THE IMPACT OF DIRECT AND INDIRECT TAXES ON INCOME INEQUALITY

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Abstract
High levels of income and wealth disparities are traditionally considered as one of the most peculiar characteristics of countries with low levels of economic development. However, in the last decades, the issue of income inequality has also become a concern in developed economies. This has stimulated new studies on the subject and, fiscal policy has emerged as one of the most promising fields of research. This article seeks to empirically confirm whether tax systems with a higher share of direct taxes in total revenue have redistributive impacts capable of reducing inequality in income distribution. We investigate a sample of 53 countries with different levels of income and tax structures, over the period 2000-2012. We estimate the complete sample of countries as well as for two country groups, that is, for countries of the Organization for Economic Cooperation and Development (OECD) and non-OECD countries. Following a system GMM approach, our results provide evidence that a tax system in which direct taxes are more important for tax collection is related to lower levels of income inequality in both developed and developing economies.

Keywords: Inequality; Fiscal Policy; Tax System;

Resumo
Altos níveis de desigualdade de renda e riqueza são tradicionalmente considerados características peculiares de países com baixo nível de desenvolvimento econômico. No entanto, nas últimas décadas, a questão da desigualdade de renda também se tornou uma preocupação nas economias desenvolvidas. Isso estimulou novos estudos sobre o assunto e a política fiscal emergiu como um dos campos mais promissores de pesquisa. Este artigo procura confirmar empiricamente se os sistemas tributários, nos quais a parcela dos impostos diretos na receita total é relativamente mais alta, têm impactos redistributivos capazes de reduzir a desigualdade de distribuição de renda. Analisa-se uma amostra de 53 países com diferentes níveis de renda e estruturas fiscais, durante o período de 2000-2012. Realizamos estimativas econométricas para a amostra completa de países e para os grupos de países, isto é, para os países da Organização para Cooperação e Desenvolvimento Econômico (OCDE) e países não-OCDE. Utilizando o system GMM encontramos evidências de que um sistema tributário em que os impostos diretos têm maior participação na arrecadação tributária está relacionado a níveis mais baixos de desigualdade de renda em economias desenvolvidas e em desenvolvimento.
Palavras- Chave: desigualdade; política fiscal; sistema tributário;

JEL Classifications: O15, O23, H23, E62.

Área 6 - Crescimento, Desenvolvimento Econômico e Instituições

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1- Introduction

Since the 1980s, there has been a trend of increasing inequality in the distribution of income among the world's major economies. In England, the Gini for the distribution of market income, that is before the deduction of direct taxes and aggregation of government income transfers, increased from 0.331 to 0.454, between 1975 and 2016. Over the same period, Sweden saw its market income Gini rise moderately from 0.314 to 0.366. Yellen (2014) shows that in the United States the median household income of the richest 5 percent climbed by 38 percent between 1989 and 2013. In contrast, the remaining 95 percent augmented their income by a mere 10 percent in the same period. Even in a country with solid social cohesion such as Japan, several studies have pointed to rising income inequality in the early 21st century.[5] In other words, two countries with distinctly different economic and social characteristics, the largest economy in the world and a society of high social cohesion have shown a tendency towards income concentration in recent decades.

This scenario has been drawing attention to the development and understanding of economic policies capable of reversing or at least mitigating the current trend (Stiglitz, 2017, Atkinson, 2015, Piketty, 2014, Gornick and Jäntti, 2014). For the Brazilian economy, it has long been characterized as one of the economies with the highest inequality of income distribution (Williamson, 2010), with the international discussion on the subject expanding the possibilities of understanding and opportunities of acting on this issue.

Among the economic policies related to the objective of providing a better income distribution, fiscal policy has received great attention (Poterba, 2007). Taxation and income transfer systems are means of promoting a better distribution of income in national societies. However, it is also recognized that fiscal policy has other objectives than to promote the reduction of inequality. In addition to its main function of providing revenue to the state, fiscal policy must contribute to long-term economic growth, promoting the accumulation of physical and human capital, and be a tool to reduce macroeconomic instability in the short term by helping to cushion the effects of negative shocks on income and employment levels, e.g. through automatic stabilizers.[6]

How then to reconcile the multiple objectives of fiscal policy? Traditionally, fiscal policy is under the aegis of the efficiency-equity trade-off (Stiglitz and Rosengard, 2015)[7]. And, as Martinez-Vazquez, Moreno-Dodson and Vulovic (2014) point out, in the last few decades the pendulum has gone too far towards efficiency. Is it possible to escape this dichotomy or keep it equidistant from its extremes?

The answer to this question requires efforts that are beyond the limitations of this work. However, it will help in forming one of the pieces that can be part of building a response. It aims to assess the relationship between fiscal policy and income inequality employing international data. Specifically, this article seeks to empirically confirm whether tax systems with a higher share of direct taxes in total revenue have redistributive impacts capable of reducing inequality in income distribution. In another way, the aim of this article is to provide new evidence concerning the impact of direct and indirect taxes on income inequality in a panel of 53 developing and developed countries.

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[5] Yokoyama *et al*. (2019); Yamada and Kawaguchi (2015).

[6] Obviously, these two goals, reduction of inequality and long-term economic growth, are related as new fields of research in macroeconomic theory as shown, for example, in Berg et al. (2012) and Fatás and Mihov (2013).

[7] The concept of fiscal efficiency involves both aspects related to the structure of tax collection and the impacts that taxes may have on economic decisions. In the first case, the cost of complying with tax obligations must be low, simplified. In the second, existing taxes should not distort economic agents' resource allocation decisions. Especially since the 1980s, such aspects have been used to justify the reduction or adoption of tax compensations on capital income, which ends up benefiting the wealthiest agents. The aspect of fiscal equity is linked to the concept of justice. A tax system can be considered equitable by different criteria, such as whether taxes are applied according to the income or wealth of each agent (criterion of ability to pay); whether taxes are levied according to the benefits received by taxpayers (benefit criteria); or whether taxation considers the decreasing marginal utility of income (Stiglitz and Rosengard, 2015).

