.*	*Mean*	*Std. Dev*	*Min*	*Max*	*Source*
Dependent Variables (Y_i)						
RS_i Gini	1,118	-0.041	0.019	-0.105	0.040	Calculated from World Inequality Lab (2022)
D_i Gini	1,117	0.000	0.007	-0.060	0.051	
RS_i Palma	1,128	-1.554	1.074	-6.947	1.152	
D_i Palma	1,064	0.014	0.286	-1.581	5.653	
Independent Variables:						
Gini Pre-tax	1,118	0.597	0.060	0.460	0.826	
Palma Pre-tax	1,128	7.429	3.366	3.155	24.037	
# Bands	1,118	6.131	2.926	1.000	20.000	EITD (McNabb, 2022)
Top PIT Rate	1,118	0.352	0.114	0.100	0.650	
Personal Deduction Dummy	1,110	0.881	0.324	0.000	1.000	
Ceiling Dummy	1,118	0.072	0.259	0.000	1.000	
Flat Rate Dummy	1,118	0.029	0.167	0.000	1.000	
PIT Kicks In (as a share of median income)	1,118	0.980	1.520	0.000	23.821	
Top Rate Kicks In (as a share of median income)	1,118	16.584	31.107	0.000	599.69	
Reform Dummy	1,118	0.210	0.408	0.000	1.000	
# Bands (Reform Dummy)	1,118	0.073	0.261	0.000	1.000	
Top PIT Rate (Reform Dummy)	1,118	0.103	0.304	0.000	1.000	
Personal Allowance (Reform Dummy)	1,140	0.166	0.372	0.000	1.000	

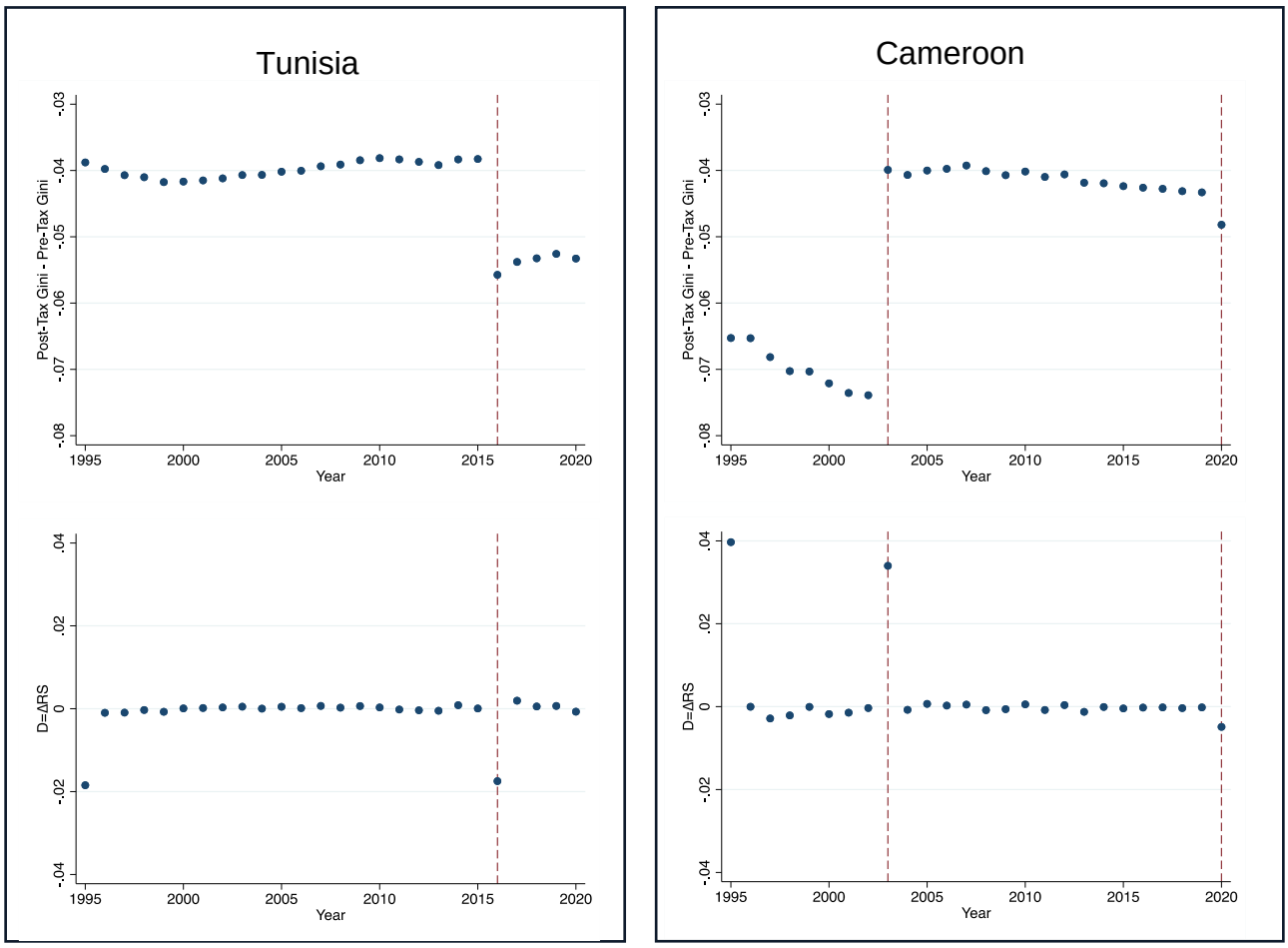
Top Threshold (Reform Dummy)	1,140	0.137	0.344	0.000	1.000	
∆.# Bands	1,058	-0.085	0.813	-13.000	4.000	
∆.Top Rate	1,058	-0.003	0.026	-0.300	0.150	
∆.log (Personal Deduction)	904	0.067	0.288	-1.764	3.689	
∆.log (Top threshold)	1,038	0.059	0.411	-3.689	5.521	
log Per Capita GDP (USD)	1,140	6.982	1.088	4.683	10.036	IMF WEO (IMF, 2022)
log Inflation	981	1.626	1.111	-3.305	6.242	WDI (World Bank, 2022)
Electoral Democracy Index (v2x_polyarchy)	1,140	0.399	0.186	0.067	0.789	V-Dem; Coppedge et al. (2021)
Civil Society Participation Index (v2x_cspart)	1,140	0.639	0.227	0.038	0.954	

3.3.3 Tax reforms

We define a tax reform R_i as equal to 1 for a country-year *i* in which a reform occurred, and zero otherwise. To define different types of reform, we compute specific reform variables that capture the type T_i of an adjustment, such as changes in the number or range of bands, and change in rates, allowances or credits.

