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MASTER

MONETARY AND FINANCIAL ECONOMICS

MASTER´S FINAL WORK

DISSERTATION

HOW ECONOMIC GROWTH IMPINGES ON INCOME INEQUALITIES?

ALEXANDRE LUÍS CAMBÓIAS ROXO

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Glossary

GDP – Gross Domestic Product

GMM – Generalized Method of Moments

GNI – Gross National Income

OECD – Organization for Economic Cooperation and Development

OLS – Ordinary Least Squares

UK – United Kingdom

USA – United States of America

Abstract, Keywords and *JEL* Codes

ABSTRACT: Performing a panel data analysis for OECD countries, during the period between 1990 and 2019, this dissertation investigates the relationship between economic growth and income inequalities. The main objective is to understand how the GDP and GNI per capita affect income inequality and how they differ. The results suggest a U-shaped relationship of both measures of economic growth with the market and disposable Gini indexes, the Palma and S80S20 ratios, and the income of the wealthier 10% of population, which contradicts the Kuznets hypothesis. Regarding the thresholds' analysis, there is evidence that when GDP per capita is used, inequality is higher, leading to the conclusion that countries with policies that inflate GDP rather than GNI are the main contributors to the rise in inequalities in the last years. Furthermore, the results also show a behavioral similarity between the income of the richest 10% of population and income inequality. Lastly, there is also a possibility to promote GNI per capita increasing policies, which could lead to higher economic growth while minimizing income inequalities.

KEYWORDS: inequality; economic growth; Kuznets hypothesis; panel data.

JEL CODES: D63; O47; C23.

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HOW ECONOMIC GROWTH IMPINGES ON INCOME INEQUALITIES?

By Alexandre Cambóias Roxo

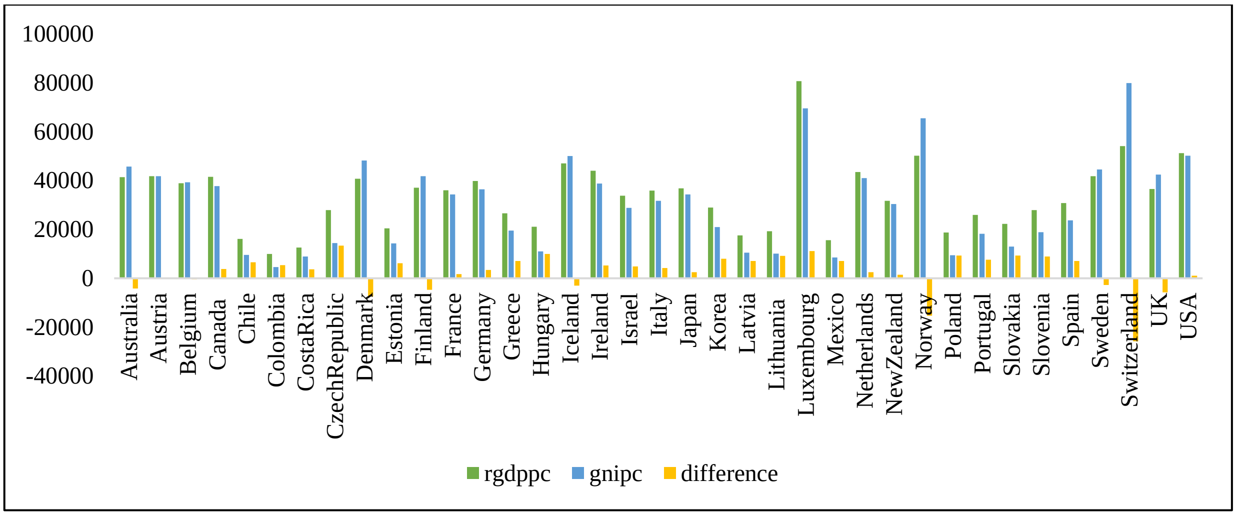
This dissertation investigates the relationship between GDP and GNI per capita and income inequalities using panel data analysis for OECD countries between 1990 and 2019. The results show a U-shaped relationship for most inequality measures and the income of the top 10% of population, contradicting the Kuznets hypothesis. There is evidence that when GDP per capita is used, inequality is higher, leading to the conclusion that countries with policies that inflate GDP rather than GNI are the main contributors to the rise in inequalities. Moreover, the richer's income follows the same behavioral pattern as income inequality. Lastly, it is possible to increase economic growth while minimizing inequalities.

1. Introduction

The relationship between income inequality and economic growth is currently one of the most researched subjects in macroeconomics. This topic earned more relevance in the last years due to the work of Thomas Piketty on *Capital in the Twenty-First Century* (Piketty, 2014) regarding inequalities in present times, which extended the general discussion on how inequality is affected by economic growth. Nevertheless, the vast literature on the topic does not reach a global consensus, as the conclusions retrieved from various studies are often contradictory. Regardless, this analysis is prominent in current economic research (Blanco and Ram, 2019; Martinez-Navarro *et al.*, 2020; Costantini and Paradiso, 2018).

This dissertation intends to explore this relationship to assess the impact economic growth can have on income inequalities for OECD countries. More precisely, it evaluates how GDP per capita and GNI per capita affect the income disparity in a group of countries. These variables are characterized differently and thus have different values, which can be seen on Figure 1, that shows the average GDP and GNI per capita and their difference. Most countries have small differences between the measures, but the GDP per capita is often higher – for example, for the Czech Republic, Ireland, and Germany. Other countries have the opposite, a higher GNI per capita, such as Norway, Switzerland, and the United Kingdom (UK). This difference exists from the fact that GDP represents all the monetary or market value of all finished goods and services produced inside a country's borders, whereas GNI also includes net receipts from abroad of compensation of employees, property income and net taxes less subsidies on production. In practice, possible causes to this disparity include offshore financial centers or tax havens, where corporate taxes are low which attracts foreign businesses that repatriate the profits, such as Ireland or the Netherlands. As a result, GDP is disproportionally higher in relation to GNI. On the contrary, countries with higher GNIs may have higher levels of external presence, receiving profits from businesses based overseas. Whatever the policy, higher levels of income inequality have been the general outcome since the 1990s, therefore, the purpose of this thesis is to understand how the two economic growth measures and their differences actually affect income inequality.

Figure 1: GDP per capita and GNI per capita comparison, averaged from 1990 to 2019.