Our sample includes countries with different levels of income and tax structures. This allows us to analyze whether the level of economic development in the respective countries impacts the relationship between the tax system and income distribution. In this manner, we firstly perform econometric estimations for the complete sample of countries and secondly for two groups, that is, for countries of the Organization for Economic Cooperation and Development (OECD) and non-OECD countries.

This paper is organized as follows. In section 2, we show the possible relations between the tax system and income distribution. In section 3 we describe the data and the variables. In section 4 we summarize the methodology and the benchmark results. In section 5 we present robustness checks. Section 6 concludes.

2 - Trade-off between efficiency and equity: the role of the tax structures

Kuznets (1955)[8] analyzed how the level of personal income distribution would be affected by the process of economic growth in the long term. The study included an empirical analysis concerning the case of the US. Initially, there would be a positive relationship between these variables, that is, an increase in the level of growth would lead to an increase in inequality in income distribution. This is due to structural change, e.g. the gradual migration of the population engaged in agricultural activities to activities in industry and commerce in urban areas. As the latter would present higher levels of productivity, income inequality would rise in the early stages of the transition from an agrarian economy to an urban-industrial economy. This relationship would become negative only after the level of income reaches a limit, with most of the population already performing functions in industry, commerce and services.

Thus, in the early stages of economic development, growth would produce more inequality, and later, in more advanced stages it would produce greater equity in the distribution of income as more workers are allocated in the higher productivity sectors. In turn, the economy would reduce its rate of growth by the end of the positive effects provided by the reallocation movement of the labor factor in the economy. Thus, the relationship between economic development and inequality of income distribution would have the shape of an inverted U curve.

However, Kuznets´s empirical work suggested that the concentration of income in the early stages would provide the basis for higher levels of aggregate saving and therefore aggregate investment, allowing the expansion of the stock of available capital and thus boosting the economy to a higher potential output level. At the microeconomic level, the increase in income inequality would be reflected in greater incentives and conditions for a portion of society to have maximum dedication and effort in productive entrepreneurial activities. This includes the willingness to act with high risk, such as technological innovation endeavors or long-term productive projects, as well as accumulating knowledge through investments in education itself, in order to earn a higher future income. Therefore, if monetary incentive is an important engine of human endeavor, economic agents will be better able and willing to reach their economic potential when they have the prospect of receiving all or almost all of the gains from their business or work effort. The result would be an increase in productivity and, consequently, a higher level of production in the long term, benefiting all economic agents.

[8] The debate over the validity of the empirical finding of Kuznets has been extensive and controversial. Kuznets (1955) himself recognized the limitations of the database used in this work: “In concluding this paper, I am acutely conscious of the meagerness of reliable information presented. The paper is perhaps 5 per cent empirical information and 95 per cent speculation…” (Kuznets, 1955, p. 26). For a literature advocating the Kuznets hypothesis, see Higgins and Williamson (2002) and Barro (2000). For papers that present limits to the validity of such hypothesis, see: Anand and Kanbur (1993), Deininger and Squire (1998) and Bértola (2005).

Inherent in this reasoning is the assumption of the existence of a perfect or complete credit market, that is, that any economic agent can access (borrow) the resources necessary to invest in physical or human capital regardless of their initial level of economic resources (see, Acemoglu, 2009). In this idea, there is no room for the possibility that from a certain level of income inequality, the negative aspects outweigh the positive effects for economic growth, that is, the economy enters the descending part of the inverted U curve, in which income inequality pushes down the rate of economic growth.

However, withdrawing the perfect credit market hypothesis is sufficient to find mechanisms in which income and wealth inequality may undermine economic growth. For example, if income inequality reaches a level in which a significant portion of the population finds it difficult to achieve adequate levels of health and accumulation of knowledge through education, a loss is generated in the aggregate productive potential of the economy. Without the capacity to accumulate human capital, some of these individuals who would have high entrepreneurial and innovative capacity will be wasted (Cingano, 2014). On the other hand, the part of society benefited by the concentration of income starts to have stimuli and ability to influence the decisions of economic policy to its own benefits (North, 1990; Acemoglu and Robinson, 2012; Stiglitz, 2017). For instance, by pressing for the reduction of the tax rates of the highest income parcels or lobbying for tax benefits. Holding everything else constant, this would reduce the government's ability to collect revenue by raising public debt or cutting government spending (Stiglitz, 2017).

In the first case, an increase in public debt will probably result in an increase in the real interest rate of the economy, which will have a negative impact on long-term growth. In the second, cutting government spending may result in lower development of basic infrastructure or provision of health and education services, especially for the lower income population, which also has the potential to reduce long-run economic growth capacity, and therefore the potential level of income. In addition, to pressuring the state in their favor, the more affluent households would take on more defensive and rent-seeking behaviors, reducing their entrepreneurial endeavors and prioritizing efforts to manipulate market and government in favor of maintaining the *status quo* (Atkinson, 2015).

Thus, a vicious cycle is formed between income inequality and economic growth (North, 1990; Acemoglu and Robinson, 2012). Over time, this cycle may result in political instability, with the poorer sections of the population more susceptible to the speeches of populist politicians (Cingano, 2014). This is detrimental to productive investment, given the element of uncertainty it imposes on the horizons of economic calculations, reinforcing the perverse cycle described above.

Therefore, as discussed above, there are several theoretical hypotheses capable of indicating both a positive and negative relationship between inequality of income distribution and economic growth or the level of income. It also shows that relationship is non-linear and exhibits a variety of developments. In the last decades, several empirical studies have attempted to estimate this relationship. Persson and Tabellini (1994), for example, have found evidence that a more equal income distribution is positively related to both the rate of growth and the level of income. More recently, Berg et al. (2012) also pointed to income inequality as a factor that hinders long-term economic growth.

Thus, the recognition in recent years that income inequality goes beyond an issue of distributive justice. It can also be detrimental to economic growth and thus has stimulated studies outlining possible policy avenues that can tackle this issue (Cingano, 2014; Ostry,Berg and Tsangarides, 2014; Kennedy et al., 2016). It is in this context that fiscal policy, more specifically the tax structure, has been gaining attention. This raises the question whether market determined distributional outcomes can be reduced by a given tax system and thus provide a more equality distribution of disposable income among agents, that is, income after payment of taxes and receipt of transfers? Theoretically, the answer is yes. It is enough to tax higher income agents and to transfer funds raised to lower income individuals. At the limit of its redistributive effort, the tax structure can

lead to disposable income equality between agents, leading to an economy presenting a Gini index equal to zero (see, e.g., OECD, 2011).