We illustrate our methodological approach with the example in Figure 6, which shows the evolution of the RS (Gini) in Tunisia and Cameroon between 1995 and 2020. Tunisia implemented only one reform to the PIT system during this period, in 2016, when the government changed rates and thresholds and reduced the number of PIT bands by one. For Cameroon, there was a major PIT reform in 2003, which adjusted thresholds and rates and reduced the number of bands from 11 to four. The left-hand panel of Figure 6 displays the RS_i and D_i for Tunisia in the upper and lower quadrants respectively. On the right-hand side the same metrics are shown for Cameroon. For both countries, we observe a change in the redistributive capacity of PIT following reforms (denoted by dashed red lines). For Tunisia, prior to the 2016 reform the redistributive capacity of PIT yielded about 0.04 point reductions in the Gini Coefficient. Post-reform, this increased to 0.06. From the lower panel, we can see that, overall, there is little change in the redistributive capacity of PIT on an annual level, aside from the reform year. However, for Cameroon we see the opposite effect: following the reform of 2003, the redistributive capacity of PIT decreases from around 0.075 to 0.04. While there are a range of experiences around PIT reforms, more often than not countries' experiences mirror those of Cameroon – i.e. reforms decrease the redistributive capacity of PIT – rather than Tunisia.

Figure 6 PIT reform and inequality in Tunisia and Cameroon: *RS$_i$ & D$_i$*



Source: Authors' calculations from EITD (2022) and WID (2022)

We estimate the drivers of redistributive capacity of the PIT as follows. A fixed effects regression model is used to control for time-invariant country characteristics which may be correlated with our independent (tax reform) variables. This could reflect governance outcomes, poverty levels or socioeconomic characteristics, for example. We estimate the following regression model:

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 R_i + \beta_3 RT_i + \beta_4 X_i + \delta_i + u_i + v_i \qquad [4]$$

Y_i is our dependent variable such as RS_i or D_i in a given country-year i. Features of the tax system are incorporated as T_i, while RT_i captures reforms to those features. R_i is our most basic indicator of reform and is a dummy variable (=0 in a non-reform year, =1 in a reform year). RT_i are specified either as dummy variables or as first differences to the levels of the variable. X_i is a vector of country-level socioeconomic control variables, such as per capita GDP, inflation and governance indicators. δ_i is a vector of year dummies, while u_i are country fixed effects and v_i denotes time-variant unobserved

effects.[14] The same framework is used for each estimation, while the exact specification differs according to the dependent variable in question. Since we use a country fixed effects model, time invariant variables such as geographic region or income group are not included.

[14] The governance indicators included are from the V-Dem dataset (Coppedge et al., 2021). They are the Electoral Democracy Index and Civil Society Participation Index.

4 Econometric analysis

4.1 Tax system design

Our first specification considers RS_i as the dependent variable, and regresses this on our indicators capturing features of the PIT system in a given country-year. The results are displayed in Table 3.

Tax system features, T_i in this estimation, include the following: the number of PIT bands (*# of bands*), the top PIT rate, a dummy variable equal to one if a personal allowance exists (this might take the form of a zero rate, tax free allowance or universal credit) (*Personal Allowance Dummy*), a dummy equal to one if a ceiling applies to the effective tax rate (*Ceiling Dummy*) and a dummy variable equal to one if the country had a flat rate system in place (*Flat Rate Dummy*). In columns II–IV, we introduce controls for the first percentile to which a PIT applies (*PIT Kicks In*) and the percentile where the top rate is levied (*Top Rate Applied*). These variables are calculated as the share of income relative to the median income (defined as the average of the mean income of the person in the 50th and 51st percentiles of the income distribution).[15] Finally, in column V, we introduce a control dummy for any country-year where a reform to the PIT system occurred (*Reform Dummy*). We control for the pre-tax Gini Coefficient throughout, and all model specifications include year dummies δ_i.

Recall that a negative value for RS_i represents a 'positive' outcome in the sense that post-tax inequality is lower than pre-tax inequality (post-Gini Coefficient minus pre-Gini Coefficient). Hence, a negative coefficient on any independent variable implies that, for a unit increase in T_i, RS_i increases (say, from minus 0.5 to minus 0.6), and hence redistributive capacity increases. Thus, a positive coefficient on any independent variable implies a reduction in redistributive capacity. The number of tax bands is not significantly related to the RS_i in any of the specifications. This is not unexpected as the number of bands in and of itself might simply impact upon the 'smoothness' of the distribution of effective tax rates across the income distribution, but not the potential to redistribute income. In turn, the *Top PIT Rate* has a negative and statistically significant effect across all specifications, suggesting that a higher top rate increases the

[15] We also tested two further specifications of this variable. The first defined them according to the percentile at which PIT kicks in and the top rate is applied, while the second defined each as a share of GDP per capita. The latter approach yields qualitatively similar results in terms of sign and significance, while the former was considered unsuitable because, for a large number of country-year observations, PIT kicked in at a level of income *above* the average income of a person in the 100th income percentile. It was thus deemed an unsuitable way to measure this particular PIT system feature.

redistributive capacity of PIT. The presence of a ceiling on tax payable also increases redistributive capacity.[16] This result is somewhat surprising as we would expect, *ex ante*, that a ceiling would *reduce* the redistributive capacity of a PIT system when marginal rates are higher than said ceiling. We further find that the presence of a flat rate diminishes redistributive capacity, as shown in a positive effect and thus decline in RS_i. This is expected as flat rates, or proportional tax systems, are by design less progressive.

Table 3 Fixed-effects estimation Reynolds-Smolensky index

	I	II	III	IV	V
Dependent Variable:			**Reynolds-Smolensky index RS_i**		
Pre-tax Gini	0.0160	0.007	0.014	0.007	0.007
	(0.030)	(0.028)	(0.030)	(0.028)	(0.028)
# of bands	-0.001	0.001	-0.001	0.000	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Top PIT Rate	-0.099***	-0.099***	-0.099***	-0.099***	-0.099***
	(0.015)	(0.013)	(0.016)	(0.014)	(0.014)
Personal Allowance Dummy	-0.002	-0.003	-0.002	-0.003	-0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ceiling Dummy	-0.027***	-0.029***	-0.024***	-0.027***	-0.026***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Flat Rate Dummy	0.012**	0.013**	0.011**	0.013**	0.013**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
PIT Kicks In		0.002***		0.002**	0.002**
		(0.001)		(0.001)	(0.001)
Top Rate Applied			0.000	0.000	0.000
			(0.000)	(0.000)	(0.000)
Reform Dummy					-0.000
					(0.001)
Constant	-0.005	-0.005	-0.004	-0.004	-0.003
	(0.025)	(0.024)	(0.025)	(0.024)	(0.024)
Observations	1,112	1,112	1,112	1,112	1,112
R-squared	0.344	0.383	0.358	0.390	0.391
# of Countries	48	48	48	48	48

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.
All specifications include time dummies.