Source: Elaborated by the author based on data from Penn World Table and World Bank

From the seminal work by Kuznets (1955), it is known that there is a relationship between economic growth and income inequality, hence the focus of the literature is on how this relationship really performs, that is, what shape it takes. The two more prevalent shapes on the literature are inverted U-shaped curves, as suggested by Chambers (2007), Barro (2008), and Jha (1996), for example, or U-shaped curve, as suggested by Kim *et al.* (2011), Blanco and Ram (2019), and Sayed (2020), among others. Likewise, this thesis studies this effect using economic growth measures the GDP per capita and the GNI per capita. Furthermore, as income inequality, redistribution, and concentration measures, it is used seven different metrics of inequality. Firstly, the market Gini index and disposable

Gini index, that evaluate how much the income distribution deviates from the perfectly equal society; secondly the redistribution, that measures how the inequality is reduced due to taxes and transfers; thirdly, the ratios of Palma and S80S20 that divide higher income shares by lower income shares to understand the distribution of income between classes; finally, to evaluate the evolution of income within classes, the income shares of the top 10 and the bottom 40 of population.

The contribution of the dissertation to the literature is underpinned on following elements. First, it is considered 37 OECD countries - the majority of developed countries - in a recent period (1990-2019). Second, it is utilized the latest version of the SWIID (Standardized World Income Inequality Database), version 9.3, from Solt (2020), for market and disposable income Gini. Third, complementary measures are used to provide a more in-depth picture of the impact of GDP and GNI per capita on income inequality. Fourth, it is used GNI per capita as relevant variable of the analysis, besides the usual GDP per capita, and the comparison between the two. Finally, we employ several alternative estimation methods, namely, Ordinary Least Squares (OLS) with fixed effects, Driscoll-Kraay with fixed effects and first differences Generalized Method of Moments (GMM). Furthermore, we provide growth-inequality measures' thresholds for both *per capita* GDP and *per capita* GNI which lead us to conclude that it should be promoted policies to, on average, increase the GNI in order to reduce inequalities while promoting higher economic growth rates, not only because there are higher levels of income inflows to an economy but because it helps to maximize economic performance at lower inequality levels.

The remainder of the thesis is organized as follows. Section 2 reviews the relevant literature on the relationship between economic growth and income inequality. Section 3 describes the data and methodology employed in the empirical analysis. Section 4 reports and discusses the findings. Section 5 presents the main conclusions.

2. Literature Review

The relationship between economic development and income inequality was pioneered by Kuznets (1955), where it was suggested an inverted-U relation between the two variables, which resulted from the evolution of income inequality through the stages of development of a country. That is, as the per capita income increases, the inequality will initially increase until it reaches the turning point, where it starts to decrease.

Kuznets' explanation of this behavior derives first from two factors that influenced this early increase: the industrialization, when rural workers moved to urban areas where the income was higher and the inequalities were more severe, and the concentration of savings by the top income groups. However, these two factors would be surpassed by other aspects, such as legislative interference and political decisions that would contribute to a weakening effect on the savings concentration, and the rise of non-agricultural sectors' income that offset the inequality increasing effect provoked by the industrialization. The final product is the Kuznets' hypothesis: an inverted U-shaped relationship between income inequality and economic development.

Thereafter, in his article, Kuznets added that "this work is perhaps based on 5% empirical information and 95% speculation", which opened the doors to economists to assess his hypothesis in the future. Robinson (1976) developed a two-sector model for a country undergoing economic development and reached the prevalence of the same inverted U-shaped relationship. He then added that in the case of the absence of explicit countervailing policies, developing countries will have increased or unchanged inequality in the long term.

The literature on the relationship between economic growth and income inequality has been extensively studied in the last decades and the conclusions from those studies have not been consensual. Different articles reach different conclusions on the sign of the relationship, the shape of the curve, and the joint relation between the variables. Then, some studies point to a linear relationship (positive or negative), others conclude by an insignificant relation, and others found a non-monotonic relationship (U-shaped or inverted U-shaped). These results' discrepancy is related to differences in datasets, estimation methods and variables used. Adding to the differences, when comparing within similar datasets, the results of different studies show this discrepancy as well.

In more recent studies, concerning the analysis for a panel of different countries, the relationship between income inequality and economic growth has also been found. From two separate studies using semiparametric methods, this conclusion was reached. Chambers (2007) studied, with a panel data model for 29 countries, the relationship between past growth and current income inequality and found that the short and medium run past economic performance is positively related to inequality. However, in the long run the same is not observed, thus leading to the result of the inverted U-shaped curve.

For 75 countries in a cross-sectional study, Lin *et al.* (2006) corroborate the Kuznets' hypothesis without and with two social choice variables: the share of population employed in the public sector and the share of social transfers on GDP. The semi-parametric regression yields an inverted U-shaped relationship between income inequality and economic development. Considering a panel dataset of 75 countries, Jha (1996) also confirms the Kuznets hypothesis. This result is supported after checking for robustness for schooling and the economic growth rate. It is also stated that faster-growing countries end up staying less time in the increasing inequality portion of the Kuznets curve.

Regarding the relationship mentioned above, Barro (2000) through a fixed effects model and for 84 countries confirms the Kuznets hypothesis. This study concluded that there is little overall relation between income inequality and rates of growth. In particular, it is also determined that the relation does not explain the greater part of the variation in inequalities over time, across countries, as it does not reflect only the level of per capita GDP but also the effect of technological change on the distribution of income. However, it can be seen that the Kuznets curve "emerges as a clear empirical regularity". Later, Barro (2008) added the effect of openness to trade on income inequality and found that inequality rose as the degree of openness increased. On the other hand, the increase of openness to trade also positively affected economic growth, creating an opposite effect on inequality by reducing poverty.

Additionally, List and Gallet (1999), with a panel dataset of 71 countries between 1961 and 1992, discovered that the Kuznets hypothesis holds for lower and middle developed countries, however, for higher developed countries, the relationship between income inequality and per capita income becomes positive again. According to the authors this relationship could be related to the shift from an industrial to service-based sector, which is supported by Bishop *et al* (1991) who conclude that a shift towards a service-based economy results in greater income disparity. Conversely, Zhou and Li (2011), considering 75 countries from 1962 to 2003, confirmed the Kuznets curve relationship from a certain threshold ($1340 GDP per capita), but not below. The inverted U-shaped relationship does not hold for low levels of development, as opposed to the conclusion from List and Gallet (1999).

Nonetheless, the literature is divided, as there are also studies proving different relationships between income inequality and economic development for a panel of countries and critiques to the Kuznets approach and results. The most notorious one is from Piketty (2013), with a new approach relating the level of inequality with the average capital return rate, *r*, compared to the GDP growth rate, *g* ($r > g$). Therefore, for Piketty (2013), there is a regular U-shaped relationship between income inequality and economic growth for the United States and similar developed countries. Furthermore, this behavior is also proved by Alvaredo *et al.* (2018) where it is stated that the recent rise in inequality comes from shifts in policy and institutions, not from mechanical deterministic consequences of globalization and technological changes. In addition, the top 1% has increased their share of income more than the bottom 50% which means their income is 100 times higher, even considering the decrease in inequality of emerging countries.