However, under high marginal tax burdens, economic agents with greater human capital and productivity would be discouraged from offering labor, entrepreneurial efforts, and accumulating capital. On the other side, economic agents benefiting from government transfers would also reduce their time of insertion in the labor market or be discouraged from investing in human capital accumulation. At the firm level, higher taxation on capital and income, would discourage the formation of domestic capital and, in a context of capital mobility between countries, would stimulate the firm's migration to economies with a less onerous tax structure. In the end, all these would be deleterious actions on the level and rate of growth of the output of an economy over time. That is, from a given point of redistribution, the equity effort ends up imposing a high sacrifice on economic efficiency. The challenge for modern societies is to avoid this point.

In recent decades, the concern with economic efficiency has supported several actions to reduce the redistributive role of the State's fiscal policy. The belief in the efficiency of the market's allocative capacity has fueled criticism of employing direct taxes. According to Martinez-Vazquez et. al (2014), since the 1980s, reductions in the average and maximum rates of direct taxes have been observed in most of the developed countries, with the objective of reducing tax distortions on the allocative decisions of private agents. Direct taxes, such as incidents on labor income and capital gains, are losing ground in the tax structure and becoming less progressive, according to Duncan and Sabirianova (2008).

In turn, tax structures have been increasingly based on indirect taxes (consumption taxes, excises, customs duties etc.) which supposedly would be more neutral to the considerations related to labor supply and, mainly, entrepreneurship (Vartia, 2008; Djankov et al., 2009). In the distinction made by Atkinson and Stiglitz (1976) to distinguish direct taxes from indirect taxes, the weight of the tax burden is less and less dependent on the individual characteristics of the taxpayer. For Stiglitz (2017), this reflects the capture of tax systems, via pressure on the political system, by the most economically wealthy individuals. Moreover, increases in inequality in these economies have been observed in the same time period. Thus, the question arises whether these two sets of events, such as a change in the fiscal structure towards a greater participation of the collection through indirect taxes and an increase in income disparity, are related.[9] After all, in the last few decades, the fiscal policy pendulum seems to have been drawn towards the issue of efficiency. Perhaps, for the benefit of long-term economic growth itself, now is the time for this pendulum to be influenced by distributional issues as well.

Several authors indicate the existence of a relationship between the tax structure and the level of income inequality of a country, for instance Bastagli et al. (2012), Chu et al. (2004) and Woo et al. (2013). The conclusion of the first two studies is that inequality in income distribution can be partially explained by the level and progressiveness of taxes. They also point out that, in general, direct taxes tend to favor a more equal distribution of income, while indirect taxes tend to increase inequality. Woo et al. (2013) analyze the effects tax structure on income inequality in a panel of advanced and emerging market economies over the last three decades. Coherent with Bastagli et al. (2012) and Chu et al. (2004) progressive taxation and social benefits are consistently associated with lower inequality for disposable income. Decoster et al. (2010) used microdata from five European countries to simulate what would happen to the degree of progressiveness of their tax systems if there were a reduction in the weight of direct taxes and an increase in indirect taxes. They concluded that it would lead to less progressiveness in the tax system.

Thus, the tax system can play an important role in reducing income inequality, as also pointed out in Burman (2012). In addition, the results of Woo et al. (2013) show that fiscal policy may favor the

[9] The work of Diamond and Mirrlees (1971) and Atkinson and Stiglitz (1976) supported the construction of a optimal tax theory in which indirect taxation is suboptimal and that redistribution must be achieved only with direct income tax.

long-term trends of both equality and growth by promoting education and training among low-and middle-income workers. Such findings are in line with results presented by Persson and Tabellini (1994), Berg et al. (2012) and Lee and Son (2016) on the existence of a negative relationship between economic growth and income inequality.

In summary, indirect taxes, as taxes on goods and services, tend to be more regressive because poorer individuals spend a greater share of their income on consumption, so they are likely to pay a proportionally higher average tax than the people with higher income. This directly impairs the ability of the population with the lowest income to accumulate physical or human capital. As consumers ultimately pay indirect taxes, and lower income groups spend a higher share of their income, it is generally expected that these taxes result in higher income inequality. On the other hand, direct taxes, such as individual income tax, are assumed to be progressive and contributing to decreasing inequality.

As exposed throughout this section, evidence accumulated that economic growth itself, that is, long-term allocative efficiency, may be hampered by current levels of income inequality, when these impair the ability of various economics agents to accumulate physical and human capital. In this context, even the pace of innovation can be hindered. In the same vain, studies show the importance of the tax structure for reducing income inequality. Therefore, the efficiency-equity trade-off to which fiscal policy is subject needs to be recalibrated. Our current work is part of this effort to empirically assess the relationship between fiscal structure and income distribution and assist in highlighting the need for this recalibration. The next section discusses how this is accomplished.

3 - Data and Variables

In this paper we use the Government Revenue Dataset (GRD) from the International Center for Tax and Development (ICTD) and United Nations World Institute for Development Economics Research (UNU-WIDER)[10] to provide clarity and further the discussion on the relationship between direct and indirect taxes and inequality. Specifically, we are using from this dataset: a) the total direct taxes, excluding social contributions and resource taxes, including non-resource taxes on income, profits and capitals gains, taxes on payroll and workforce and taxes on property; b) the total indirect taxes, including resource revenues, including taxes on goods and services, taxes on international trade and other taxes; c) the percentage of total expenditure in total GDP. The measure of inequality, the Gini index, is extracted from Word Bank database. Our sample covers 26 OECD countries and 27 non-OECD countries during the period 2000 to 2012.

Table A.1 in appendix summarizes the descriptive statistics and the correlation matrix. The Gini index has a maximum value of 60 and a minimum value of 22, which reflects a high disparity among the countries studied. Direct taxes have a lower level than indirect ones, with average values of 6.5% and 10.5%, respectively. Taxes have a negative correlation with inequality. In the same vain, expenditures also present a negative relationship.