The presence of a personal allowance (*Personal Allowance Dummy*) does not seem to impact redistributive capacity. We would expect *ex ante* that a personal allowance would lead to a more progressive and redistributive tax schedule. However, what matters more is the point at which tax contributions become positive. As much as this is an artefact of the way we model the PIT system on income distributions, it also suggests that the income level at which PIT becomes payable is a significant determinant of its redistributive capacity. The higher the income level at which the PIT kicks in, the lower the redistributive

[16] Regardless of the value of the top marginal PIT rate, some countries cap the effective tax rate for any individual at a certain percentage of their income.

capacity overall. We further observe that whether a reform, in the shape of any adjustment, has taken place in a particular country-year does not yield significant effects on redistributive capacity. In turn, this also suggests that, if reforms occurred, they may not be guided by an inequality-reducing rationale.

We investigate this further in the next section, which focuses on a more detailed understanding of the impact of reforms on the dependent variable, RS_i.

4.2 Tax system reform

In order to better estimate the effects of tax system reforms on the redistributive capacity of PIT, we specify the dependent variable in first differences D_i, as defined above in equation [3].[17] Specifying the variable in this manner allows us to understand whether PIT reforms (on the right-hand side) are associated with *changes* in the RS, and hence changes in redistributive capacity (analogous to that depicted in the lower panes of Figure 6). Independent variables in this model are specified in two forms: first, a set of dummy variables indicating whether there was a reform to a specific facet of the PIT system (the number of bands, the top rate, personal tax-free allowance and the point at which the top rate is applied) in a given country-year; and a second set of controls capturing the magnitude of such changes.[18] We also control for country-specific socioeconomic features (namely log GDP per capita, log inflation and indices of electoral democracy and civil society participation) in order to better understand the environments in which PIT reforms can be more inequality-reducing.

The interpretation of the coefficients here is as follows. A negative effect again implies an increase in redistributive capacity, and vice versa. Results are shown in Table 4. In all specifications we control for the pre-tax Gini at *i-1.* Column I regresses $\boldsymbol{D_i}$ on the reform dummy. The coefficient is positive and significant, suggesting that, on average, reforms to the PIT system have *reduced* its redistributive capacity. This is somewhat expected, given our initial observation of declining redistributive capacity overall since the 1950s. Turning to column II, where reforms are broken down by type, all effects are positive and hence diminish redistributive capacity, save for reforms to the number of bands. Reforms to the top marginal PIT rate and the point at which the top rate is applied are both statistically significant at the 1% level. This suggests that reforms to top PIT rates and reforms to the point at which the top rate is applied largely drive the reduction in redistributive capacity. Turning to columns III and IV, the dependent variables of interest are the first differences of the PIT system features. Here, the effect of a change in the top PIT rate is negative and statistically significant. This implies again that an

[17] $D_i = (RS_i - RS_{i-1})$

[18] The variables capturing the ∆.Personal Allowance and ∆.Top Rate Applied are, in this case, specified as the natural log of those amounts in local currency.

increase in the top marginal PIT rate *increases* the redistributive capacity of PIT. The results also suggest that levying the top PIT rate at a higher point in the distribution is positively associated with the dependent variable. As this point increases, the redistributive capacity of PIT is lessened. Both of these results are fairly intuitive, given our context and simulation. Where, on average, just 10% of the populations in our sample are subject to the top PIT rate with high levels of income concentrated among them, an increase in the marginal tax rate will yield greater reductions in inequality due to PIT. Similarly, when the point at which the top rate is applied moves up in the income distribution, fewer individuals are subject to the top rate. In turn, the reduction in inequality and thus redistributive capacity of PIT falls. We reiterate that our approach does not account for any behavioural effects, i.e. tax evasion.[19] It is likely that a ceiling on the top marginal PIT rate is applied after which behavioural effects on both the extensive and intensive margins would wash out much or all of the redistributive capacity of the increased top rate.[20]

Table 4 Fixed effects estimation: change in Reynolds-Smolensky index

	I	II	III	IV
Dependent Variable:		$D_i = (RS_i - RS_{i-1})$		
Pre-tax Gini (lag)	0.006	0.006	0.002	-0.004
	(0.007)	(0.008)	(0.006)	(0.006)
Reform Dummy	0.003***			
	(0.001)			
# of bands (reform dummy)		-0.000		
		(0.002)		
Top PIT Rate (reform dummy)		0.003***		
		(0.001)		
Personal Allowance (reform dummy)		0.001		
		(0.001)		
Top Rate Applied (reform dummy)		0.002**		
		(0.001)		
∆.# of bands			-0.000	-0.000
			(0.000)	(0.000)
∆.Top PIT Rate			-0.115***	-0.119***
			(0.020)	(0.023)
∆.Personal Allowance			-0.005	-0.005
			(0.003)	(0.003)
∆.Top Rate Applied			0.002***	0.002***
			(0.001)	(0.001)
Constant	-0.004	-0.004	-0.001	-0.002
	(0.005)	(0.005)	(0.004)	(0.005)

[19] Piketty and Saez (2013), for example, explore the idea of revenue-maximising top rates on labour income.

[20] Fully exploring such effects would require an impact evaluation of income tax returns pre- and post-reform. Jouste (2021), for example, explores this for Uganda, when the top marginal PIT rate increased from 30% to 40% in the 2012/13 financial year.

Observations	1,058	1,058	892	796
R-squared	0.094	0.122	0.363	0.382
# of Countries	48	48	45	44
Year Dummies	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

4.3 Inequality measured by the Palma Ratio

In this section, we replicate the specifications above but focus on the Palma Ratio. In Table 5, the dependent variable is, again, $\boldsymbol{RS_i}$ and the independent variables capture the features of the tax system design at time ***i***. The results resemble those of the Gini Coefficient. However, we also see that the effect of a personal allowance now significantly increases redistributive capacity. This can be explained by the fact that the Palma Ratio places more emphasis on individuals in the tails of the distribution, and a personal allowance is likely to confer a proportionately greater benefit to those in the bottom 40% than those in other parts of the income distribution.

