The Effect of Income Inequality on Tax Revenue Dynamics

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Abstract

A fresh look in cross countries data reveals that global inequality has been decreasing over the recent years. However, important income disparities remain within countries. In this paper, we investigate the effect of inequality on government taxes revenue dynamics using a large sample of 101 developed and developing countries over the period 1995-2017. The Generalized Method of Moments (GMM) for dynamic panel data estimations show that income disparities significantly harms taxes revenue mobilization, and the results are robust to different income inequality measurements and to tax revenue composition. In addition, in line with previous evidence, we find that countries' capacity to mobilize tax revenue is intrinsically related to their stage of development, though the relationship is non-linear. Furthermore, sound financial sector and high institutional quality improve taxes revenue collection. Our findings emphasize that income distribution policies matter for more taxes revenue mobilization.

JEL Codes: H2O, D63

Key words: Income Inequality, Taxes Revenue, Developed and developing countries.

I. Introduction

Global inequality has been decreasing the recent years but looking at picture on within countries income distribution reveals that high contrast remains (IMF, 2018). Increasing concern has been raising among policy makers as well as academics, about the impact of inequality on macroeconomic performances and social cohesion. Inequality is associated with an unstable macroeconomic environment and more fragility of the financial sector. It also affects social cohesion, feeds polarization, and lead to internal instability and conflict (IMF, 2018).In this paper, we explore whether income inequality undermines tax revenue mobilization. Since the Addis Ababa Conference in July 2015, Domestic Revenue Mobilization (DRM) appears as a main tool to finance the Sustainable Development Goals (SDGs). The importance of DMR also came out with the recent fall in commodity prices which inflected severe economic complication to resource-dependent countries – underlining the necessity of government revenue source diversification. External funding, notably multilateral and bilateral official development assistance, have been for decades, the important source of financing in most of developing countries. However, the IMF(2018) recently shows that the level of debt service has risen in low income developing countries since end-2013 and warns of debt crisis in these countries. Yet, structural transformation investments are necessary. Regarding the excessive debt build-ups coupled with the large financing needs, it makes it imperative to boost and promote internal revenue collection to fill-up the financing gap and get the external debt sustainable. The study also examines the effect of inequality on the government taxes revenue composition.

Income inequality can affect tax revenue collection through several channels. First, large income inequality favors informal sector development (Alonso and Garcimartín, 2011) that results in more tax evasion since informal economy is known to be hard to tax. Second, income inequality is one of the main reasons for massive immigration. In fact, when citizens, specifically young people, feel they are being treated unfairly combined with the absence of social protection schemes, that increases the incentive to migrate. That in turn represents a potential loss of taxpayers for the countries of departure and a gain of taxpayers for the countries of destination and this phenomenon is more likely to happen in countries with high unemployment rates. Third, the negative impact of inequality on tax revenue could operate through what we call “purchasing power-effect”. Indeed, income inequality supposes that the bulk of the income of the state is cornered by a small group of individuals (who have a small marginal propensity

to consume or invest in capital goods i.e. "capitalists") while the remaining large part of the population including "hand-to-mouth individuals" (i.e. individuals with high marginal propensity to consume) shares the small part of the income. Yet, value-added taxes (VAT) and consumption taxes are widely recognized to be an important component of total tax revenue. Therefore, the low purchasing power of the huge part of the population would results in low consumption and thereby in a non-substantial VAT to collect.

However, the impact of income distribution on government tax revenue did not receive a particular attention and the literature is limited. Pessino and Fenochietto (2010) and Fenochietto and Pessino (2013) exploring the determinants of tax effort in developing countries found a negative relationship between tax revenue and income distribution. In addition, a study by Combes and Ouedraogo (2016), analysing the nexus between inclusive growth and tax revenue, indirectly examined the effect of inequality on government tax revenue. The bulk of the studies rather addressed the impact of inequality on output growth (Barro, 1999; Easterly, 2007, Galor and Moav, 2004; Grigoli et al., 2016; Grigoli and Robles, 2017). Indeed, Alesina and Perotti (1996) emphasized that income inequality generates political and economic instability that reduces investment. Excessive inequality is prejudicial to economic growth and is associated with greater financial instability (IMF, 2018). Few subsequent studies focused on the redistributive role of taxation in reducing inequality (Coady and Gupta, 2012; Oishi et al., 2018; Nallareddy et al., 2018; Taghizadeh-Hesary et al., 2018)

Taking advantage of a recent cross-country dataset on a broad sample, this paper is the first to provide a strong empirical evidence of the impact of income distribution on tax revenue dynamics. Using a large sample of 101 developed and developing countries over the period 1995-2017 and employing generalized method of moments (GMM) estimator to circumvent the potential issue of endogeneity, the results show that income inequality negatively affects tax revenue. This finding is consistent even if we consider several components of tax revenue: (i) taxes on income, profits, and capital gains; (ii) taxes on payroll and workforce; (iii) taxes on goods and services and (iv) taxes on property. These findings are strengthened by a set of robustness checks, including the use of alternative data source for income inequality, adding more control variables, using quintiles income distribution, and running the baseline specification on five-year non-overlapping sub-periods. The empirical finding suggest that more income

distribution policies and reducing income disparities are important for greater tax revenue mobilization.

The paper contributes to the literature by expanding the studies on the determinants of tax revenue mobilization using a large sample of countries. In addition, unlike to the previous works (Pessiono and Fenochietto, 2010 ; Fenochietto and Pessino, 2013) which only demonstrated a negative correlation between inequality and tax revenue, this paper empirically provide the first strong evidence that income inequality arms tax revenue collection by addressing the potential endogeneity issue.

The rest of the paper proceeds as follows: in the next section, we introduce the dataset and some stylized facts. Section 3 describes the empirical methodology while the section 4 presents and discuss the estimates results. Section 5 concludes the study.