The rejection of the Kuznets curve was previously expressed by Deininger and Squire (1996) since there was not found any relationship between aggregated income growth and the Gini coefficient; that is, modest changes in the coefficient could not be explained by the changes in income. In turn, Deininger and Squire (1998) confirmed the previous conclusions, concluding that for low-income countries the relationship between income and inequality is negative for the vast majority of the countries, which is worsened when Latin American countries are introduced to the study. Therefore, the authors obtained little empirical evidence in support of the Kuznets curve. Gallup (2012) also contributed to a rejection of the Kuznets hypothesis as he encountered a U-shaped relationship between income inequality and economic growth, using a nonparametric model for 87 countries.

We can advance that the shape of the Kuznets curve is not consensual when analyzing a panel of countries. This discrepancy can come from the differences between OECD and non-OECD countries, as Martinez-Navarro *et al* (2020) noted in a model with education, development and democratic level applied to 187 countries for the period between 1970 and 2016. More specifically, the main drivers of this relationship's validation are non-OECD countries, as OECD countries sometimes follow the opposite pattern of Kuznets, although Martinez-Navarro *et al* (2020) stated that the Kuznets inverted U-shaped curve could be seen for all countries in general. Cheng and Wu (2016) assessed the relationship between economic development and income inequality for

China in the period between 1978 and 2011 and found an inverted U-shaped curve, validating the Kuznets curve. Through the analysis of 12 Arabic countries for the period between 1990 and 2015, Sayed (2020) does not observe a validation of the Kuznets hypothesis. The relationship found was a U-shape curve between growth and inequality. Furthermore, the control variables education, openness and urbanization used showed positive effects on inequalities. In addition, for Spain, De La Escosura (2008) focusing on the evolution of the inequality found support for the Kuznets curve arguing that during periods of political instability inequality grew, whereas during periods of economic growth it decreased.

Besides the analysis of the relationship between income inequalities and economic growth for a panel of different countries, the literature focuses on the analysis of the United States of America (USA). The authors study the relationship with a panel of the states of the country. For example, Kim *et al.* (2011) concluded by a U-shaped relationship between inequality and development, for the period from 1945 to 2004, hence rejecting the Kuznets hypothesis. Blanco and Ram (2019) found that there was a regular U-shaped relationship, however, by accounting spillover effects from one state to another, this relationship is not seen anymore as there is an insignificant relation between income and inequality. Ram (1991) had already rejected the Kuznets hypothesis for the USA states from 1947 to 1988. Costantini and Paradiso (2018), with nonparametric and semiparametric estimations and using panel data of the USA states during 1960 and 2015, found a S-shaped relationship between inequality and GDP per capita. Nevertheless, the estimated rising segment of inequality starts when the GDP per capita is at low levels. Finally, studying for the United States as a whole, Rubin and Segal (2015), with a dynamic model in which changes in both income inequality and GDP per capita growth are determined simultaneously, found that income is sensitive to both GDP per capita and market returns. However, the top income groups are the most sensitive to current GDP growth and the future expected growth, meaning that the relation between market return and changes in income is less important if capital gains are excluded.

There are authors that analyze different aspects of the relationship between income inequality and economic development. For instance, Lundberg and Squire (2003) studied the simultaneous evolution of growth and inequality, that is, testing if inequality and growth are joint outcomes of other variables in a simultaneous equation model

(SEM). The study, applied to 125 countries, concluded that the determinants of both inequality and growth are not mutually exclusive, as most variables - such as government expenditure, inflation, and the Sachs-Warner index[1] - are jointly significant for both. Supplementing this paper, and using a similar simultaneous equation model, Huang *et al*. (2009) estimated, for 83 countries over the period of 1965 to 2003, the joint effects of inequality on growth and vice versa. The empirical results state that growth and inequality are highly interrelated since growth has a positive effect on inequality and inequality has a negative effect on growth, which means the relationship is bilateral. Huang *et al.* (2009) also found that the driving forces of growth are higher investment shares, lower government, and financial development, whereas the determinants for inequality are lower inflation, higher government spending, and education, which means it is not in accordance with Lundberg and Squire (2003). Lopez (2006), in turn, studied the relationship between income inequalities and economic growth in the decades of 1970, 1980, and 1990. For 1970s and 1980s, there was no relation between the variables, however, for the 1990s, it was found a relation between growth and inequality changes.

Moreover, the discussion extended for the inverse relationship, that is, the impact of income inequality on economic growth. Vo *et al.* (2019), for instance, analyzed the factors that affect inequality and growth for 158 countries and 86 middle-income countries from 1960 to 2014. Using Dumitrescu and Hurlin (2012) Granger non-causality test, a bidirectional relationship between income inequality and economic growth was detected (causality running from income inequality to growth and vice-versa). Furthermore, through the System Generalized Method of Moments (SYS-GMM) estimations, there is evidence of the negative impact of inequality on economic growth. In addition, Shin (2012) argued that both positive and negative relationships are possible depending on the development stage of the country. More specifically, higher inequality can slow growth in the early stages of development, but it can also encourage growth when near the steady state.

In the Appendix, Table A1 is a synthesis of the empirical literature review.

[1] Sachs-Warner index is a composite openness index, which includes tariffs, non-tariff restrictions and measures of exchange rate, developed by Sachs and Warner (1995).

3. Empirical Framework

3.1. Data

This empirical analysis is supported by a sample of 37 OECD countries, specifically Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom and the United States of America, and it uses panel data during the period between 1990 and 2019.[2] Although there is data for some variables until 2021, the analysis excludes more recent years due to the lack of data of relevant variables and also to expunge the potential impact of the COVID-19 global pandemic.

For a deeper analysis, the dependent variables chosen are different income inequality, redistribution and concentration measures. Firstly, representing average income inequality measures, the variables market Gini index, which denotes the estimate of Gini index of inequality in equivalized household market (pre-tax, pre-transfer) income (*gini_mrkt*), and the disposable Gini index, that characterizes the estimate of Gini index of inequality in equivalized household disposable (post-tax, post-transfer) income (*gini_disp*), that were obtained from Solt (2020) database (version 9.3 of SWIID). Additionally, there is the Palma ratio, which is calculated by dividing the income share of the richest 10% of population by that of the poorest 40% (*Palma*) and the ratio of the average income of the 20% richest to the 20% poorer (*S80S20*), both retrieved from the World Income Inequality Database. Regarding income redistribution measures, it was used the variable that defines the estimated absolute redistribution (*redist*), that is, the difference between the market Gini index and the disposable Gini index. Finally, the top 10% and the bottom 40% population's income share (*top10* and *bottom40*, respectively), that are from the World Income Inequality Database, represent the income concentration measures. The use of different measures allows not only capturing different effects of income measures on income inequalities and making comparisons between them, but also serves the purpose of sensitivity analysis.

[2] Turkey has been excluded due to lack of data.