Turning to tax system *reform*, Table 6 shows results from a set of estimations on the Palma Ratio, where the dependent variable is the change in said ratio, expressed as $\boldsymbol{D_{i,}}$. Again, the results are, qualitatively, fairly similar: reforms to PIT on average over our sample period have not increased redistributive capacity. However, when considering the Δ variables, only the coefficient on Δ top PIT rate has a significant effect. Again, this highlights the importance of taxes levied on those in the top end of the income distribution.

One key advantage of the Palma Ratio is that it is more accessible due to its expression of proportionality in comparison to the Gini. When we consider the results shown in Table 5, we can say that, for a one pp increase in the top marginal PIT rate (measured between 0 and 1), the redistributive capacity as measured by the Palma Ratio increases by 0.3. This means that the multiple of top to bottom incomes declines (say the top 10% held eight times more than the bottom 40% in a given country-year, and they now hold only 7.6 times as much). Personal allowances have the same, but less pronounced, effect of a 0.2-point reduction.

Table 5 Fixed effects estimation Reynolds-Smolensky index: Palma Ratio

	I	II	III	IV	V
Dependent Variable			**Reynolds-Smolensky index RS_i**		
Pre-tax Palma Ratio	-0.251***	-0.259***	-0.252***	-0.259***	-0.258***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)
# of bands	-0.028	0.025	-0.054	0.002	0.006
	(0.092)	(0.099)	(0.097)	(0.103)	(0.102)
Top PIT Rate	-3.093***	-3.080***	-3.076***	-3.069***	-3.063***
	(0.437)	(0.429)	(0.444)	(0.429)	(0.427)
Personal Deduction Dummy	-0.233**	-0.279**	-0.244**	-0.283**	-0.285**
	(0.108)	(0.112)	(0.106)	(0.109)	(0.111)
Ceiling Dummy	-1.203***	-1.271***	-1.095***	-1.187***	-1.192***
	(0.115)	(0.110)	(0.129)	(0.114)	(0.115)
Flat Rate Dummy	0.351**	0.382**	0.320*	0.357**	0.360**
	(0.159)	(0.171)	(0.162)	(0.173)	(0.174)
PIT kicks in		0.057***		0.052***	0.052***
		(0.011)		(0.012)	(0.012)
Top rate applied			0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)
Reform Dummy					0.030
					(0.022)
Constant	1.878***	1.810***	1.893***	1.826***	1.813***
	(0.372)	(0.378)	(0.375)	(0.382)	(0.379)
Observations	1,110	1,110	1,110	1,110	1,110
R-squared	0.797	0.808	0.802	0.811	0.811
# of countries	48	48	48	48	48

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

Table 6 Change in the Reynolds-Smolensky index: Palma Ratio

	I	II	III	IV
Dependent Variable		$D_i = (RS_i - RS_{i-1})$		
Pre-tax Palma Ratio (lag)	0.022***	0.022***	0.020***	0.018**
	(0.008)	(0.008)	(0.007)	(0.007)
Reform Dummy	0.113***			
	(0.033)			
# of bands (Reform Dummy)		0.036		
		(0.058)		
Top PIT Rate (Reform Dummy)		0.066*		
		(0.034)		
Personal Deduction (Reform Dummy)		0.049*		
		(0.025)		
Top Rate Applied (Reform Dummy)		0.060**		
		(0.028)		
Δ # of bands			-0.000	0.000
			(0.016)	(0.016)
Δ Top PIT Rate			-0.3877***	-3.962***
			(0.807)	(0.885)
Δ Personal Deduction			-0.071	-0.072
			(0.106)	(0.114)
Δ Top Rate Applied			0.054	0.038
			(0.041)	(0.038)
Constant	-0.149*	-0.153*	-0.097	-0.584
	(0.085)	(0.086)	(0.102)	(0.374)
Observations	1,058	1,058	892	796
Number of id	48	48	45	44
R-squared	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

5 Towards a closer estimate of employment income

As discussed in 15, the approximation of labour incomes is key for the interpretation of our findings. Taking the average amount and share of NNI earned by a representative individual in each percentile as taxable wage income comes short, in that it assumes all income accrues from labour, and is earned in the formal sector.

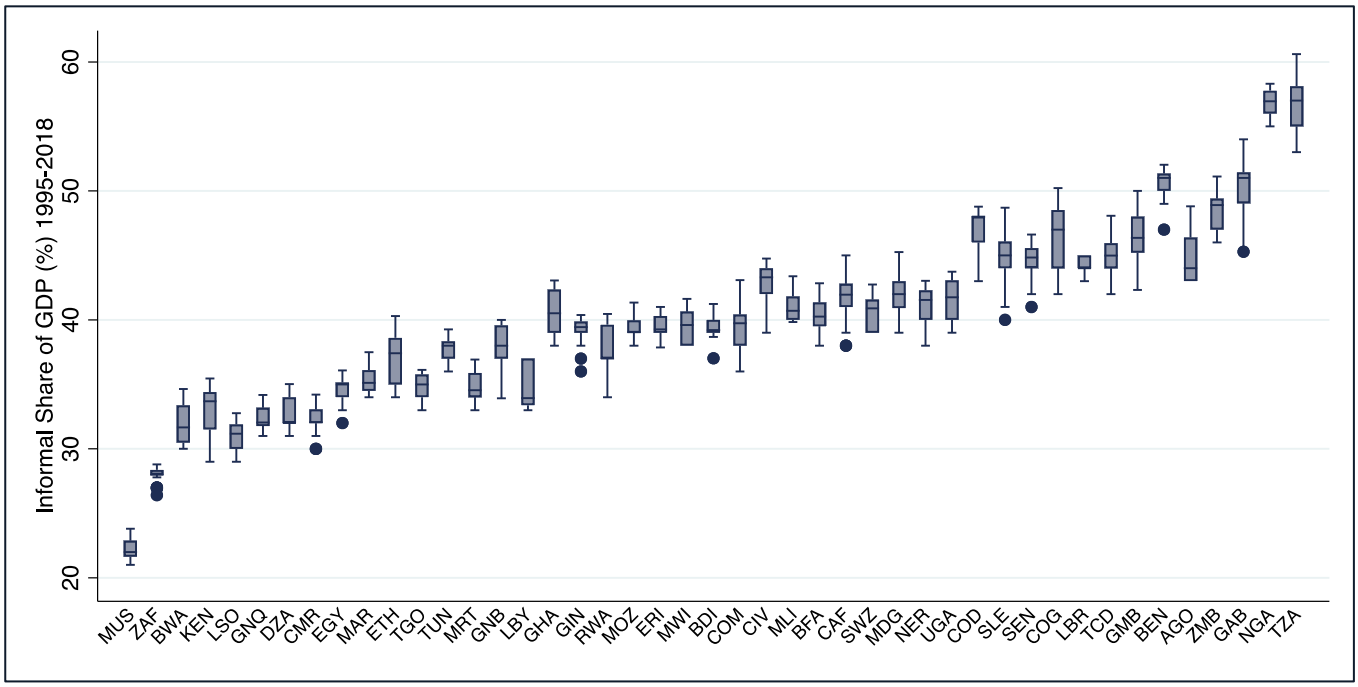
These assumptions do not hold in practice. Using estimates from the Informal Economy Database (IED) (Elgin et al., 2021), we thus adjust the income data from the WID and attempt to estimate a closer proxy for formal income in each country-year percentile. This step does not, however, correct income distributions by distinguishing between labour and capital income. While cross-country estimates of the labour share of GDP are available from the International Labour Organization, this data does not elicit how labour and capital income is earned *throughout* the income distribution; rather, it depicts more broadly how much labour contributes to a country's GDP. To discount our income measure by using a country-level average across the distribution would be a strong assumption and mostly invalid for those at the top end of the distribution, where income shares from capital tend to be higher (Piketty, 2014). As a consequence, we did not make any adjustments along these lines.