2. Data and stylized facts

We compiled a comprehensive dataset from various sources including the World Bank's World Development Indicators (WDI), the International Monetary Fund's Government Finance Statistics (GFS) and the International Country Risk Guide (ICRG). More precisely, our dataset consists of a yearly unbalanced panel of 101 countries covering all income groups[1] from all regions over the period 1995-2017 and is based on data availability[2].

For income inequality data, we predominantly relied on the Gini index from the World Bank's WDI. This index is computed using primary household survey data and captures the extent to which the distribution of income among households or individuals within a country deviates from a perfectly equal distribution situation. Statistically, the Gini index refers to the area between the Lorenz curve and a hypothetical line of perfect equality, expressed as a percentage of the maximum area under this line[3]. Gini index data ranges from 0 to 100, with 0, the absolute equality state and 100, the perfect inequality. The average value of the Gini index in the sample stands at 40, the lowest and highest values are of 24 (Ukraine) and 66 (Malawi), respectively. Figure 1 provides insight on cross region and income groups disparities of

[1] World Bank countries' classification.

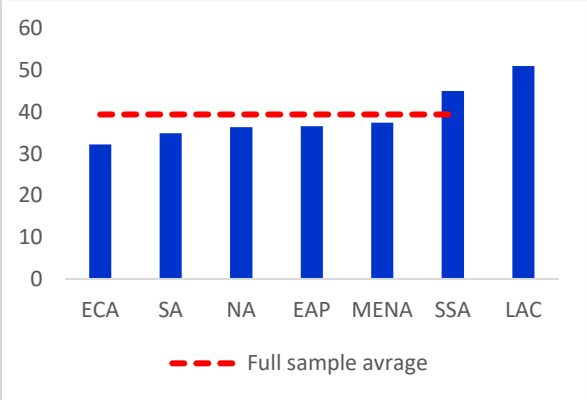
[2] The complete country list is provided in Table A1 of Appendices .

[3] See PovcalNet for more detailed information on the index construction

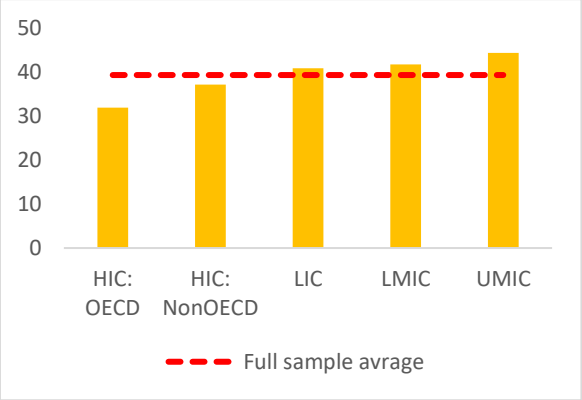
the Gini index. As one can observe (fig. 1.a), the average value of the Gini index in Latin America & Caribbean and in Sub-Saharan Africa countries overstep the full sample average line while Europe & Central Asia are fare below the line. This indicates that income disparities are more pronounced in LAC and SSA countries than in ECA countries. Regarding the income level, only OECD countries stand below the sample average value of the index while the income gaps in low income countries are high (fig. 1.b)

Figure 1: Inequality by region and income groups (average values)

1.a. Inequality by region



1.b. Inequality by income level



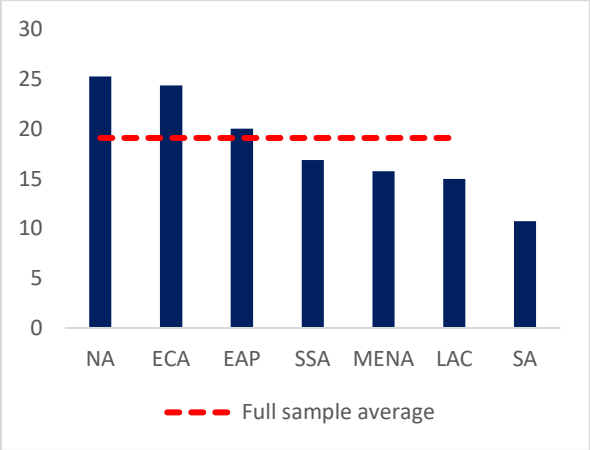
Note: ECA= Europe and Central Asia; SA= South Asia; NA: North America; EAP: East Asia & Pacific; MENA=Middle East and North Africa; SSA= Sub-Saharan Africa; LAC= Latin America & Caribbean; HIC: High Income Countries; LIC=Low-Income Countries; LMIC=Lower-Middle Income Countries; UMIC=Upper- Middle Income Countries.

Data on tax revenue are extracted from the IMF's Government Financial Statistics database for diverse reasons. First, this dataset is a unique global one that provides very detailed public finance data in line with the international standards (GFSM 2014). Second, these data allow for comparability both over time and across countries (Aldasoro and Seiferling, 2014) and the GFSM 2014 represents the latest internationally accepted methodology for the compilation of government financial statistics in a systematic manner, with well-established definitions and classifications. Third, unlike to other databases on government tax revenue, the GFS provides the most detailed classification of government's tax revenues for a large coverage across countries and over time, and the data are compiled by the IMF's Statistics Department, which ensures consistency across countries, the quality and the accuracy of data under a common methodology for all countries. In addition to the total tax revenue, our tax