Moreover, to depict economic growth, the independent variables used are the natural logarithm of expenditure side real GDP at chained PPPs (in million 2017 US dollars) divided by the population (in millions), that is, the real per capita GDP (*lngdppc*), and the natural logarithm of gross national income divided by the population, at constant 2015 US dollars (the GNI per capita - *lngnipc*). These variables can be found on the Penn World Table (version 10.0) and the World Bank database, respectively.

Furthermore, the following control variables are included in the regressions, as is common in the literature revised previously: the annual inflation rate (*infl*), measured by the consumer price index, from the OECD database; the sum of exports and imports as a percentage of GDP to represent the openness degree of a country (*open*), from World Bank database; the urbanization rate, as the percentage of population living in urban areas (*urban*), from the World Bank database; the investment rate, as the gross capital formation in percentage of GDP (*invest*), from the World Bank; the human capital index (*hc*), which represents the amount of human capital that a child born today can expect to acquire by age 18 in each country, retrieved from the Penn World Table; and the government final consumption (*gcons*), from the World Bank database. In the Appendix (Tables A2 and A3), it is reported the descriptive statistics and the correlation matrix between the variables under study.

3.2. Methodology

Regarding the methodology, the analysis employs a panel-data approach with a cross-sectional and time-series dimensions to investigate the relationship between economic growth and income inequality. Due to the use of two relevant independent variables, namely GDP per capita and GNI per capita, it is considered two specifications. The first specification is as follows:

$$Ineq_{it} = \beta_0 + \beta_1 \ln(gdppc_{it}) + \beta_2 \ln(gdppc_{it})^2 + \sum_{k=3}^{n} \beta_k * X_{j,it} + \theta_i + \mu_t + \varepsilon_{it} \quad (1)$$

where $Ineq_{it}$ is the measure of inequality for country *i* (*i* = 1, …, *N*) and period *t* (*t* = 1, …, *T*), which can take form of market Gini (*gini_mrkt*), disposable Gini (*gini_disp*), redistribution (*redist*), Palma ratio (*Palma*), S80S20 ratio (*S80S20*), top 10 (*top10*) and bottom 40 (*bottom40*); $\ln(rgdppc_{it})$ is the natural logarithm of real GDP per capita (*lngdppc*) in country *i* for period *t*; $X_{j,it}$ corresponds to the control variable X_j in country *i* for period *t*; θ denotes cross-specific effect of country *i*; μ is a time-effect of period *t*; and ε is the random disturbance error of country *i* and period *t*.

The second specification is this form:

$$Ineq_{it} = \beta_0 + \beta_1 \ln(gnipc_{it}) + \beta_2 \ln(gnipc_{it})^2 + \sum_{k=3}^{n} \beta_k * X_{j,it} + \theta_i + \mu_t + \varepsilon_{it} \quad (2)$$

where the relevant independent variable becomes the GNI per capita (*lngnipc*). The remainder variables already have a known meaning.

These specifications allow the analysis of the impact of economic growth in income inequality, as it is usually seen in the literature (Lin *et al.*, 2006; Martinez-Navarro *et al*, 2020).

Furthermore, three estimation methods will be used to produce a more realistic set of results. The first one, to solve for unmeasured heterogeneity that pooled OLS ignores, is the OLS with fixed effects. From Driscoll and Kraay (1998), Driscoll-Kraay is used with fixed effects to have a consistent and robust covariance matrix estimation in the presence of very general cross-sectional and temporal dependence. Beside this, it is also heteroskedasticity consistent. Finally, the first differences GMM, proposed by Arellano and Bond (1991), is employed which entails taking the first differences and then using lagged levels of the dependent variable as instruments for endogenous variables in the first-differences equation. This procedure has advantages over the simple cross-sectional regressions for dynamic panel models, as for instance, the estimates will no longer be biased by any omitted variable, the use of instrumental variables allows parameters to be estimated consistently in models that include endogenous variables, and the use of instruments allows consistent estimation even with measurement errors.

4. Analysis and discussion of results

The analysis will be divided into three parts; in the first one it is considered the results for the real GDP per capita and in the second one for the GNI per capita. Afterwards, it is compared the two sets of results.

4.1 GDP per capita

Starting with the relationship between the income inequality and redistribution measures, namely, the market Gini index, the disposable Gini index, the redistribution, the Palma ratio and the S80S20 ratio, and the GDP per capita, presented below on Tables

1 to 3, that show the results for the regressions using the OLS with fixed-effects, the Driscoll-Kraay with fixed-effects and the GMM. It is possible to notice that all measures demonstrate a U-shaped relationship for the regressions OLS and Driscoll-Kraay with fixed-effects, which is proven by the negative correlation of the inequality measures with GDP per capita and the positive correlation with GDP per capita squared, that is, as GDP per capita rises, inequality falls; however, once a certain threshold is reached, inequality increases. Furthermore, this result is supported by statistically significant values at 1% level of significance, for all measures but redistribution, which has insignificant values for OLS regressions and statistically significant at 10% for Driscoll-Kraay. Regarding the GMM estimation, the findings are solely significant to the redistribution, Palma ratio and S80S20 ratio, where it is observed a similar behavior as on the previous regressions except for redistribution, which shows an inconsistent inverted U-shaped relationship with GDP per capita.

Table 1: OLS with fixed effects Results, GDP per capita.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	*gini_mrkt*	*gini_disp*	*redist*	*Palma*	*S80S20*	*bottom40*	*top10*
ln(gdppc)	-30.073***	-27.989***	-2.084	-8.114***	-33.043***	23.487***	-39.198***
	(4.901)	(4.033)	(3.349)	(0.634)	(3.023)	(2.614)	(3.617)
ln(gdppc)^2	1.372***	1.375***	-0.003	0.395***	1.597***	-1.128***	1.899***
	(0.246)	(0.203)	(0.168)	(0.032)	(0.151)	(0.130)	(0.180)
hc	-2.817***	-1.976***	-0.841	-0.302***	-0.316	-0.881*	-3.025***
	(0.835)	(0.687)	(0.571)	(0.113)	(0.537)	(0.465)	(0.643)
gcons	-0.041	-0.208***	0.167***	-0.010**	-0.036	0.098***	-0.052*
	(0.036)	(0.029)	(0.024)	(0.005)	(0.023)	(0.020)	(0.028)
infl	0.018**	0.015**	0.003	-0.002**	-0.014**	0.005	-0.003
	(0.008)	(0.007)	(0.006)	(0.001)	(0.005)	(0.005)	(0.006)
open	0.023***	0.004	0.019***	0.001	0.004	0.002	-0.000
	(0.004)	(0.003)	(0.003)	(0.000)	(0.002)	(0.002)	(0.003)
urban	-0.044*	0.004	-0.048***	-0.013***	-0.079***	0.066***	-0.020
	(0.025)	(0.020)	(0.017)	(0.003)	(0.016)	(0.014)	(0.020)
invest	-0.000	-0.031**	0.030***	-0.006***	-0.022**	0.038***	-0.044***
	(0.016)	(0.013)	(0.011)	(0.002)	(0.010)	(0.009)	(0.013)
Threshold	57,437.62	26,322.57		28,879.47	31,082.36	33,264.10	30,370.34
Observations	1,055	1,055	1,055	1,068	1,068	1,068	1,068
R-squared	0.455	0.228	0.429	0.274	0.207	0.183	0.277