Employing estimates from the IED (Elgin et al., 2021), we account for the share of national income earned informally (and thus not likely to be subject to tax under a PIT). The IED contains estimates of the informal share of GDP between 1993 and 2018 for 45 African countries in our sample.[21] Figure 7 shows a box plot of these estimates. We consider the income distribution as a whole and estimate cumulative shares from the lowest to the highest income position, and then equate the share of national income that is earned informally with the corresponding share of cumulative income from the bottom up. The PIT system is then only applied to income percentiles above the informality share, which are then assumed to be wholly formally earned. Figure 8 illustrates this for the case of Uganda in 2015. The IED estimates the share of informal income to be 40%, which according to the WID is earned by the bottom 84

[21] We employ the Multiple Indicators Multiple Causes estimates.

percentiles for this country-year.[22] We thus apply the PIT system only to percentiles 85 and above. Figure 8 highlights the incomes in percentiles 51–84 on which PIT for Uganda in 2015 was levied when not accounting for informality. Incomes of these percentiles are now assumed to be informally earned and thus not taxed. Table 12 in **Error! Bookmark not defined.** shows the percentile at which this process dictates that incomes are assumed to be formal for each country in 2018 (the most recently available year in the IED).

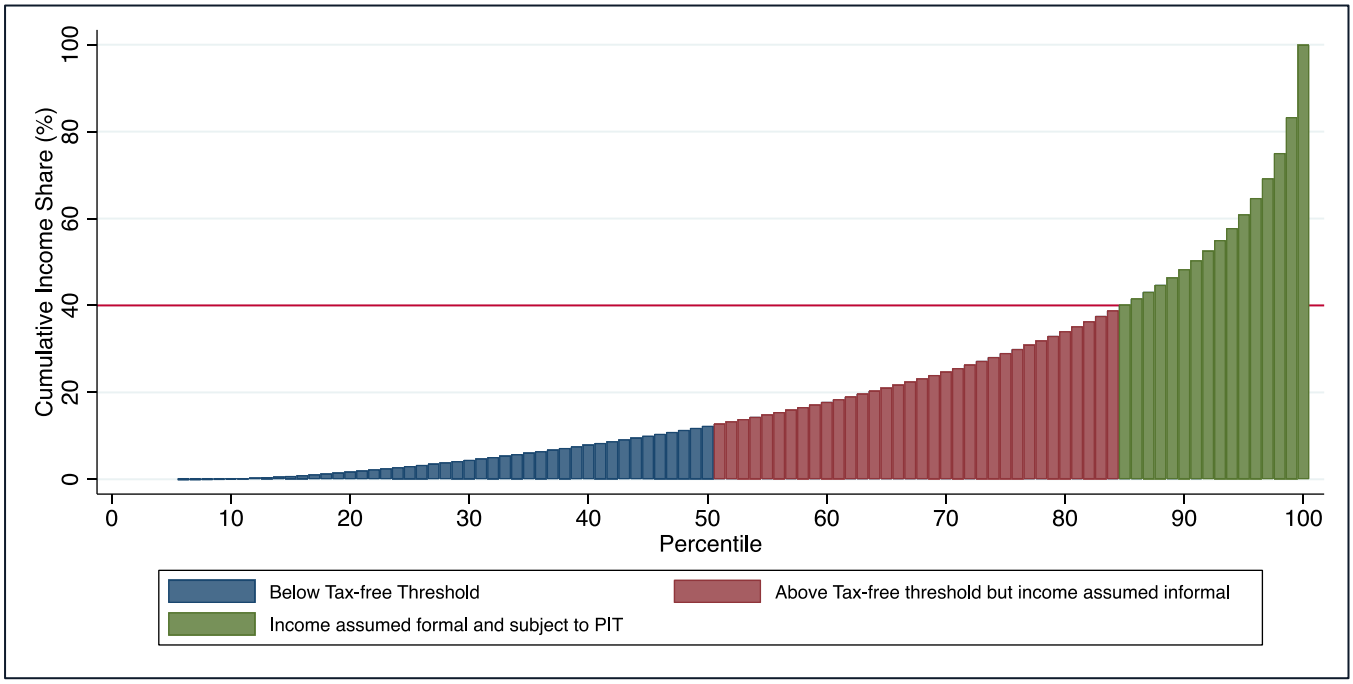
Figure 7 Informal share of GDP (%) 1995–2018



Source: IED (Elgin et al., 2021)

[22] We round here to the nearest integer.

Figure 8 Adjusting for estimates of informality: Uganda 2015



Source: Authors' illustrations from EITD, WID and IED

We acknowledge that to assume that *all* activity below a certain threshold is informal and thus not taxable might not accurately capture how informal incomes are earned throughout the income distribution.[23] Our approach thus rests on the assumption that incomes at higher percentiles are mostly formal. In other words, the likelihood of a worker earning a formal wage – or being visible enough to the tax authorities – increases as incomes grow. Informal wages are typically lower than formal wages in many contexts; this is often because formal sector jobs require higher qualifications, which command a higher wage.