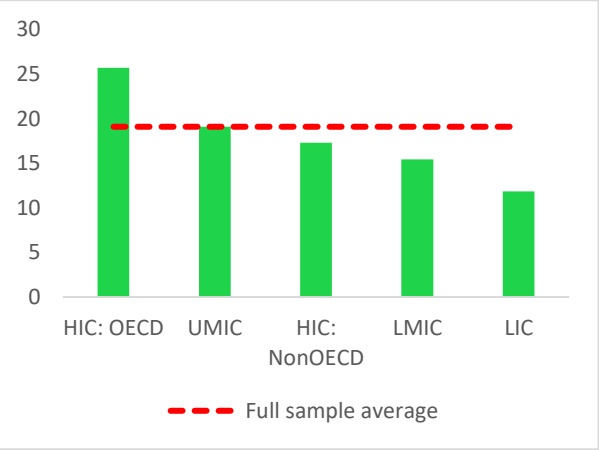
data include the following tax components: taxes on goods & services, taxes on income, profits, & capital gains, taxes on international trade & transactions, taxes on payroll & workforce, taxes on property, and value-added taxes.[4] Governments' tax capacity across regions and income groups is shown in the figure 2[5]. SSA, MENA, LAC and SA regions feature low tax-to-GDP ratio standing below the sample average (19%) while NA and ECA stand above the sample average (fig. 2.a). Focusing on the income level, it appears that the income level and the tax capacity are positively associated. OECD countries exhibit the highest total tax revenue ratio (26%) whereas the ratio is of 12% in low income countries (fig. 2.b).

Figure 2: Total tax revenue by region and income groups (average values)

2.a. Total tax ratio by region



2.b. Total tax ratio by income level



In figures 3 and 4, we present the total tax revenue and inequality dynamics and the relationship between the two variables, respectively. It clearly emerges a downward trend of inequality over the past two decades suggesting a gradual less unequal distribution of revenues among countries even though, as mentioned above, inequality

[4] Note that tax data are all expressed in percentage of GDP and social contributions and grants are excluded since they are not taxes (see GFSM, 2014 for details).

[5] Graphs on the tax composition across regions and income groups are provided in Figure A1 of Appendices

within countries remain high[6]. On the opposite side, there is a growing tax effort in the country sample. Thus, we could infer that less income inequality is associated with more tax revenue and that is confirmed by the negative relationship in figure 4. Denmark and Sweden (HIC:OECD countries) exhibit a low GINI score which is associated with an high tax ratio, while Nigeria shows the opposite.

Figure 3: Gini index & tax ratio

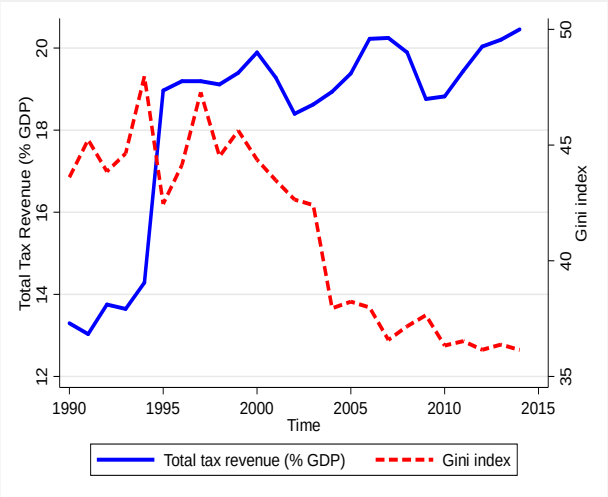
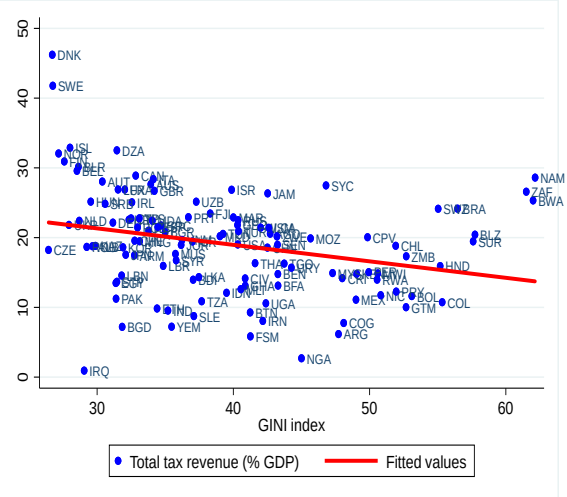


Figure 4: Gini index & tax ratio



3. Empirical methodology and variables

The empirical equation specified to analyse the effect of income inequality on government tax revenue is as follows:

$$Taxrev_{i,t} = \alpha + \beta Taxrev_{i,t-1} + \psi Ineq_{i,t} + \boldsymbol{Z}_{i,t}\delta + \lambda_i + \zeta_t + \varepsilon_{it} \qquad \textbf{(Eq.1)}$$

$Taxrev_{i,t}$ is the total tax revenue for country i at time t. We include the one-period lagged value of the dependant variable, $Taxrev_{i,t}$ because of the inertia in the total tax revenue. $Ineq_{i,t}$ stands for income inequality measured by the Gini index and $\boldsymbol{Z}_{i,t}$ is a set of variables that explain the government tax revenue ratio. λ_i and ζ_t denote time-invariant country-level characteristics and time-varying factors, respectively that could potentially affect the tax ratio. The last term, ε_{it} is an idiosyncratic disturbance.

[6] Inequality remain high specifically in advanced economies owing to financial integration, domestic policies, international trade, and technological advances (IMF, 2018)

In the literature, several studies have analyzed the driving factors of government taxes revenue. Lotz and Morss (1967) in their first contribution highlight that the level of development (measured by per capita GDP) and the trade openness (captured by the size of the foreign trade) are associated with conditions which favor tax revenue collection in developing countries. Subsequent studies emphasized additional determinants of tax-to-GDP ratio. The shares of agriculture and mining (resource rent) sectors as well as external debt are found to be significant determinants of countries tax ratios. Agriculture share, which still represents an important share in least developed economies, is negatively associated with the level of tax revenue (Chelliah et al., 1975; Leuthold, 1991; Tanzi, 1992; Stotsky and WoldeMariam, 1997) while mining and external debt are positively associated with tax revenues (Cheliiah et al., 1975; and Tanzi, 1992). However, the relationship between natural resource sector and tax revenue remains controversial. Indeed, in line with the resource curse debate, recent studies point out a negative association between resource rent and government tax revenue. For instance, Belinga et al. (2017) examining the nexus between hydrocarbon and non-hydrocarbon revenues using a probabilistic model framework on a panel of 30 resource-rich countries over the period 1992-2012, highlight a crowding-out effect of resource revenue on non-resource revenue. Natural resource bonanza is associated with less incentive in tax collection.