Notes: (a) Robust standard errors in brackets; (b) Constant term estimated but omitted for reasons of parsimony; (c) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 2: Driscoll-Kraay with fixed effects Results, GDP per capita.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	*gini_mrkt*	*gini_disp*	*redist*	*Palma*	*S80S20*	*bottom40*	*top10*
ln(gdppc)	-45.005***	-32.981***	-12.024*	-8.279***	-32.316***	23.906***	-44.196***
	(12.189)	(7.577)	(6.244)	(1.343)	(6.800)	(3.313)	(4.995)
ln(gdppc)²	2.270***	1.681***	0.589*	0.406***	1.570***	-1.166***	2.197***
	(0.619)	(0.376)	(0.320)	(0.065)	(0.330)	(0.161)	(0.244)
hc	0.884	-1.077	1.962***	-0.387**	-0.763	-0.484	-2.776***
	(0.995)	(0.873)	(0.445)	(0.165)	(0.617)	(0.579)	(0.905)
gcons	0.018	-0.178***	0.196***	-0.009***	-0.026	0.087***	-0.052
	(0.080)	(0.053)	(0.046)	(0.003)	(0.016)	(0.024)	(0.034)
infl	0.004	0.005	-0.002	-0.004**	-0.016**	0.011*	-0.014
	(0.010)	(0.006)	(0.005)	(0.002)	(0.006)	(0.005)	(0.010)
open	0.021***	0.004	0.017***	0.001	0.004*	0.001	-0.000
	(0.006)	(0.005)	(0.003)	(0.001)	(0.002)	(0.003)	(0.006)
urban	0.035	0.031	0.005	-0.010**	-0.074***	0.056***	0.017
	(0.043)	(0.020)	(0.026)	(0.004)	(0.022)	(0.016)	(0.015)
invest	-0.023	-0.038*	0.015	-0.006	-0.024	0.040**	-0.039
	(0.021)	(0.020)	(0.019)	(0.005)	(0.022)	(0.016)	(0.024)
Threshold	20,191.07	18,213.80	27,095.71	26,790.77	29,487.44	28,318.95	23,347.88
Observations	1,055	1,055	1,055	1,068	1,068	1,068	1,068
R-squared	0.327	0.166	0.332	0.2273	0.175	0.118	0.172

Notes: (a) Robust standard errors in brackets; (b) Constant term estimated but omitted for reasons of parsimony; (c) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 3: GMM Results, GDP per capita.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	*gini_mrkt*	*gini_disp*	*redist*	*Palma*	*S80S20*	*bottom40*	*top10*
ln(gdppc)	1.668	-0.338	3.701**	-3.969**	-23.712*	6.940**	-15.129***
	(2.917)	(2.911)	(1.738)	(2.015)	(12.259)	(3.132)	(4.840)
ln(gdppc)²	-0.074	0.016	-0.167**	0.195*	1.172*	-0.328**	0.731***
	(0.143)	(0.144)	(0.085)	(0.101)	(0.622)	(0.155)	(0.243)
hc	-0.616	-0.263	-0.170	-0.129	-0.821	-0.101	-0.867**
	(0.460)	(0.324)	(0.288)	(0.138)	(0.891)	(0.306)	(0.436)
gcons	0.029	-0.003	0.042***	-0.001	0.012	-0.008	0.002
	(0.023)	(0.017)	(0.016)	(0.003)	(0.018)	(0.018)	(0.031)
infl	-0.006	-0.002	-0.002	0.000	-0.002	0.000	-0.017*
	(0.005)	(0.004)	(0.003)	(0.001)	(0.006)	(0.006)	(0.009)
open	-0.002	-0.002	-0.001	0.001	0.009	-0.001	0.002
	(0.002)	(0.002)	(0.001)	(0.001)	(0.006)	(0.002)	(0.003)
urban	0.026**	0.010	0.008	-0.012*	-0.093*	0.026*	-0.027
	(0.013)	(0.012)	(0.011)	(0.007)	(0.056)	(0.014)	(0.018)
invest	-0.007	-0.004	-0.004	-0.003**	-0.023***	0.012*	-0.007
	(0.006)	(0.005)	(0.003)	(0.001)	(0.008)	(0.006)	(0.008)
Threshold			64,915.28	26,289.45	24,736.64	39,311.34	31,199.37
Observations	961	961	961	974	974	974	974

Notes: (a) Robust standard errors in brackets; (b) Constant term estimated but omitted for reasons of parsimony; (c) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Additionally, on Tables 1-3, it is also displayed the effect of other control variables on the inequality and redistribution measures. To begin, when the result is significant in the regressions using the OLS, Driscoll-Kraay and GMM, the human capital variable has a negative impact on the majority of measures, with the exception of the positively impacted redistribution. The government consumption reveals a negative impact on disposable Gini index, Palma ratio, but a positive impact on redistribution. For the remaining measures it shows no significance. The variable for inflation negatively affects the Palma and the S80S20 ratios, whereas the market and disposable Gini indexes are affected positively. According to the OLS and Driscoll-Kraay regressions, the openness degree has a positive effect on the market Gini index, the redistribution and the S80S20 ratio. For the urbanization rate, the effect on most inequality and redistribution measures is negative for all regressions. Finally, the investment rate has a negative impact on the disposable Gini index, Palma and S80S20 ratios, when looking at the OLS, Driscoll-Kraay and GMM regressions.

In regard to the income concentration measures, such as the top 10 and bottom 40 shares of income, the results are highly significant and consistent for the three estimation methods presented in Tables 1-3. The two measures have contrasting behaviors, as the bottom 40 has an inverted U-shaped relationship with GDP per capita and the top 10 reveals a U-shaped one. In other words, the top 10 richest people see their income decrease during an initial phase of economic growth, but increasing after reaching certain threshold of GDP per capita, whereas the bottom 40 population observe the opposite, as their income increases during the initial stages of economic growth, but then decreases once reached the threshold. The impact of the explanatory variables on these concentration measures can also be seen on Tables 1-3, for the regressions using fixed-effects OLS and Driscoll-Kraay and GMM. The results are mostly similar between regressions, with the exception of GMM with low levels of statistical significance. On the one hand, human capital, government consumption, inflation, and investment all have a negative impact on the income of the top 10% of the population. On the other hand, the income of the bottom 40% of population is affected positively by government consumption, inflation, urbanization, and investment. These findings are consistent because the two concentration measures have generally opposed behaviors if one increases the other decreases from the same variable's impact.