Table 7 shows the results of the RS as measured by the Gini Coefficient and Palma Ratio, both before and after the adjustment for informality. On average, the value of RS_i of the Gini increases to around -4.7, while that of the Palma Ratio increases to around -1.76.

[23] It is also not a given that all 'formal' income will be taxed. The administrative capability of the revenue authorities will dictate the extent to which tax compliance and formality align.

Table 7 Outcome variables before and after adjusting for informal incomes

Variable (Y_i)	**Obsv.**	**Mean**	**SD**	**Min.**	**Max.**
RS_i Gini	1,118	**-0.041**	0.019	-0.105	0.040
RS_i Gini Adjusted Income	1,030	**-0.047**	0.019	-0.034	0.0001
RS_i Palma	1,128	**-1.55**	1.074	-6.947	1.152
RS_i Palma Adjusted Income	1,030	**-1.76**	1.148	-6.760	-0.246

Source: Authors' calculations

As the PIT system is applied to a smaller share of the income distribution mostly towards the top end, our simulation suggests that its redistributive capacity increases. This is not surprising as higher post-tax incomes move closer to pre-tax middle incomes. Yet, it might be misleading to interpret this as increased redistributive capacity. Rather, it captures the importance of top rates/thresholds, but also highlights the issue of the taxpayer base when discussing the progressivity of PIT, as a smaller taxpayer base also yields less revenue overall to invest in public goods and social spending. We further highlight this in Figure 8. There are two distinct effects that matter for our outcome. 'Middle' incomes (post-tax) remain unchanged in terms of their proportionality towards bottom incomes. Hence inequality between the poorest and middle does not change. Those at the top now hold a lower relative share of post-tax income, bringing them closer to both bottom and middle incomes. Hence, inequality reductions as reflected in a higher (more negative) ***RS*** measuring our proposed redistributive capacity primarily stem from reducing the gap between the top end to other parts of the distribution. The outcomes from modifying for informality are analogous to a country adopting a higher tax exemption threshold. The main takeaway thus should not perhaps be the redistributive capacity, but the consequence of a smaller tax base. We re-estimate the regressions from 27 in Table 8 and Table 9 respectively.

Our main results all hold, although we observe different effects for some cases. For example, a percentage point increase in the top rate increases redistributive capacity from -.099 to -0.135. The effect of the presence of a tax ceiling on redistributive capacity is now lower, decreasing from around -0.25 to -0.15. Another notable difference shown in Table 3 is that the reforms now have a positive and significant effect, supporting our previous contention that PIT reforms generally have decreased redistributive capacity.

Table 8 Fixed effects estimation Reynolds-Smolensky index, adjusted income

	I	II	III	IV	V
Dependent Variable:			**Reynolds-Smolensky Index RS_i**		
Pre-tax Gini	0.030	0.019	0.027	0.017	0.018
	(0.031)	(0.029)	(0.031)	(0.029)	(0.029)
# of bands	0.001	0.003	0.000	0.002	0.002
	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
Top PIT Rate	-0.135***	-0.135***	-0.134***	-0.134***	-0.134***
	(0.015)	(0.011)	(0.016)	(0.012)	(0.012)
Personal Allowance Dummy	0.005	0.004	0.004	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ceiling Dummy	-0.015***	-0.017***	-0.011**	-0.014***	-0.014***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Flat Rate Dummy	0.014***	0.015***	0.013**	0.014***	0.014**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
PIT Kicks In		0.002**		0.002**	0.002**
		(0.001)		(0.001)	(0.001)
Top Rate Applied			0.000	0.000	0.000
			(0.000)	(0.000)	(0.000)
Reform Dummy					0.001**
					(0.000)
Constant	-0.013	-0.012	-0.011	-0.010	-0.011
	(0.024)	(0.022)	(0.024)	(0.022)	(0.022)
Observations	980	980	980	980	980
R-squared	0.454	0.505	0.476	0.516	0.517
# of Countries	44	44	44	44	44

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

Table 8 confirms our findings in Table 4. Overall, effects are slightly more pronounced. We also see that changes to personal allowances are now associated with a significant decrease in redistributive capacity. We do not, in the interest of space, replicate the estimates for RS_i and D_i using the Palma Ratio. The results – along with a short interpretation – are presented in 49.

Table 9 Fixed effects estimation: ∆ Reynolds-Smolensky index, adjusted income

	I	II	III	IV
Dependent Variable:		$D_i = (RS_i - RS_{i-1})$		
Pre-tax Gini (lag)	0.005	0.009	0.005	0.000
	(0.007)	(0.008)	(0.006)	(0.006)
Reform Dummy	0.006***			
	(0.001)			
# of bands (reform dummy)		0.002		
		(0.001)		
Top PIT Rate (reform dummy)		0.004***		
		(0.001)		
Personal Allowance (reform dummy)		0.002**		
		(0.001)		
Top Rate Applied (reform dummy)		0.003***		
		(0.001)		
∆.# of bands			0.000	0.000
			(0.000)	(0.000)
∆.Top PIT Rate			-0.129***	-0.136***
			(0.016)	(0.018)
∆.Personal Allowance			0.001	0.002
			(0.002)	(0.002)
∆.Top Rate Applied			0.003***	0.003***
			(0.001)	(0.001)
Constant	-0.005	-0.008	-0.004	-0.008
	(0.005)	(0.005)	(0.004)	(0.006)
Observations	972	934	788	716
R-squared	0.205	0.285	0.537	0.550
# of Countries	46	44	40	40
Year Dummies	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

6 Discussion, limitations and policy implications

This study explores the redistributive capacity, understood as a potential inequality reduction, of PIT systems in a panel of African countries. To the best of our knowledge, this is the first attempt at such a broad-scale assessment. Owing to the rich coverage of both the EITD and WID, we make a number of improvements on related studies. We find that, when applied to the entire income distribution, the redistributive capacity of PIT can, on average, yield a 4.1-point reduction in the Gini Coefficient. The same effect holds concerning the Palma Ratio. Yet we find that, overall, the redistributive capacity of PIT has declined since the 1990s, and that reforms to PIT systems have contributed to, rather than offset, this trend.

The use of percentile distributions of average net national income goes further than recent work that attempts to understand the effect of PIT on inequality. Previous studies used, for example, an exogenously determined income distribution (Sabirianova Peter et al., 2010; McNabb and Granger, 2022), or a synthetically computed measure (Vellutini and Benitez, 2021). Our income measure from the WID can perhaps more accurately capture the redistributive capacity of PIT.