Others studies including Davoodi and Grigorian (2007), Gupta (2007), Gordon and Li (2009), Clist and Morrissey (2011), Fenochietto and Pessino (2013), Feger and Asafu-Adjaye (2014), outlined the pivotal role of institutional quality, inflation, education, political stability, external aid, and financial development on tax mobilization. Furthermore, Balima et al. (2016) investigated the relationship between the initiation of a sovereign bond market and tax revenue mobilization behavior on a broad panel of countries. Drawing on Propensity Score Matching (PSM) methods, the results show that bond market participation significantly fosters domestic tax revenue mobilization and reduces internal tax revenue instabilities. Finally, a more recent paper by Gnangnon and Brun (2018) examining the implications of closing the internet gap on public revenue mobilization finds that the reduction of internet gap influences positively country's non-resource tax revenue, and poorest countries appear particularly to be the most important beneficiaries of that reduction of the gap on non-resource revenue.

Taking stock of aforementioned literature, the vector $\boldsymbol{Z}_{i,t}$ includes the development level captured by the per capita real income level, the level of financial development, the endowment in natural resource, the level of trade openness, and quality of institutions that we proxied by the level of corruption:

- **GDP per capita**: countries' tax capacity is related to their level of economic development proxied by real GDP per capita. High income countries are expected to raise more tax revenue than developing countries thanks to more efficient and strong tax administration, higher degree of economic and institutional sophistication and the higher demand for public goods and services (Lotz and Morss, 1967; Tanzi 1983; Pessino and Fenochietto, 2010; Fenochietto and Pessino, 2013; Crivelli and Gupta, 2014). To capture the non-linearity effect of the level of development and tax capacity, we include the squared of the per capita of real GDP.

- **Financial development**: a sound and developed financial sector can improve tax collection (Gordon and Li, 2009). In a presence of ineffective financial system, firms could successfully evade tax payment by conducting business in cash, which is harder for tax administration to monitor. That is said, a high financial development combined with a greater access to credit allow individuals and corporates to finance profitable projects, which in turn favor tax contribution.

- **Natural resources**: The effect of natural resource rent on tax revenue ratio is widely evidenced in the literature but remain controversial. While pioneering studies evidenced a positive effect of natural resource rent on tax revenue (Cheliiah et al., 1975 and Tanzi, 1992), recent studies show that natural resource endowment is associated with lower tax revenue suggesting a natural resource curse (Sachs and Warner, 2001; Eltony, 2002; Melou and al., 2017). During commodity prices upswings, governments in resources-rich countries have less incentive to mobilize tax revenues: resource rent crowds-out tax revenue.

- **Openness to international trade**: trade openness expressed as total trade (imports and exports) over the GDP is expected to positively influence tax revenue through households consumption and domestic corporate profits

(Stotsky and WoldeMariam, 2006; Pessino and Fenochietto 2010; Gnangnon and Brun, 2018). Therefore, trade liberalization policies, in addition to substantially increase trade volume in the countries could favor more tax collection.

- **Quality of institutions**: we proxied institutional quality by the level of corruption in the country. The ICRG corruption index provides an assessment of corruption in the political system. Corruption is a threat for tax revenue collection as it affects tax administration and tax officers and is a great canal for tax evasion. So, strong political institutions will promote adequate tax administrations and allow more tax revenue collection. The corruption index ranges from 0 to 6 with 0, the highest level of corruption while 6 equates the lowest level of corruption. Table A2 of Appendix provides descriptive statistics of the variables used for the study.

Simultaneity bias is one potential source of endogeneity when it comes to estimate the **Eq.1**. Indeed, the tax structure (e.g., a progressive tax system) can also affect income inequality. For instance, tax expenditures on consumption goods and social promoting policies are associated with less income inequality. Moreover, the estimation of this equation is subject to omitted variables bias. Additional factors including the fiscal policy, tax administration features, tax rates and tax base, and cultural considerations are more likely to shape government tax ratio. Thus, relying on classical Ordinary Least Squares (OLS) estimator would lead to biased coefficients. The appropriate estimator regarding these endogeneity issues appear to be the Generalized Method of Moments (GMM), specifically the system-GMM by Blundell and Bond (1998). The system-GMM estimator is designed for dynamic specifications, with current realizations of the dependent variable influenced by the past ones. In addition, this estimator suits models with some independent variables that are or might not be strictly exogenous. Hence, this estimator will allow, not only to correct the endogeneity of our interest variable – income inequality, but also to correct for endogeneity of all right-hand side variables by using the lagged values as instruments. However, the validity of the GMM estimation relies on the main assumption that instruments are exogenous (Roodman, 2009). Therefore we resort to Hansen's test for over-identifying restrictions to check the validity of the instruments. Another condition that validates the GMM estimator is the absence of second-order serial correlation in the residuals in difference.

Accordingly, the Arellano-Bond's test is used check that condition. The estimation results are presented in the following section.

4. Estimates results

This section discusses the empirical finding based on the system-GMM estimator. We firstly present the baseline results and further, we provide robustness checks.