4.2 GNI per capita

The results for the relationship between the income inequality and redistribution measures and GNI per capita are presented below on Tables 4-6, for the regressions using the OLS with fixed-effects, the fixed-effects with Driscoll-Kraay and the GMM. The first two models suggest a U-shaped relationship for all measures, with statistically significant values, except for redistribution on OLS with fixed effects. By contrast, the GMM estimator does not produce statistically significant results for the relationship of the GNI per capita with the measures, with the exception of the redistribution, that with a significance at 5% level of significance shows an inverted U-shaped relationship, contradicting the previous regression.

Table 4: OLS with fixed effects Results, GNI per capita.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	*gini_mrkt*	*gini_disp*	*redist*	*Palma*	*S80S20*	*bottom40*	*top10*
ln(gnipc)	-19.189***	-14.199***	-4.990*	-5.754***	-24.294***	11.745***	-26.194***
	(4.295)	(3.587)	(2.981)	(0.655)	(3.108)	(2.440)	(3.443)
ln(gnipc)^2	0.881***	0.709***	0.172	0.297***	1.231***	-0.528***	1.319***
	(0.228)	(0.191)	(0.158)	(0.035)	(0.165)	(0.130)	(0.183)
hc	-2.510***	-1.511**	-0.999*	-0.371***	-0.408	-0.574	-3.973***
	(0.845)	(0.706)	(0.586)	(0.127)	(0.602)	(0.473)	(0.667)
gcons	0.003	-0.170***	0.172***	-0.004	-0.013	0.103***	-0.051*
	(0.038)	(0.031)	(0.026)	(0.006)	(0.027)	(0.021)	(0.030)
infl	0.034**	0.027*	0.007	0.002	0.010	-0.008	0.004
	(0.017)	(0.014)	(0.012)	(0.003)	(0.013)	(0.010)	(0.014)
open	0.028***	0.013***	0.014***	0.003***	0.014***	-0.007***	0.015***
	(0.004)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)
urban	-0.056**	-0.016	-0.040**	-0.018***	-0.117***	0.103***	-0.040*
	(0.027)	(0.022)	(0.019)	(0.004)	(0.020)	(0.015)	(0.022)
invest	-0.004	-0.022	0.018	-0.006**	-0.022*	0.019*	-0.023*
	(0.017)	(0.014)	(0.012)	(0.003)	(0.012)	(0.010)	(0.014)
Threshold	53,692.73	22,339.34		16,104.74	19,263.41	67,974.91	20,495.81
Observations	925	925	925	934	934	934	934
R-squared	0.461	0.236	0.393	0.261	0.215	0.186	0.273

Notes: (a) Robust standard errors in brackets; (b) Constant term estimated but omitted for reasons of parsimony; (c) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 5: Driscoll-Kraay with fixed effects Results, GNI per capita.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	*gini_mrkt*	*gini_disp*	*redist*	*Palma*	*S80S20*	*bottom40*	*top10*
ln(gnipc)	-40.068***	-23.497**	-16.572***	-5.924***	-24.120***	17.353***	-34.512***
	(11.727)	(9.112)	(4.188)	(1.694)	(7.799)	(4.876)	(7.410)
ln(gnipc)^2	2.121***	1.262***	0.860***	0.305***	1.217***	-0.853***	1.797***
	(0.596)	(0.453)	(0.227)	(0.084)	(0.388)	(0.237)	(0.364)
hc	0.415	-0.863	1.278***	-0.553***	-1.055**	-0.418	-4.207***
	(0.741)	(0.520)	(0.356)	(0.103)	(0.446)	(0.341)	(0.427)
gcons	0.103*	-0.119***	0.222***	-0.005	-0.009	0.083***	-0.042
	(0.052)	(0.042)	(0.032)	(0.004)	(0.027)	(0.019)	(0.032)
infl	-0.031	-0.010	-0.021*	-0.002	-0.001	0.021	-0.036
	(0.028)	(0.020)	(0.011)	(0.005)	(0.021)	(0.016)	(0.023)
open	0.030***	0.014***	0.016***	0.003***	0.013***	-0.008***	0.015***
	(0.003)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)
urban	0.016	0.014	0.002	-0.018***	-0.119***	0.084***	-0.012
	(0.037)	(0.014)	(0.027)	(0.006)	(0.028)	(0.019)	(0.025)
invest	-0.029	-0.032	0.003	-0.005	-0.022	0.023	-0.023
	(0.025)	(0.022)	(0.021)	(0.006)	(0.031)	(0.015)	(0.022)
Threshold	12,651.67	11,041.65	15,288.92	16,505.94	20,122.90	26,153.72	14,804.27
Observations	925	925	925	934	934	934	934
R-squared	0.379	0.186	0.337	0.229	0.183	0.129	0.222

Notes: (a) Robust standard errors in brackets; (b) Constant term estimated but omitted for reasons of parsimony; (c) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 6: GMM Results, GNI per capita.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	*gini_mrkt*	*gini_disp*	*redist*	*Palma*	*S80S20*	*bottom40*	*top10*
ln(gnipc)	-1.691	-1.507	3.457**	-2.831	-16.659	4.818	-8.360*
	(2.530)	(2.054)	(1.352)	(1.784)	(10.297)	(3.691)	(5.038)
ln(gnipc)²	0.093	0.079	-0.165**	0.145	0.855	-0.229	0.418
	(0.124)	(0.105)	(0.068)	(0.093)	(0.542)	(0.186)	(0.265)
hc	-0.336	-0.193	0.106	-0.066	-0.540	-0.183	-0.953*
	(0.380)	(0.254)	(0.232)	(0.118)	(0.721)	(0.369)	(0.489)
gcons	0.068***	0.016	0.060***	-0.000	0.012	-0.016	0.032
	(0.018)	(0.018)	(0.014)	(0.003)	(0.019)	(0.018)	(0.028)
infl	-0.003	-0.001	0.004	0.002	0.012	-0.008	0.001
	(0.005)	(0.004)	(0.003)	(0.002)	(0.012)	(0.011)	(0.011)
open	0.000	-0.000	-0.001	0.001	0.009	-0.001	0.005**
	(0.002)	(0.002)	(0.001)	(0.001)	(0.006)	(0.002)	(0.003)
urban	0.015	-0.002	0.005	-0.016*	-0.105	0.027	-0.031
	(0.015)	(0.011)	(0.011)	(0.009)	(0.064)	(0.018)	(0.021)
invest	-0.009	-0.007**	0.000	-0.004*	-0.030**	0.016**	-0.011
	(0.006)	(0.003)	(0.004)	(0.002)	(0.012)	(0.007)	(0.009)
Threshold			35,445.71				
Observations	856	856	856	865	865	865	865

Notes: (a) Robust standard errors in brackets; (b) Constant term estimated but omitted for reasons of parsimony; (c) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Analyzing the effects of the explanatory variables on the income inequality and redistribution measures, presented on Tables 4-6 for all regressions, it is possible to see the negative impact of the human capital has on the majority of the measures, excluding the redistribution, which is positively affected. Furthermore, the impact of the government consumption varies between regressions, with redistribution consistently being positively affected. In regard to inflation, it affects positively the market and disposable Gini indexes while negatively affecting the redistribution. The openness degree, in the OLS and Driscoll-Kraay regressions, shows a positive effect on all measures. The impact of urbanization rate is negative on most inequality measures, with the exception of the disposable Gini index, which is insignificant. Finally, according to the OLS regression, the investment rate affects the Palma and S80S20 ratios negatively, which is complemented by the positive effect on the disposable Gini index from the GMM regression.