There are some limitations to the approach taken here. For many of the countries included in our sample, large shares of income are earned informally; our income measure does not distinguish between labour and capital income; and it is inherently difficult to control for the administrative capability of tax authorities. In 34, we utilise data from the World Bank in order to adjust the WID income measures for the first of these shortcomings. We find that the magnitude of the effects reported earlier increases somewhat, but this is largely due to our simulation approach and the effects on the size of taxable incomes.

While we have attempted to adjust the NNI concept from the WID to better approximate formal wage earnings on which PIT would be levied, we acknowledge that the measure will still be capturing significant amounts of capital income. However, even our initial estimates, before adjustment, go further towards understanding the redistributive capacity of PIT. We did not incorporate behavioural responses on the intensive and extensive margins to tax reforms, though in reality there is likely some theoretical (and practical)

maximum to the level at which PIT rates should be set.[24] We further do not account for any degree of administrative capability or tax avoidance. Thus, we assume perfect tax compliance in our simulations. Again, this likely does not reflect reality in most countries. Given that we have attempted to adjust our income distributions for informality, this concern applies mainly to those at the top end of the distribution, where evasion may be more common.

It is not straightforward to place our results in context with other findings due to the differences in methodologies employed. However, we draw some parallels to recent work. Granger et al. (2022) report that the change in inequality between market and disposable income in LICs is, on average, just 2 Gini points.[25] Barnes et al. (2018), using the SOUTHMOD tax-benefit microsimulation models, break down changes in inequality in six African countries according to fiscal instrument.[26] They find that the effect of imposing direct taxation on the Gini varies between 3.5pp in Ethiopia to just 0.3pp in Zambia. A simple average of these reductions is 1.52 Gini points, which is just over a third of the $\boldsymbol{RS_i}$ in this paper (4.2 Gini points), for the same countries.

Perhaps the key finding from our estimations is that the redistributive capacity of PIT in our sample of African countries has generally worsened, despite reforms. This result complements existing work – Gupta and Jalles (2022), for example – who found that tax reforms did not reduce income inequality in sub-Saharan Africa. Our estimations attempt to provide some clues as to why this is the case. For example, one of the most common reforms observed in our study sample – reductions in the top marginal PIT rate – has a negative impact on the redistributive capacity of PIT. In turn, the point at which the top PIT rate is set is one of the key determinants of redistributive capacity.

Regarding the role of PIT as a redistributive tool in African countries, a few political economy considerations are important. First, it is not a given that PIT is necessarily designed with equity outcomes in mind in many countries. It may rather be the case that it is designed with efficiency and tax revenue in mind: i.e., increasing public revenue. That the inequality-reducing effect of PIT has been declining over time, and reforms have generally not offset this trend, might reflect government preferences and the concurrent growth in transfer systems on the African continent in recent years.[27] Thus, policy-makers may prefer to prioritise the amount of public revenue generated by PIT, and redistribute that revenue through a transfer system. However, the reality is that many transfer systems in LICs

[24] There may also be concerns over the neutrality of the tax system, and thus pressure to keep top marginal PIT rates close to marginal corporate tax rates.
[25] Disposable income is the sum of market income – direct taxes + cash transfers. Thus, the finding is not *entirely* comparable to our results here due to the inclusion of cash transfers.
[26] Ethiopia, Ghana, Mozambique, South Africa, Tanzania, and Zambia.
[27] It has been fairly well established that transfer systems are more effective redistributive instruments than direct taxes.

and LMICs do not operate efficiently, might be costly to establish or run (due to complex targeting methods or transfer mechanisms, for example) or be absent entirely (Holmes and Lwanga-Ntale, 2012). A PIT system levied on as large a share of the workforce as possible is, thus, a reasonable option for tackling inequality; it is administratively and legislatively more straightforward to enhance the progressivity of PIT, adjust a tax-free allowance or change marginal rates than it is to expand or even establish entirely new transfer systems. At the same time, high earners (i.e. those subject to the top tax rate) are likely more politically connected and thus effective lobbying might reduce the ability of governments to enact such changes. This is important in light of our finding that, currently, narrow PIT bases mean that it is the taxation of those in the top percentiles that dictates much of the redistributive capacity of PIT. A further – and not unimportant – underlying explanation for the trends that emerge from the present analysis is that a major tenet of the IMF's programme for tax reform in LICs in the 1980s was to dissuade governments from using the tax system for 'purposes of social engineering', such as redistribution (see Moore et al., 2018). Thus, it is plausible that, since the 1980s, PIT policy design has evolved without this purpose in mind.

In summary, a key finding emerges: in contexts where formal incomes are concentrated among top percentiles, PIT reforms that might best increase its redistributive capacity are those that target the top rate and threshold. Our findings show that PIT systems in Africa, if levied on a broad enough base, do have significant potential to shape inequality outcomes, and should be further studied as part of building more equitable tax systems and welfare states.

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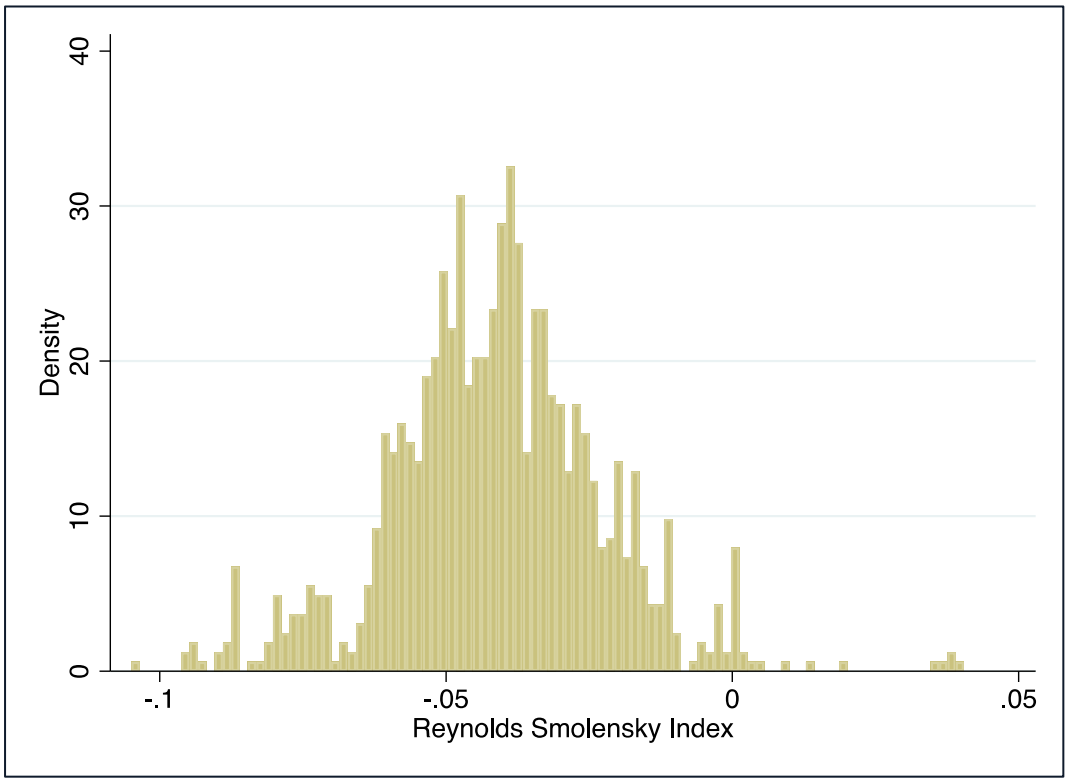
Appendix 1 Distribution of RS_i