4.1. Baseline results

The table 1 presents the empirical results of GMM-based estimations of the effect of income inequality on tax ratio. The validity of the different specifications is confirmed by the Arellano–Bond statistics AR(1)) and AR(2) and by the Hansen test of over identification restrictions[7]. Column [1] reports the results of the effect of inequality on total taxes revenue. It emerges a clear negative impact of on government total tax revenue (see column [1]). The coefficient associated with the Gini index is negative and strongly significant. More precisely, a one percentage increase in the Gini index is associated with a reduction in government total tax ratio by 0.4 percentage points. Thus, income inequality harms countries' total tax revenue mobilization and that comforts previous studies (Pessino and Fenochietto, 2010; Fenochietto and Pessino, 2013; and Combes and Ouedraogo, 2016).

The findings are also supported in columns [2] to [6].. Income inequality negatively and significantly affects taxes on income & profits (column [2]), taxes on payroll & workforce (column [3]), value-added taxes (column [4]), taxes on goods & services (column [5]), and taxes on property (column [6]) and the effect is greater for the first two subcomponents ((column [2] & [3]).

Regarding the control variables, overall, the results are in line with previous findings. Countries capacity to collect more tax revenue is positively connected to their stage of development measured by the per capita real income and that relationship is not linear. In addition, consistent with Gordon and Li (2009), a sound financial sector is an important asset for more tax mobilization. Likewise, greater trade openness and high institutional quality characterized by a low level of corruption is associated with greater

[7] See Roodman (2009) for more details.

tax revenue. As for natural resource rents, it is positively associated with total tax revenue and tax subcomponents except taxes on goods and services (column [5]).

4.2. Robustness analyses

In this section we perform a set of robustness exercises aiming at strengthening the baseline results. We first re-estimate our baseline specification using alternative measures of income inequality. Second, to mitigate the omitted variable bias, we include more control variables relevant to explain countries tax-to-GDP ratio. Third, we use five-year non-overlapping sub-periods (i.e. 1995-1999, 2000-2004, 2005-2009, 2010-2014 and 2015-2017) data instead of yearly-based data.

Table 1: Baseline results

	Dependent Variables: Log Taxes Revenue (% GDP)					
	[1]	[2]	[3]	[4]	[5]	[6]
	Total tax	Income	Payroll	VAT	Goods	Property
Lag. Dep. Var.	0.319***	0.286***	1.009***	0.773***	0.970***	0.802***
	(0.0201)	(0.00786)	(0.00732)	(0.00552)	(0.000934)	(0.00188)
Log GINI index	**-0.436*** **	**-0.591*** **	**-0.620** **	**-0.212** **	**-0.0175*** **	**-0.0838*** **
	(0.127)	(0.0400)	(0.261)	(0.0824)	(0.00322)	(0.0242)
Log GDP_pc (const. 2010 US$)	0.299***	0.465***	1.919***	0.121**	0.0674***	2.448***
	(0.0802)	(0.0955)	(0.569)	(0.0536)	(0.00419)	(0.0771)
Log GDP_pc sqr (const. 2010 US$)	-0.0137***	-0.0228***	-0.107***	-0.00634**	-0.00392***	-0.131***
	(0.00433)	(0.00569)	(0.0293)	(0.00295)	(0.000261)	(0.00478)
Log private credit (% GDP)	0.0307***	0.0561***	-0.145***	0.0267***	0.00171***	0.0268***
	(0.0117)	(0.00904)	(0.0443)	(0.00855)	(0.000515)	(0.0104)
Log total trade (% GDP)	0.101***	0.0598***	0.000181	0.00328	0.00546***	0.0519***
	(0.0202)	(0.0109)	(0.0462)	(0.0149)	(0.000728)	(0.00760)
Log total natural resources rents (% GDP)	0.0144***	0.0551***	0.0287***	0.00368	-0.00137***	0.0107***
	(0.00360)	(0.00283)	(0.00763)	(0.00227)	(0.000109)	(0.00262)
Control of corruption	0.0630***	0.209***	0.138**	0.0107	0.00211**	0.166***
	(0.0126)	(0.0108)	(0.0625)	(0.0103)	(0.000854)	(0.0125)
Constant	1.447**	0.677	-5.683***	0.469	-0.181***	-11.44***
	(0.681)	(0.432)	(2.097)	(0.441)	(0.0166)	(0.270)
Nb. of observations	1440	1440	514	1154	1414	1179
Countries	101	101	41	86	100	91
AR(1) p-value	0.0309	0.00145	0.0211	0.191	5.77e-05	0.0199
AR(2) p-value	0.285	0.167	0.0858	0.371	0.866	0.261
Hansen OID (p-value)	0.110	0.252	1.000	0.329	0.923	0.313

Significance : *** 1%, ** 5%, * 1% Standard errors in parentheses

4.2.1. Using alternative data source for income inequality

In our baseline estimation, we relied on the World Bank Gini index as measure of inequality. We use now the income inequality index from the World Income Inequality

Database version four (WIID4) developed by the United Nations University (UNU-WIDER). The WIID4 has the advantage to include more information which allows the selection of consistent inequality estimates (Chauvet et al., 2018). Thus, we re-estimate **Eq.1** using WIID4's inequality index and the results are reported in table 2. As one can see, our baseline findings remain broadly consistent. The coefficient associated with the Gini index is also negative and statistically significant for total tax revenue (column [1]) and for tax subcomponents (column [2]-[6]).