Furthermore, by examining the results for the remaining two income concentration measures in Tables 4-6, it is possible to conclude that the GNI per capita and the two measures have different relationships. That is, the results for the variable bottom 40 reveal an inverted U-shaped relationship, while the top 10 show a U-shaped relationship. These relationships are validated by the models using the OLS with fixed-effects and the Driscoll-Kraay estimation methods; however, it is not validated for the GMM as it lacks statistical significance. Tables 4-6 also show the effect of the explanatory variables on the two concentration measures for all regressions. The results are identical through regressions, with the exception of the GMM that presents low levels of significance. Firstly, human capital, government consumption, urbanization rate and investment rate all affect the income of the top 10% of the population negatively, while the openness degree has a positive impact. Secondly, the income of the bottom 40% of population is positively influenced by the government consumption, urbanization rate, and investment rate, and negatively by the openness degree.

4.3 Comparison between GDP and GNI per capita

The analysis of the above-mentioned tables leads to the conclusion that there are differences in the results when using the GDP per capita or the GNI per capita as independent variable. Although the behaviors on the inequality, redistribution and concentration measures are similar, the thresholds are different. This can be used to justify the difference in actual GDP and GNI per capita and the influence of some policies.

On Table 7, it is shown the thresholds from the regressions – OLS with fixed effects, Driscoll-Kraay with fixed effects and GMM - using the GDP and GNI per capita. From this table we can conclude that for the OLS with fixed effects all measures that show a U-shaped relationship with economic growth - market Gini index, disposable Gini index, Palma ratio, S80S20 ratio – have a higher threshold when GDP per capita is used rather than GNI per capita. This implies that when countries are decreasing these measures, they reach a higher minimum when using the GDP per capita, i.e., they do not decrease the inequality as much as when GNI per capita is used as growth at the turning point. In regard to the bottom 40, that has an inverted U-shaped curve, the threshold is higher when using GNI per capita, which means that the countries are increasing the income of the bottom 40% of population and reach a lower maximum when GDP per capita is used: a lower increase in income. Consistently, the income of the top 10% of population reaches a higher minimum when using the GNI per capita, therefore, it does not decrease the income as much as when GDP per capita is used.

Table 7: Thresholds for GDP and GNI per capita, by estimation method.

Method	OLS-FE			DFE			GMM		
Variable	*GDPpc*	*GNIpc*	Difference	*GDPpc*	*GNIpc*	Difference	*GDPpc*	*GNIpc*	Difference
gini_mrkt	57,437.62	53,692.73	3,744.89	20,191.07	12,651.67	7,539.40			
gini_disp	26,322.56	22,339.34	3,983.22	18,213.80	11,041.65	7,172.15			
redist				27,095.71	15,288.92	11,806.79	64,915.28	35,445.71	29,469.57
Palma	28,879.47	16,104.74	12,774.73	26,790.77	16,505.94	10,284.83	26,289.45		
s80s20	31,082.36	19,263.41	11,818.95	29,487.44	20,122.9	9,364.54	24,736.64		
bottom40	33,264.1	67,974.91	-34,710.81	28,318.95	26,153.72	2,165.23	39,311.34		
top10	30,370.34	20,495.81	9874.53	23,347.88	14,804.27	8,543.61	31,199.37		

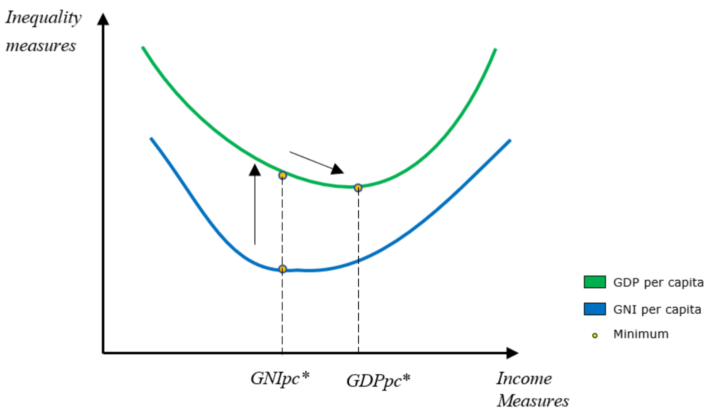
The Driscoll-Kraay with fixed effects regression's thresholds, for the measures that have a U-shaped relationship with economic growth (market Gini index, disposable Gini index, redistribution, Palma ratio and S80S20 ratio) behave similarly to the OLS with fixed effects. Nevertheless, there is the behavior of the redistribution, which shows a higher threshold when GDP per capita is used, which means that as redistribution decreases with economic growth, the minimum point is reached first with GDP per capita, therefore the redistribution decreases more with GNI per capita. In this regression, the bottom 40 exhibits a different behavior, in that the GDP per capita threshold is reached at a higher level, implying that the bottom 40% of population's income increases more until the turning point when the GDP per capita is used. Finally, the top 10 measure shows the same behavior as the OLS with fixed effects.

To conclude, the thresholds of the GMM regression are only significant for the measure redistribution. Because this measure has an inverted U-shaped relation with economic growth in this regression and the threshold is higher for GDP per capita, it means that as the redistribution increases with economic growth, the maximum is reached for lower levels when the GNI per capita is used.

These results can be used to draw some conclusions. For the variables that exhibit a U-shaped relationship – market and disposable Gini indexes, and Palma and S80S20 ratios – with a positive difference between GDP and GNI per capita thresholds, it can be stated that countries with higher GDPs per capita than GNI have a bigger contribute to higher income inequality. In other words, as when using GDP per capita the inequality is higher than when using GNI, the countries with policies that inflate the GDP but not the GNI – tax havens or offshore financial centers, for example – contribute more to the rise in income inequalities. The same rationale can be applied to the concentration measures top 10 and bottom 40, as we conclude that countries with higher GDP per capita than GNI per capita contribute more to the increase in the top 10's income share and the decline in bottom 40's income share (when looking at the OLS regression, although the same cannot be said for Driscoll-Kraay). Finally, for the redistribution (assuming the consistent inverted U-shaped relationship from GMM estimator), a positive difference between GDP and GNI per capita shows a bigger contribute of the countries that inflate more the GNI per capita for the decline in redistribution.