The relationship between inequality and direct and indirect taxes can be observed in the years 2000 and 2012 in the OECD and non-OECD countries, as illustrated in Figure A1. In general, there is an increase in inequality in developed countries, with a reduction in direct taxes and almost no change in indirect taxes. In turn, in the developing countries, there is a reduction in inequality, with an increase in both direct and indirect taxes.

Table 1 shows the averages of direct and indirect taxes revenues and Gini index for the OECD and non-OECD countries. In both groups we can observe a relatively higher dependence on indirect taxes than on direct taxes. However, while in non-OECD countries indirect tax revenues exceed more than

[10] More detailed information on the GRD can be found in Prichard et al. (2014).

twice the direct revenues, in OECD countries the difference is only 6 percentage points. For Pickering and Rajput (2018) this reflects the fact that in low-income countries, the capacity to raise income taxes is often limited. These authors observe that within the OECD members, income taxes are around 32% of revenue, whilst in the rest of the world income taxes are just 20% of revenue.

Table 1: Descriptive statistics

	OECD				Non-OECD		
COUNTRY	DT	INDI	GINI	COUNTRY	DT	INDI	GINI
AUT	0.45	0.40	26.40	ARG	0.31	0.56	48.38
BEL	0.55	0.37	27.38	BGR	0.19	0.55	32.01
CAN	0.68	0.22	31.85	BLR	0.13	0.76	28.51
CZE	0.27	0.37	26.74	BOL	0.19	0.80	53.67
DEU	0.33	0.53	28.51	BRA	0.48	0.52	56.01
DNK	0.42	0.41	26.46	COL	0.35	0.42	55.84
ESP	0.40	0.41	33.64	CRI	0.29	0.70	49.32
EST	0.32	0.55	33.80	DOM	0.23	0.72	49.64
FIN	0.30	0.54	26.95	ECU	0.26	0.74	52.07
FRA	0.33	0.45	29.22	GEO	0.20	0.72	40.54
GBR	0.41	0.31	34.13	HRV	0.13	0.76	31.11
GRC	0.31	0.46	34.50	IDN	0.22	0.24	32.08
HUN	0.32	0.56	28.89	KAZ	0.20	0.38	30.62
IRL	0.38	0.37	31.73	KGZ	0.17	0.63	31.19
ITA	0.51	0.39	33.29	LTU	0.34	0.53	34.35
LUX	0.47	0.37	27.39	LVA	0.17	0.58	35.63
MEX	0.30	0.61	49.62	MDA	0.03	0.79	34.29
NLD	0.40	0.44	26.49	PAN	0.29	0.30	54.20
NOR	0.16	0.25	27.84	PER	0.31	0.55	49.98
POL	0.22	0.55	33.84	PRY	0.13	0.58	52.72
PRT	0.28	0.44	36.86	ROU	0.25	0.51	31.55
SVK	0.28	0.49	26.98	RUS	0.07	0.62	40.42
SVN	0.24	0.51	24.54	SLV	0.30	0.62	47.34
SWE	0.22	0.50	26.85	THA	0.37	0.50	40.87
TUR	0.20	0.46	40.25	UKR	0.21	0.54	28.56
USA	0.53	0.04	37.55	URY	0.27	0.60	45.68
				VEN	0.13	0.32	44.19
Total	0.36	0.42	31.22	Total	0.23	0.59	41.88

Source: World Bank.

Notes: the definitions of income used to calculate the Gini indexes differ among surveys; for example, for high-income economies the Gini indexes are calculated directly from the Luxembourg Income Study database, using an estimation method consistent with that applied for developing countries. For details consult: <https://databank.worldbank.org/metadataglossary/gender-statistics/series/SI.POV.GINI>.

DT and IND are total direct and indirect taxes respectively as a % of total revenue.

The Gini index of the OECD group is much smaller than the non-OECD group, as expected. Then, inequality tends to be lower in high-income countries, apparently not contradicting the Kuznets hypothesis. The question that arises now is: to what extent can direct taxes reduce inequality? Is this effect smaller for the non-OECD group?

4- Methodology and Results

We adopted the Generalized Method of Moments (GMM) system estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) that completely explores the dynamic panel data structure to correct for the endogeneity problem by using lagged values of the endogeneous explanatory variable and or dependent variable as instruments[11]. Specifically, when choosing instrumental variables, we are treating all variables as endogenous. We recall that the validity of the system GMM method is subject to the absence of second order autocorrelation of the errors and the exogeneity of the instruments.

We adopt the following equation as a base:

$$Y_{it} = \alpha Y_{it-1} + \varphi_1 DI_{it} + \varphi_2 IND_{it} + \mu_i + e_{it}$$

As this is a panel model each observation is indexed over i (= 1...N) cross-section groups (countries) and t (= 1...T) time periods (annual observations), Y_{it} is the measure of the income inequality for the 53 OECD and, non OECD countries *i* in period *t*, Y_{it-1} is the dependent variable lagged over a period, DI_{it} is the direct taxes revenue, IND_{it} is the indirect taxes revenue, μ_i a country-specific random effect that controls for all unobservable effects on the dependent variable that are exclusive to the country and do not vary over time, and e_{it} is an error term that varies over both countries and time. The lag of the dependent variable as a right hand side variable generates dynamics in the model, which may be crucial for recovering consistent estimates of other parameters (Bond, 2002).

Applying the Arellano-Bond test, in all specifications we reject the null hypotheses of the AR(1) test of no autocorrelation in the error terms and we accept it for AR(2). This ensures that the lagged variables can be used as instruments, that is, the instruments are internal. To verify the exogeneity of the instruments we use the Hansen tests of over-identification that yields a J-statistic, which is distributed χ^2 under the null that all instruments are valid[12]. Thus, the rejection of the null hypothesis implies that some of the instruments are not valid. Additionally, we apply the Difference-in-Hansen test of exogeneity of instrument subsets, under the null that the instruments used are exogenous[13]. However, many instruments may generate a possible over-identification of the endogenous variables, not allowing adequate treatment of endogeneity and generating biased estimates and may also impede the power of the Hansen test itself. To tackle this issue, we collapse the instrument matrix, which specifies creating one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance (Wintoki et al., 2012).