Table 2: Robustness check: Using WIID4 inequality index

	Dependent Variables: Log Taxes Revenue (% GDP)					
	[1]	[2]	[3]	[4]	[5]	[6]
	Total tax	Income	Payroll	VAT	Goods	Property
Lag. Dep. Var.	0.891***	0.131***	0.838***	0.841***	0.388***	0.511***
	(0.00594)	(0.0273)	(0.00464)	(0.00223)	(0.0259)	(0.0206)
Log Gini index (WIID)	**-0.110*** **	**-0.746** **	**-0.372*** **	**-0.164*** **	**-0.775*** **	**-1.122** **
	(0.0164)	(0.349)	(0.136)	(0.0614)	(0.0879)	(0.458)
Log GDP_pc (constant 2010 US$)	0.128***	1.284***	0.825**	-0.342***	0.138*	-1.352***
	(0.0124)	(0.203)	(0.397)	(0.0620)	(0.0744)	(0.301)
Log GDP_pc sqr (const. 2010 US$)	-0.00673***	-0.0682***	-0.0545**	0.0205***	-0.00653	0.0974***
	(0.000770)	(0.0120)	(0.0216)	(0.00360)	(0.00406)	(0.0179)
Log private credit (% GDP)	-0.00546***	0.00454	0.225***	0.0486***	0.0653***	-7.08e-05
	(0.000994)	(0.0277)	(0.0424)	(0.00499)	(0.0151)	(0.0379)
Log total trade (% of GDP)	0.00992***	0.0251	-0.265***	-0.0124*	0.0739***	-0.304***
	(0.00190)	(0.0357)	(0.0313)	(0.00705)	(0.0235)	(0.0506)
Log total natural resources rents (% GDP)	0.00262***	0.0699***	0.0105	0.000516	-0.0133***	-0.00868
	(0.000446)	(0.0123)	(0.0109)	(0.00217)	(0.00441)	(0.0159)
Control of corruption	0.00976***	0.271***	0.141***	-0.0547***	-0.0469***	-0.210***
	(0.00236)	(0.0440)	(0.0367)	(0.00984)	(0.0117)	(0.0650)
Constant	0.101	-1.699	-1.608	2.115***	2.811***	8.939***
	(0.0733)	(1.481)	(1.253)	(0.415)	(0.446)	(2.348)
Nb. of observations	957	952	365	773	940	805
Countries	87	86	39	72	87	79
AR(1) p-value	0.0471	0.00833	0.0388	0.225	0.0652	0.0587
AR(2) p-value	0.257	0.244	0.204	0.640	0.258	0.244
Hansen OID (p-value)	1.000	0.148	1.000	0.367	0.202	0.126

Significance : *** 1%, ** 5%, * 1% Standard errors in parentheses

Furthermore, since WIID4 includes quantile data, we also run de regression only for total tax revenue (column [1] of the baseline table using quintiles income distribution. Note that quintiles refer to the shares of total income going to each fifth of the population ordered according to the size of their incomes. For instance, the first quintile group includes the poorest 20% of the population, while the fifth quintile represent the

richest 20%. The results are reported in table A3 of Appendices and our results remain solid. Income inequality negatively affect tax revenue regardless of the income quintile..

4.2.2. Adding more control variables

The second robustness exercise consists in adding more control variable to mitigate omitted variable bias. To do so, we firstly control for personal remittances. It is evidenced in the literature (Ebeke, 2010) that remittances inflows not only, significantly increase government tax revenue level, but also reduce its volatility. So, we expect remittances inflows to increase more tax revenue through VAT and sales taxes by rising households consumption.

In column [2] we control for inflation. Hyperinflation or high inflation episodes are associated with low tax revenue as stressed by Tanzi (1977). For instance, it was proven that much of the sharp collapse in the tax revenue over the period 1974-1975 in Argentina would be related to the high inflation rate occurred the same period. Thus, we control for inflation.

We also control for the level of education and the population size that are both expected to positively contribute to more tax revenue (see column [3]). A highly educated society is more likely to comply with their taxes and a large population is a potential for tax collection.

Finally, agriculture sector, most of the time, benefits from important tax exemptions and, in developing countries where this sector remains an important share of the economy, these exemptions represent non-negligible tax revenue losses. Accordingly, we control for this variable and we expect the agriculture share (% GDP) to be negatively associated with tax revenue.

These additional variables are extracted from World Bank's WDI excepted data on the level of education we proxied by the human capital index and inflation which are from Penn World Table version 9 (PWT 9.0) database and IMF's World Economic Outlook, respectively. The estimation results are reported in table 3. Consistent with the theoretical predictions, all the variables have the predicted sign and are statistically significant. More personal remittances received, greater population and high level of education are positively associated with tax revenue (see column [4] et [6]). At the opposite, high inflation rates impede on tax collection (column [3]) corroborating the

Tanzi effect as well as agriculture share (column [5]). Our baseline findings remain comforted. However, the magnitude of the coefficient associated to the Gini index considerably lowers when controlling for the level of education (column [6]). That underscores the fact that the level education closes income gaps and thereby reduce the effect of inequality on the government tax revenue.