Figure 9 Distribution of RS_i (all countries and years pooled across available observations)



Source: Authors' computations from EITD and WID

Appendix 2 Countries included in the study

Algeria	Liberia
Angola	Libya
Benin	Madagascar
Botswana	Malawi
Burkina Faso	Mali
Burundi	Mauritania
Cabo Verde	Mauritius
Cameroon	Morocco
Central African Republic	Mozambique
Chad	Namibia
The Comoros	Niger
Rep. of the Congo	Nigeria
Côte d'Ivoire	Rwanda
Dem. Rep. of the Congo	Senegal
Djibouti	Seychelles
Egypt	Sierra
Equatorial Guinea	Somalia
Eritrea	South Africa
Eswatini	South Sudan
Ethiopia	Sudan
Gabon	São Tomé and Príncipe
Gambia	Tanzania
Ghana	Togo
Guinea	Tunisia
Guinea-Bissau	Uganda
Kenya	Zambia
Lesotho	

Appendix 3 Adjusted Income Palma Ratio Estimates

Table 10 Adjusted Income Palma Ratio Estimates

	I	II	III	IV	V
Dependent Variable:	$D_i = (RS_i - RS_{i-1})$				
Pre-tax Palma	-0.243***	-0.252***	-0.244***	-0.252***	-0.252***
	(0.014)	(0.013)	(0.014)	(0.013)	(0.013)
# of bands	0.017	0.081	-0.018	0.050	0.058
	(0.085)	(0.083)	(0.093)	(0.090)	(0.088)
Top PIT Rate	-3.834***	-3.841***	-3.808***	-3.821***	-3.807***
	(0.409)	(0.368)	(0.426)	(0.374)	(0.368)
Personal Allowance Dummy	-0.089	-0.119	-0.103	-0.127	-0.130
	(0.114)	(0.117)	(0.108)	(0.113)	(0.114)
Ceiling Dummy	-0.570***	-0.634***	-0.439***	-0.531***	-0.538***
	(0.107)	(0.102)	(0.131)	(0.114)	(0.112)
Flat Rate Dummy	0.278**	0.303**	0.239**	0.272**	0.266**
	(0.105)	(0.119)	(0.112)	(0.121)	(0.124)
PIT Kicks In		0.063***		0.057***	0.057***
		(0.009)		(0.011)	(0.010)
Top Rate Applied			0.002	0.001	0.001
			(0.001)	(0.001)	(0.001)
Reform Dummy					0.057***
					(0.016)
Constant	1.812***	1.722***	1.836***	1.748***	1.722***
	(0.312)	(0.313)	(0.313)	(0.316)	(0.310)
Observations	980	980	980	980	980
R-squared	0.838	0.853	0.844	0.856	0.858
# of Countries	44	44	44	44	44

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

We see from Table 10 that the majority of previously reported results hold, but with differences in the magnitude of the estimated coefficients. For example, we observe that, for a 1 percentage point

increase in the top marginal PIT rate (which is measured between 0 and 1), the *inequality-reducing effect of the PIT system* increases to by around 0.38 (or the ratio of income in the top 10% to the bottom 40% falls by 0.38 more following a top rate increase of 1 ppt). This effect is somewhat higher than what was presented earlier in Table 5 (around 0.30). Turning to Table 11, the same pattern emerges, with the qualitative findings unchanged but slight changes in coefficient estimates.

Table 11 Adjusted Income Palma Ratio Estimates

	I	II	III	IV
Dependent Variable $Di = (RS_i - RS_{i-1})$				
Pre-tax Gini (lag)	0.023***	0.024***	0.023***	0.021***
	(0.007)	(0.008)	(0.007)	(0.007)
Reform Dummy	0.168***			
	(0.031)			
# of bands (reform dummy)		0.108**		
		(0.051)		
Top PIT Rate (reform dummy)		0.096***		
		(0.032)		
Personal Allowance (reform dummy)		0.041		
		(0.029)		
Top Rate Applied (reform dummy)		0.082***		
		(0.022)		
∆.# of bands			0.010	0.010
			(0.014)	(0.015)
∆.Top PIT Rate			-4.180***	-4.259***
			(0.788)	(0.870)
∆.Personal Allowance			0.050	0.050
			(0.062)	(0.066)
∆.Top Rate Applied			0.062*	0.050
			(0.035)	(0.032)
Constant	-0.184**	-0.193**	-0.141	-0.570
	(0.077)	(0.078)	(0.087)	(0.346)
Observations	936	934	788	716
R-squared	0.151	0.205	0.308	0.304
# of Countries	44	44	40	40
Year Dummies	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10.

Appendix 4 Percentile at which incomes are assumed to be formally earned, 2018

Table 12 Percentile at which incomes are assumed to be formally earned, 2018

Country	Percentile	Country	Percentile
AGO	91	LSO	79
BDI	91	MAR	78
BEN	91	MDG	86
BFA	80	MLI	78
BWA	84	MOZ	92
CAF	94	MRT	100
CBV	80	MUS	60
CIV	82	MWI	87
CMR	78	NER	78
COD	86	NGA	90
COG	91	NMB	86
COM	82	RWA	82
DZA	66	SEN	83
EGY	76	SLE	83
ETH	74	SWZ	90
GAB	87	TCD	87
GHA	82	TGO	78
GIN	75	TUN	76
GMB	86	TZA	93
GNB	89	UGA	86
GNQ	81	ZAF	87
KEN	73	ZMB	94

Source: Authors' calculations from EITD and Elgin et al. (2021)