Table 2 shows the results. In all specifications the Hansen's p-values, that are robust to heteroscedasticity and autocorrelation, validate the over-identification restriction and the exogeneity of instrument subsets. A quick look at columns A–E of Table 2 reveal the presence of strong inertia in the measure of income inequality (Gini Index), as suggested by the relatively large coefficient of the lagged dependent variable, which captures anything historic (past) from the model. Other studies also find a similar result (Woo et al., 2013; Azevedo et al., 2014). As we are focusing on the effects of direct and indirect taxes on inequality, in the regression of Table 2, we do not add additional controls but do this at a later stage of the analysis as a robustness check.

[11] The potential sources of endogeneity are among others: omitted variables that are present in the error term; simultaneity bias and, the time-invariant unobservable variables, as well as the quality of fiscal institutions.
[12] Instead of the Sargan test the Hansen J statistic does not require homoscedasticity for testing overidentification.
[13] As recommended by Roodman (2009) the p-values for the Hansen tests are above the minimum of 0.25.

Table 2: Effects of direct and indirect taxes revenues, as a % of GDP, on income inequality

Variables	A	B (OECD)	C (OECD)	D (non-OECD)	E (non-OECD)
L.gini	0.960***	0.768***	1.016***	0.962***	0.978***
Direct	-18.587*	-20.888		-22.973	
Indirect	24.990**	88.078***		26.679*	
Direct OECD			-36.142**		
Indirect OECD			19.231*		
Direct non-OECD					-21.408*
Indirect non-OECD					19.708*
N. of Observations	609	312	609	297	609
N. of Countries	52	26	52	26	52
N. of Instruments	24	18	16	19	10
N. of Lags	3/5	2/2	2/5	3/7	3/4
AR(1)	0.000	0.002	0.000	0.010	0.000
AR(2)	0.775	0.110	0.633	0.855	0.781
Diff-in-GMM	0.656	0.825	0.473	0.648	0.391
Diff-in-IV	0.347	0.380	0.331	0.938	0.660
Hansen test	0.260	0.340	0.230	0.639	0.237

Notes: AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen test of overidentification is under the null that all instruments are valid. Diff-in-GMM and Diff-in-IV refers to difference-in-Hansen test of exogeneity, which is under the null that the subset of instruments (GMM or IV) used for the equations in levels is exogenous. The values reported for the autocorrelation and Hansen tests are *p*-values. All estimations include orthogonal deviations, two-step and collapsed. Bias-corrected heteroscedasticity-robust standard errors driven by Windmeijer (2005). ***, ** and * refer to being statistically significant at the 1%, 5% and 10% levels, respectively.

In column A of Table 2 we perform a regression for the whole sample of countries. The coefficients of direct and indirect taxes are significant, the former is negative and the latter is positive, confirming that while the rise of revenue from direct taxes reduces inequality an increase of revenue from indirect taxes worsens inequality. In other words, a rise of 1% of GDP in direct taxes reduces the inequality measure by 0.185.

In addition, we split the sample in OECD countries and non-OECD countries, columns B and D respectively, to capture possible differences between the groups. The results are very similar with the whole group, the main difference is that for OECD countries direct taxes are not statistically significant. However, when we introduce interactive dummies variables for the groups, as shown in columns C and E, both variables of tax revenues are statistically and economically significant. The inverse relationship between direct taxes and inequality may reflect the progressive structure of the tax systems of the analyzed countries. With a progressive tax system, increases in direct tax revenue would yield a larger redistributive effect and thus lower inequality (Lambert, 2001; Muinelo‐Gallo and Roca‐Sagalés, 2013).

When we compare the magnitudes of the coefficients, in columns C and E, a rise of 1% of GDP in revenues with direct taxes reduces the Gini index of OECD countries by 0.36, while a rise of the same amount and revenues for Non-OECD countries reduces the Gini index to a lower extent by 0.21. The impact of the direct taxes on inequality is much larger for the OECD group, maybe representing that the progressivity of the tax system is more efficient in the richer countries, as expected initially. Goñi et al. (2011) find similar results. Comparing the Gini coefficients of gross and disposable income, to infer the redistributive impact of direct taxes, the authors conclude that direct taxes reduce the levels of income inequality much more in European countries than in Latin America. While the direct taxation lowers the Gini coefficient of household incomes by an average 5 percentage points for fifteen European countries considered, in Latin American countries their impact on inequality is very weak, on average, the Gini coefficients decline by just 1 percentage point. Therefore, it indicates that, even if the direct taxes of Latin American countries had the same average relative participation in government revenues as that observed in developed economies, the tax system

would have less redistributive impact overall.

Even so, the results presented in table 2 indicate that increasing the share of direct taxes in the tax collection of Latin American countries would help to reduce the level of income inequality observed in the region. In other words, there seems to be room for the region's tax systems to prioritize the distributive issue. Especially because, as Berg et al. (2012) showed that this group of countries does not appear to have tax systems favorable to efficiency in the trade-off indicated by Stiglitz and Rosengard (2015).

5 - Robustness check

The aim of this section is to investigate whether the main results remain robust after controlling for different variables. To do this we adopt two strategies. Firstly, we use the direct and indirect taxes as of percentage of total revenue and not GDP as before, and thus including an additional control variable, the total government expenditure. There is evidence that indicates that at least some types of government spending can reduce the level of income inequality in different countries and regions of the world (for example Goni et al 2011; Lustig et al 2013; Martinez-Vazquez et al 2014; Lustig 2016 and Fernandes et al 2019).

Secondly, we run the base regressions that are shown in Table 2 with total government expenditure and other controls variables that appear in the literature as factors that can affect the degree of income inequality. Specifically we include human capital, welfare and exchange rate. These variables stem from the Penn World Tables. The variable for human capital is an index of human capital per person, based on years of schooling and returns to education; For welfare measure we are using the welfare-relevant TFP at constant national prices; and for exchange rate it is the national currency/USD.The results are presented in Tables 3 and 4.