Table 3: Robustness check: Adding more control variables

	Dependent Variables: Log Total Taxes Revenue (% GDP)					
	[1]	[2]	[3]	[4]	[5]	[6]
Lag. Dep. Var.	0.319***	0.354***	0.374***	0.384***	0.408***	0.871***
	(0.0201)	(0.0225)	(0.00827)	(0.00936)	(0.0114)	(0.00298)
Log GINI index	**-0.436*** **	**-0.242** **	**-0.335*** **	**-0.232*** **	**-0.169*** **	**-0.0114** **
	(0.127)	(0.100)	(0.0486)	(0.0393)	(0.0404)	(0.00522)
Log GDP_pc (const. 2010 US$)	0.299***	0.211***	0.259***	0.629***	0.579***	0.0229*
	(0.0802)	(0.0800)	(0.0377)	(0.0442)	(0.0686)	(0.0117)
Log GDP_pc sqr (const. 2010 US$)	-0.0137***	-0.00864*	-0.0116***	-0.0343***	-0.0324***	-0.000376
	(0.00433)	(0.00441)	(0.00224)	(0.00271)	(0.00412)	(0.000741)
Log private Credit (% GDP)	0.0307***	0.0250**	0.0357***	0.0100*	0.0521***	0.00653***
	(0.0117)	(0.0113)	(0.00618)	(0.00594)	(0.00433)	(0.000886)
Log total trade (% GDP)	0.101***	0.103***	0.0600***	0.111***	-0.0580***	0.0116***
	(0.0202)	(0.0222)	(0.0103)	(0.0164)	(0.0133)	(0.00204)
Log total natural resources rents (% GDP)	0.0144***	0.0107***	0.0130***	0.00366	0.0172***	0.00328***
	(0.00360)	(0.00342)	(0.00136)	(0.00323)	(0.00289)	(0.000461)
Control of corruption	0.0630***	0.0634***	0.0557***	0.147***	0.145***	0.0131***
	(0.0126)	(0.0125)	(0.00835)	(0.0122)	(0.0103)	(0.00211)
Log personal remittances, received (% GDP)		0.000771	0.00130	0.0352***	0.0891***	0.00910***
		(0.00446)	(0.00348)	(0.00436)	(0.00499)	(0.000682)
Log inflation, consumer prices (annual %)			-0.00249***	-0.00474***	-0.00319**	0.000594
			(0.000889)	(0.00169)	(0.00129)	(0.000389)
Log of population (in millions)				0.0476***	-0.00826	
				(0.0127)	(0.00960)	
Log agriculture, value added (% GDP)					-0.0762***	
					(0.0141)	
Human capital index						0.00431**
						(0.00178)
Constant	1.447**	1.036*	1.278***	-1.507***	0.114	0.160***
	(0.681)	(0.591)	(0.229)	(0.348)	(0.349)	(0.0358)
Nb. of observations	1440	1423	1336	1155	1124	1292
Countries	101	101	101	96	95	96
AR(1) p-value	0.0309	0.0342	0.0382	0.0511	0.0581	0.0359
AR(2) p-value	0.285	0.281	0.258	0.278	0.349	0.236
Hansen OID (p-value)	0.110	0.0297	0.245	0.277	0.350	0.976

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.2.3 Estimations on five-year non-overlapping sub-periods

We undertake our last robustness exercise by reperforming the system-GMM estimation on five-year non-overlapping sub-periods (i.e. 1995-1999, 2000-2004, 2005-2009, 2010-2014 and 2015-2017) data instead of yearly-based data. Indeed, using five-year windows data is likely to minimize the traditional issue of short-term shocks. The results are presented in table A4 in appendix. The baseline results are still robust to the using of that kind of data. Overall, inequality is harmful to government total tax revenue and to the different tax revenue components.

5. Conclusion

This paper has examined the impact of inequality on government total tax revenue.. Drawing on a large sample of 101 countries over the period 1995-2017. In contrast to previous few works, our studies addressed the issue of endogeneity through the use of the Generalized Method of Moments (GMM) estimator. We find that income inequality is associated with lower total tax revenue and tax revenues subcomponents. The results are robust to the use of alternative source of income inequality data and regardless of the income quintile used. In addition, our findings remain valid when controlling for more variables to mitigate the omitted variable bias. Furthermore, in accordance with the classic literature on the determinants of government tax revenue, our results show that countries' capacity to raise tax revenue is related to their of economic development but we find that the relationship is not linear. Sound financial sector and high institutional quality are found to improve taxes revenue collection. Income inequality is a global issue both in developing and developed countries and need to be addressed. Regarding the policy implications of the paper, the empirical findings call for more income-equalizing policies. It clearly appears that combating income inequality would provide important opportunities for greater tax revenue collection and for sustainable development goals achievement.

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Appendices

Table A1: Country list

Albania	Croatia	Kazakhstan	Senegal
Algeria	Cyprus	Kenya	Serbia
Angola	Czech Republic	Korea, Rep.	Seychelles
Argentina	Denmark	Lebanon	Sierra Leone
Armenia	Egypt, Arab Rep.	Liberia	South Africa
Australia	Estonia	Luxembourg	Spain
Austria	Fiji	Malawi	Sri Lanka
Bangladesh	Finland	Malaysia	Swaziland
Belgium	France	Mali	Sweden
Belize	Georgia	Mauritius	Switzerland
Benin	Germany	Mexico	Tanzania
Bhutan	Ghana	Moldova	Thailand
Bolivia	Greece	Mongolia	Togo
Botswana	Guatemala	Morocco	Tunisia
Brazil	Honduras	Namibia	Turkey
Bulgaria	Hungary	Netherlands	Uganda
Burkina Faso	Iceland	Nicaragua	Ukraine
Burundi	India	Nigeria	United Kingdom
Cabo Verde	Indonesia	Norway	United States
Canada	Iran, Islamic Rep.	Pakistan	Uruguay
Chile	Ireland	Paraguay	Vietnam
China	Israel	Peru	Yemen, Rep.
Colombia	Italy	Poland	Zambia
Congo, Rep.	Jamaica	Portugal	
Costa Rica	Japan	Russian Federation	
Cote d'Ivoire	Jordan	Rwanda	

Table A2: Variables, data source and descriptive Statistics

Variables	Definition	Sources
Tax revenues	Tax revenues in percentage of GDP	IMF's GFS
Inflation	Consumer price index (average) in percentage	IMF's WEO
GDP per capita	Purchasing power parity (PPP) Per Capita, constant 2010 prices	World Bank's WDI
Natural resource rents	Total Natural resource rents	
Trade	Trade openness represented by the sum of imports and exports over GDP	
Agriculture, value added	Share of agriculture, forestry, and fishing, value added in GDP	
Population	Total population	
Personal remittances	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.	
Gini index	Index measuring the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution	
Financial development	Private Credit (% GDP)	World Bank's FinStats 2017
Human capital index	Index of human capital	PWT 9.0
Corruption	Assessment of corruption within the political system	ICRG

Variable	Obs	Mean	Std. Dev.	Min	Max
Gini index	2,361	39.47254	8.822288	24.1	65.8
Total taxes revenue(% GDP)	2,242	19.67618	8.241782	0.9262937	62.2241
Log GDP per capita (const. 2010 US$)	3,476	8.300203	1.494274	5.229296	11.62597
Log private Credit (% GDP)	3,16	3.401149	0.9987459	-.8767924	5.872588
Log Total Trade (% GDP)	3,284	4.284867	0.6199233	-3.863269	6.27615
Log total Natural resource rents (% GDP)	3,424	.5763274	2.28399	-8.140079	4.490501
Corruption	2,673	2.794987	1.267564	0	6
Log Personal remittances (% of GDP)	3,149	0.1743561	1.890125	-10.45195	3.985754
Log inflation rate	3,069	1.479361	1.19604	-7.393417	10.10279
Log total population	3,141	15.7657	2.028749	9.129889	21.03897
Log agriculture, value added (% GDP)	3,271	2.156446	1.137755	-1.369635	4.369983
Human capital index	2,806	2.411593	0.6999271	1.049339	3.734285

Table A3: Robustness check: Using Gini index quintiles

	Dependent Variable: Log Total Tax Revenue (% GDP)				
	(1)	(2)	(3)	(4)	(5)
Lag. Dep. Var.	0.505***	-0.0376	1.014***	1.016***	0.437***
	(0.0425)	(0.208)	(0.00198)	(0.00185)	(0.0315)
1st Quintile	**-0.0967*** **				
	(0.0226)				
2nd Quintile		**-1.120****			
		(0.487)			
3rd Quintile			**-0.0759*** **		
			(0.00479)		
4th Quintile				**-0.0850*** **	
				(0.00541)	
5th Quintile					**-0.215*** **
					(0.0434)
Log GDP_pc (constant 2010 US$)	-0.184	0.337	0.0104	0.00105	-0.0182
	(0.120)	(0.363)	(0.00689)	(0.00542)	(0.0848)
Log GDP_pc sqr (const. 2010 US$)	0.0170**	-0.00928	-0.00125***	-0.000807**	0.00504
	(0.00665)	(0.0211)	(0.000443)	(0.000360)	(0.00477)
Log private Credit (% GDP)	0.0328***	0.0911*	0.00755***	0.00725***	0.0424***
	(0.0122)	(0.0476)	(0.000945)	(0.000491)	(0.00958)
Log total trade (% of GDP)	0.0345	0.108*	0.00201	0.00218*	0.0480**
	(0.0234)	(0.0619)	(0.00134)	(0.00120)	(0.0199)
Log total natural resources rents (% GDP)	0.00435	-0.0266	-0.00241***	-0.00189***	0.00435
	(0.00489)	(0.0180)	(0.000538)	(0.000525)	(0.00324)
Control of corruption	-0.0573***	0.00168	0.00295**	0.00124	-0.00813
	(0.0108)	(0.0541)	(0.00150)	(0.00150)	(0.0128)
Constant	1.655***	2.796**	0.144***	0.240***	1.873***
	(0.500)	(1.299)	(0.0299)	(0.0254)	(0.463)
Nb. of observations	257	256	256	256	257
Countries	80	79	79	79	80
AR(1) p-value	0.664	0.604	0.357	0.351	0.787
AR(2) p-value	0.293	0.393	0.267	0.270	0.404
Hansen OID (p-value)	0.389	0.0560	0.555	0.475	0.576

Significance : *** 1%, ** 5%, * 1% Standard errors in parentheses

Table A4: Robustness check: Estimations on five-year non-overlapping sub-periods

	Dependent variables : Log Taxes Revenue (% GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
	Total tax	Income	Payroll	VAT	Goods	Property
Lag. Dep. Var.	0.192***	0.237**	0.852***	0.979***	0.684***	0.677***
	(0.0690)	(0.118)	(0.0238)	(0.0653)	(0.0622)	(0.0690)
Log GINI index	**-0.319****	**-1.567*****	**-0.976*****	**-0.287****	**-0.305****	**-1.969***
	(0.161)	(0.548)	(0.203)	(0.138)	(0.125)	(1.120)
Log GDP_pc (const. 2010 US$)	0.217	0.757*	1.110**	-0.0121	0.0723	1.382
	(0.170)	(0.412)	(0.548)	(0.152)	(0.173)	(1.188)
Log GDP_pc sqr (const. 2010 US$)	-0.00843	-0.0411*	-0.0556	0.000166	-0.00407	-0.0554
	(0.00970)	(0.0234)	(0.0361)	(0.00912)	(0.0101)	(0.0690)
Log private Credit (% GDP)	0.0512**	-0.00434	0.241***	0.0359*	0.0444**	-0.0289
	(0.0229)	(0.0393)	(0.0660)	(0.0185)	(0.0219)	(0.0888)
Log total trade (% GDP)	0.0823**	0.0405	-0.0549	-0.0432	0.0364	-0.0590
	(0.0338)	(0.0481)	(0.126)	(0.0342)	(0.0260)	(0.184)
Log total natural resources rents (% GDP)	0.0115	0.0766***	0.0399*	0.00732	-0.00521	0.0554
	(0.00707)	(0.0195)	(0.0237)	(0.00620)	(0.00752)	(0.0360)
Control of corruption	0.0580*	0.238***	-0.166	-0.00830	-0.000888	-0.123
	(0.0327)	(0.0627)	(0.156)	(0.0244)	(0.0253)	(0.182)
Constant	1.712	3.531	-2.836**	1.217**	1.156	-0.756
	(1.083)	(2.161)	(1.218)	(0.598)	(0.951)	(8.545)
Nb. of observations	273	273	102	220	267	228
Countries	96	96	38	80	95	85
AR(1) p-value	0.104	0.0697	0.509	0.0158	0.00409	0.154
AR(2) p-value	0.351	0.405	0.604	0.975	0.171	0.317
Hansen OID (p-value)	0.0255	0.0290	0.718	0.477	0.172	0.231

Significance : *** 1%, ** 5%, * 1% Standard errors in parentheses

Figure A1: Tax revenue composition by region and income groups