Table 3: Robustness check using direct and indirect taxes revenues as a % of total revenue

		(OECD)		(non-OECD)	
VARIABLES	A	B	C	D	E
L.gini	0.911***	0.918***	1.006***	0.882***	0.979***
Direct	-5.563*	-0.019		1.486	
Indirect	12.202**	7.726**		13.144**	
Total expenditure	-0.032	-0.009		-0.082**	
Direct OECD			-4.737*		
Indirect OECD			6.613**		
Total exp. OECD			-0.037		
Direct non-OECD					-1.970
Indirect non-OECD					7.236**
Total exp. non-OECD					-0.085***
Observations	579	299	579	280	579
Number of country	52	26	52	26	52
N. of Instruments	24	13	36	13	24
N. of Lags	2/3	2/3	2/6	2/3	2/3
AR(1)	0.000485	0.00172	0.000396	0.0100	0.000433
AR(2)	0.927	0.0706	0.685	0.825	0.760
AR(3)	0.508	0.188	0.697	0.813	0.606
P-value Hansen test	0.420	0.327	0.632	0.647	0.470
Diff-in-GMM	0.233	0.298	0.679	0.660	0.452
Diff-in-IV	0.435	0.754	0.695	0.358	0.594

Notes: AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen test of overidentification is under the null that all instruments are valid. Diff-in-GMM and Diff-in-IV refers to difference-in-Hansen test of exogeneity, which is under the null that the subset of instruments (GMM or IV) used for the equations in levels is exogenous. The values reported for the autocorrelation and Hansen tests are *p*-values. All estimations include orthogonal deviations, two-step and collapsed. Bias-corrected heteroscedasticity-robust standard errors driven by Windmeijer (2005). ***, ** and * refer to being statistically significant at the 1%, 5% and 10% levels, respectively.

Considering only the results that are statistically significant, the coefficients of direct and indirect taxes continue to have a negative and positive sign, respectively, in all specifications. Overall, the diagnostics test indicate that the models perform well, as the Hansen tests validate the instruments and the Arellano-Bond test indicates no autocorrelation of order two in the error terms. The estimated coefficients in table 3 are smaller in magnitude than those in table 2 but as we are using different variables the magnitudes are not directly comparable. Note that in Table 3 the new control variable, government expenditures, is significant only for the non-OECD countries and the coefficient presents a negative sign.

Considering the Table 3 (column A) the variable direct taxes is statistically significant at the level of 10% and negative, indicating that an increase of 1% of total revenue from direct taxes reduces the Gini index of the whole sample of OECD and non-OECD countries by 0.06. On the other hand, an increase of 1% of total revenue with indirect taxes raises the Gini index by 0.12. Analyzing only the group of OECD countries, in column B, the results also remain similar from those in column B of Table 2, but with indirect taxes significantly positively related to inequality at the significance level of 5% and not 1% as before. The interactive dummies variables for the developed countries (Direct OECD and Indirect OECD) in column C have economically and statistically significant coefficients although with different significance levels in relation to those in column C of Table 2.

Focusing on the non-OECD countries we can see that the result for indirect taxes (column D) is statistically significant in comparison to the same column in Table 2. In column E the results are very similar with the former, but in relation to column E of Table 2 the variable Direct non-OECD is not statistically significant.

When we compare the magnitudes of the coefficients for the groups of countries, the results in Table 3 suggest that the negative impact of indirect taxes on inequality is larger for the non-OECD countries. This means that a rise in indirect taxes worsens the inequality to a larger extent than in the OECD countries. For example, comparing the results of columns B and D, a 1-percentage increase in the indirect taxes to total revenue ratio leads to inequality to widen by 0.13 for non-OECD countries, while the same increase in indirect taxes increases inequality by only 0.08 in the OECD countries. A similar result is illustrated in Table 4, taking a look at the magnitude of the coefficients for indirect taxes in columns E and H.

In the first column of Table 4 we examine the impact of direct and indirect taxes and total expenditure, all as a percentage of total GDP, for the whole sample of countries. Comparing these results with the same column in Table 2 we find that although the variable of direct taxes lost significance the total expenditure is statistically significant at the 5 percent level and has a negative sign. This indicates that the rise of the government spending can reduce income inequality. These results remain when we introduce, in column B, a measure of welfare. The variable is significant at the 5 percent level and exhibits a negative sign.

Extending these specifications to the OECD and non-OECD countries, as show columns D and G, we find that only for the first group indirect taxes remain significant. This is compatible with the regression in Table 2. However, for the non-OECD group only direct taxes revenue is significant, which is the opposite of the similar regression in Table 2.

Table 4: Robustness check using direct and indirect taxes revenues as a % of GDP and adding extra control variables

VARIABLES	A	B	C	D (OECD)	E (OECD)	F (OECD)	G (non-OECD)	H (non-OECD)	I (non-OECD)
L.gini	0.992***	1.005***	0.960***	0.909***	1.008***	0.968***	0.980***	0.986***	0.987***
Direct	-3.114	4.950	18.385	-6.372			-27.794*		
Indirect	15.534**	22.010***	37.408***	34.671**			24.154		
Total exp.	-0.036**	-0.026*	-0.036	0.003			-0.032		
Exchange rate			0.001***						
Human capital			0.156						
Welfare -TFP		-1.985**	-3.218**						
Direct OECD					-18.078*	-18.870			
Indirect OECD					20.796**	25.687*			
Total exp OECD					-0.020	0.040*			
Human capital OECD						-1.006*			
Welfare TFP OECD						1.382			
Exchange rate OECD						-0.010***			
Direct non-OECD								-24.697**	-27.693**
Indirect non-OECD								29.008**	0.745
Total exp. non-OECD								-0.055	-0.070*
Human capital NOECD									1.353*
Welfare TFP NOECD									-0.715
Exchange rate NOECD									0.000*
Observations	587	552	552	307	587	552	280	587	552
Number of country	52	49	49	26	52	49	26	52	49
N. of Instruments	24	27	15	13	29	29	20	13	22
N. of Lags	2/3	2/3	2/2	2/3	2/7	2/4	3/3	3/4	2/3
AR(1)	0.0004	0.0005	0.0007	0.0019	0.0003	0.0004	0.0113	0.0003	0.0004
AR(2)	0.728	0.675	0.666	0.0632	0.679	0.625	0.845	0.808	0.632
AR(3)	0.658	0.713	0.743	0.225	0.683	0.719	0.872	0.564	0.704
P-value Hansen test	0.651	0.737	0.737	0.387	0.331	0.546	0.629	0.463	0.394
Diff-in-GMM	0.561	0.483	0.692	0.558	0.263	0.248	0.545	0.542	0.967
Diff-in-IV	0.499	0.822	0.436	0.501	0.031	0.186	0.573	0.634	0.761

AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen test of overidentification is under the null that all instruments are valid. Diff-in-GMM and Diff-in-IV refers to difference-in-Hansen test of exogeneity, which is under the null that the subset of instruments (GMM or IV) used for the equations in levels is exogenous. The values reported for the autocorrelation and Hansen tests are *p*-values. All estimations include orthogonal deviations, two-step and collapsed. Bias-corrected heteroscedasticity-robust standard errors driven by Windmeijer (2005). ***, ** and * refer to being statistically significant at the 1%, 5% and 10% levels, respectively.

In column C of Table 4 we investigate the impact of other controls on income inequality for all countries. In addition to indirect taxes and welfare, the exchange rate is statistically significant at the 1 percent level and has a positive sign although the magnitude of the coefficient is very low. A rise of 1 monetary unit in the exchange rate can increase the Gini index by 0.001. Columns E and H show the regressions with interactive dummies for the groups of countries. In both cases the additional of total expenditure as a new control doesn't change the results, direct and indirect taxes remain significant, as in Table 2.

Additionally, in columns F and I, we verify whether the impacts of direct and indirect taxes revenue for OECD and non-OECD countries remain, in relation to Table 2, with the inclusion of four control variables: total expenditure, human capital, welfare and exchange rate. For the OECD group, column F, the results changed a little, the direct taxes are not significant but most controls are. The variable of total expenditure is statistically significant but has a positive sign, not following the

previous results. Human capital is negatively significant at the 10 percent level[14] and the exchange rate shows a negative and statistically significant coefficient. For the non-OECD group, column I, the indirect taxes are not significant. The total expenditure is significant and presents the expected negative sign, which complies with the results in Table 3. Human capital is significant at the 10 percent level and presents a positive coefficient, the same for exchange rate.

In general, the results of the robustness check indicate that while direct taxes are associated with an improvement in income distribution the indirect taxes revenue are associated with a worsening in income distribution. These findings are in line with the literature. Weller (2007) uses cross-country data from 1981 to 2002 and finds positive effects of progressive taxation on income distribution, as well Duncan and Sabirianova (2008). Also Martinez-Vazquez et al. (2014) find that progressive personal income taxes and corporate income taxes, that is, direct taxes, reduce income inequality. In this regard, one percentage point increase in the share of progressive personal income taxes to GDP results in a 0.1 percentage point reduction in income inequality, and an increase of one percentage point in the share of general sales tax in GDP increases income inequality by around 0.5 percentage points.

Ours results are also supported by other studies. Woo et al. (2013) find in the sample of 48 advanced and emerging market economies that the coefficients of indirect tax are significant and of the expected positive sign, a 1 percentage point of potential GDP increase in indirect taxes is associated with a 0.4-0.9 percent rise in inequality. However, when the authors investigate this effect exclusively for OECD country sample the coefficients of indirect taxes become insignificant. On the other hand, the coefficients of individual income taxes have mostly a positive sign and are significant in the results for the sample of 48 countries or only for the OECD countries. Muinelo‑Gallo and Roca‑Sagalés (2013), for instance, using a panel data of 21 high- income OCDE countries during the period 1972-2006 and estimating two systems of structural equations, find that the effect of direct taxes on inequality is negative and significant in all estimations, which may reflect the progressive structure of the tax systems of the analysed countries, while the indirect taxes have no significant effects on inequality.

6 – Conclusion

Our purpose in this article was to investigate empirically the assertion that tax systems, in which the share of direct taxes in revenue is higher than the share of indirect taxes, have redistributive impacts capable of reducing the inequality of income distribution, as shown, for instance, Chu et al. (2004), Decoster et al. (2010), Bastagli et al. (2012) and Martinez-Vazquez et al. (2014). This article provides new evidence about the impact of direct and indirect taxes on the inequality in a panel of 53 developing and developed countries, over the period 2000-2012.

We observed a relatively higher dependence of the countries on indirect taxes than on direct taxes and this dependence is even greater in developing countries. While the increase of revenue with direct taxes is related to lower levels of income inequality, the rise of revenue regarding indirect taxes seems to combine with higher levels of income differentials.

When we compared these relations for OECD and non-OECD groups, the results are more statistically significant for OECD countries, as expected initially. However, this does not weaken the ability of cross-national evidence to assist in the definition of redistributive policies in a specific economy, even if it is in development. It may signal the importance that issues about redistribution of

[14] Gregorio and Lee (2002) present empirical evidence on how education is related to income distribution in a panel data set covering a broad range of countries for the period between 1960 and 1990 and find that educational factors play a significant role in making income distribution more equal.

income have for the definition of the revenue collection structure of the respective governments. In developing economies, the issue of taxation is mostly treated as a source of revenue for governments, while in developed countries it seems to fit into a broader role for fiscal policy. And, based on the theory developed by Meltzer and Richard (1981), the combination of a higher level of income inequality and a greater share of indirect taxation in the non-OECD economies may indicate a deficiency in the democratic system of these countries. This is an important issue, but it goes beyond the scope of this paper.

The evidence presented in this paper indicates that it is not enough to evaluate just how much revenue is collected through taxation, but also the way it is collected. If on the one hand, taxation can jeopardize work decisions and human and physical capital formation, on the other hand it seems to be a relevant instrument to prevent the economy form reaching levels of inequality in the distribution of income that undermine sustainable economic growth in the long run. And as our results indicate, there is scope for developing countries to give more importance to aspects of income equity when defining their tax systems. This involves expanding the importance of direct taxes on total tax revenue.

Thus, the present work highlights the importance that the tax structure has for the conditions of equal income in each country. Therefore, aspects related to the issue of income distribution need to be considered in the entire discussion on tax reform. More broadly, structuring a fiscal system that can address the trade-off between efficiency and equity seems to be one of key elements for long-term economic growth.

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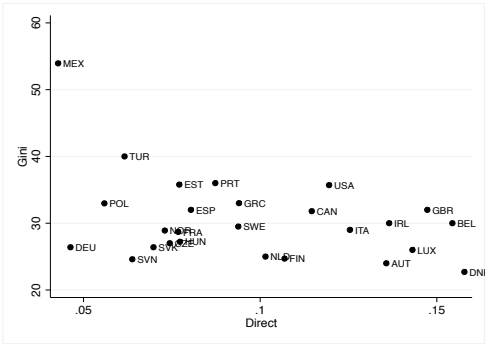
APPENDIX

Table A1: Descriptive statistics

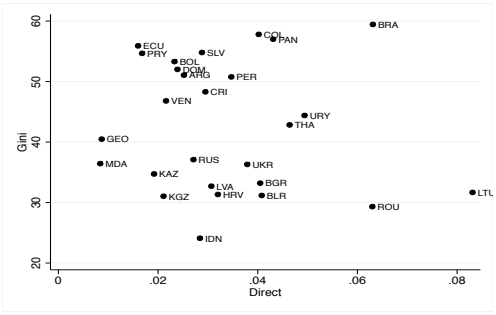
STATISTICS	VARIABLES			
	Gini	Direct	Indirect	Total expenditure
Minimum	22	0.003	0.006	9.061
Maximum	60.16	0.184	0.218	65.496
Mean	36.651	0.065	0.105	33.849
Standard Deviation	9.612	0.037	0.034	13.219
	Correlation Matrix			
	Gini	Direct	Indirect	Total expenditure
Gini	1			
Direct	-0.4248	1		
Indirect	-0.4013	0.0142	1	
Total expenditure	-0.6676	0.5189	0.3955	1

Source: Prepared by the authors.

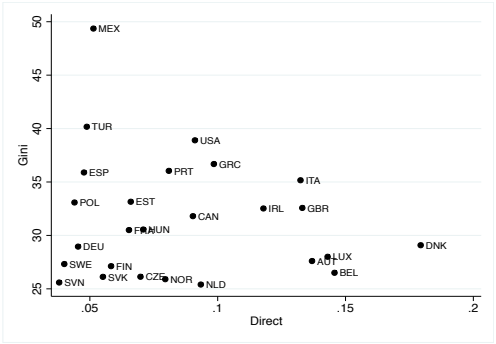
Figure A1: Gini, direct and Indirect taxes, OECD and non-OECD countries, 2000-2012



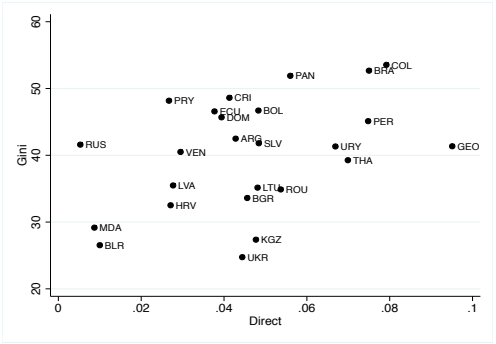
a) Gini and Direct taxes, OECD- 2000



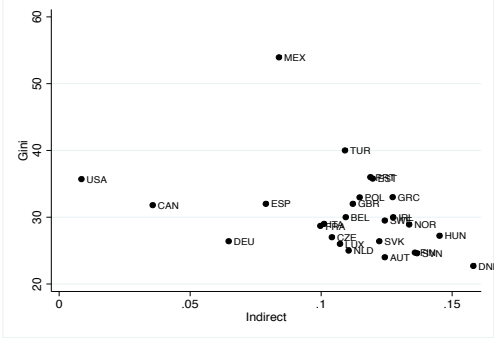
b) Gini and Direct taxes, non-OECD- 2000



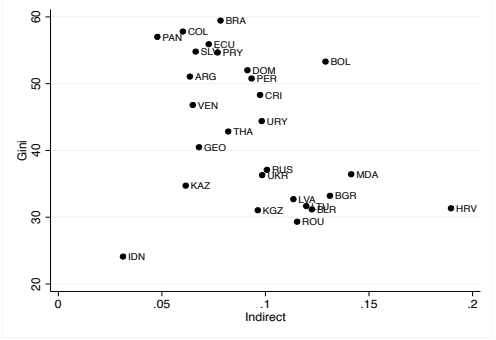
c) Gini and Direct taxes, OECD- 2012



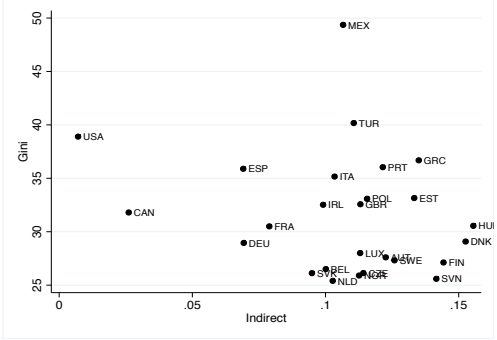
d) Gini and Direct taxes, non-OECD- 2012



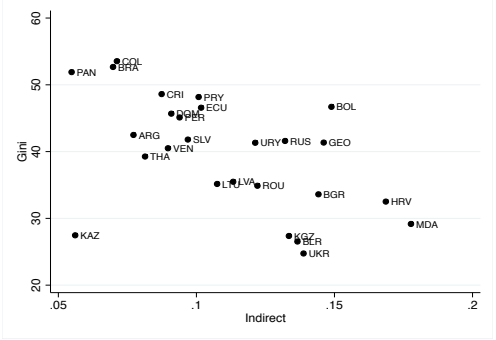
e) Gini and Indirect taxes, OECD- 2000



f) Gini and Indirect taxes, non-OECD- 2000



g) Gini and Indirect taxes, OECD- 2012



h) Gini and Indirect taxes, non-OECD- 2012

Source: Government Revenue Dataset (GRD). Prepared by the authors.