In Figure 2, it is illustrated the behavior of the income inequality measures, which have shown a U-shape with the income measures. We can conclude from this figure that it is possible to promote certain GNI per capita increasing policies by pushing from the minimum point of GNI per capita - where the income inequality is minimized - to the corresponding point on the GDP per capita curve, where the minimum has not yet been reached. This would result in a trade-off between inequality and aggregate income, that is, an increase in inequality but also an increase in aggregate income. Furthermore, there would be a horizontal decrease in inequality, maintaining the descending movement in inequality, towards a minimizing inequalities-growth threshold. In sum, the increase of GNI per capita to the level of GDP per capita could lead to a reduction of inequality for a higher level of aggregate income (GDP per capita).

Figure 2: Behavior between inequality and income



Source: Elaborated by the author.

To conclude, it is also important to note the similarities in behaviors between the top 10's income share and the inequality indexes and ratios – market and disposable Gini and the Palma and S80S20 ratios – namely that they not only show the same U-shaped relationship with economic growth (GDP and GNI per capita), but they are also similarly affected by the control variables. That is, the income of the top 10% of population always follows the same pattern as the income inequality; when one is rising the other rises as well, and vice-versa.

5. Conclusions

Income inequality has been rising since the early 1990s; as a result, is now one of the most researched topics by Economic Science. In this context, its relationship with economic growth is analyzed and the literature suggests various links between inequality and economic performance. By using panel data, this dissertation intends to understand how economic growth affects income inequality, or more precisely, how GDP and GNI per capita affect different income inequality, redistribution and concentration measures. In addition, it intends to contribute to the discussion by analyzing the difference between GDP and GNI per capita and their results.

In the empirical analysis, it is performed regressions using the estimation methods OLS with fixed effects, Driscoll-Kraay with fixed effects and first differences GMM, to explain how economic growth is linked with seven different measures – namely, market and disposable Gini indexes, Palma ratio, S80S20 ratio, redistribution, and shares of income of the top 10% and bottom 40% of population – for OECD countries, between 1990 and 2019.

Regarding the GDP per capita, it was discovered a U-shaped relationship with market and disposable Gini indexes, Palma ratio, S80S20 ratio, and the income share of the top 10% of population. The remainder measures show different effects, as the income share of the bottom 40% of population has an inverted U-shaped relationship, and the redistribution does not show consistency through regressions, having both shapes. Moreover, concerning the GNI per capita, the findings were similar, that is, the same relationships for the same measures. Therefore, in this study we did not obtain empirical evidence to support the Kuznets hypothesis.

Despite this resemblance in the relationships, there are some differences when it comes to the thresholds, that is, when the curve reaches the turning point. The threshold for the inequality measures with a U-shaped relationship with both measures of economic growth is higher when using GDP per capita, i.e., these inequality measures reach lower values when GNI per capita is used. From this, we can conclude that countries with higher GDPs than GNIs per capita – as a result of policies used to inflate the GDP, such as tax havens and offshore financial centers – are contributing more to the rise in income inequalities over the last decades. In regard to the concentration measures of income, top 10 and bottom 40, the same logic is applicable. Countries with policies inflating GDP per capita contribute the most to the increase in the income of the top 10% of the population and the decrease in the income of the bottom 40% of the population.

As a final remark, it is worth noting the behavior of the richest 10% of population in accordance with income inequality indexes and ratios, with a U-shaped relationship with both economic growth measures and similar behavior with control variables. In other words, as income inequality rises, so does the income of the wealthy; as one rises, the other rises as well. Moreover, a major point of our study is the conclusion that public authorities should take policies aiming the growth of national income leading not only to higher economic performance but also by those policies allow to reduce the levels of income disparities that potentiate economic growth. In sum, these findings support the idea that it is possible to have higher economic development with lower levels of income inequalities.

In conclusion, as suggestion for future research on the relationship between economic growth and income inequality, we propose deeper research using quantiles regressions to analyze the growth-inequality relationship considering the heterogeneity of income inequality measures of the economies. Furthermore, the results obtained are valid for OECD countries, mostly comprised of developed countries, for the period between 1990 and 2019. This analysis can be extended to study undeveloped countries and/or for longer period in future research.

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Appendix

Table A1: Synthesis of Empirical Literature Review

Reference	Methodology	Results	Sample
Kuznets (1955)	Trend analysis	Inverted U-shaped relationship	USA, UK and Germany
Robinson (1976)	Two sector model of an economy undergoing development	Inverted U-hypothesis prevails; Developing country will have increasing or unchanged inequality for a long period, in the absence of explicit countervailing policies.	Developed and developing countries
Ram (1991)	Time-series estimate for all country; Cross-section estimate	Both the time-series and cross-section estimates show that the Kuznets' hypothesis is not supported.	US states
Jha (1996)	Pooled cross-section/ time-series regression framework, with OLS estimation procedure; Robustness check for schooling and growth rate	Kuznets' hypothesis holds, even with robustness checks of schooling and growth rate; Faster-growing countries end up staying less time in the increasing inequality portion of the Kuznets curve.	76 countries
Deininger and Squire (1996,1998)	Panel data regression analysis	No relationship between aggregated income growth and the Gini coefficient; For low-income countries the relationship between growth and inequality is negative for the vast majority of the countries.	108 countries
List and Gallet (1999)	Time-series of cross-sectional data; Pooled OLS, fixed effects and random effects	Lower to middle developed countries the Kuznets hypothesis holds; For higher developed countries, the relationship between income inequality and per capita income becomes positive again. Shift from industrial sector to services as a cause of rising inequality.	71 countries (1961-1992)
Barro (2000)	Panel model with fixed effects	Little overall relation between income inequality and rates of growth; Indication that inequality retards growth in poor countries but encourages it in richer countries; The Kuznets curve emerges as a clear empirical regularity.	84 countries
Lundberg and Squire (2003)	Simultaneous equation model	Policy variables are not exclusive to inequalities or growth. Most variables are jointly significant for both.	125 countries
Lopez (2006)	Estimation of models based on variations of specification	Positive and significant correlation between growth and changes in inequality in the 90s, but not in 70s and 80s.	Not specified
Lin *et al.* (2006)	Parametric and semi-parametric (PLR) regressions	Inverted U-shaped relationship between income inequality and economic development for parametric and semi-parametric regressions.	75 countries
Chambers (2007)	Linear model and nonlinear model with augmented Kuznets curve	Short to medium- run past economic performance positively related to current income inequality, but not for the long-run; Inverted U-shaped relationship.	29 countries
Barro (2008)	Panel model with fixed effects	Inverted U-shaped curve, being stable through time; International openness has a positive effect on inequality directly. However, it also affects positively economic growth, which at least reduces poverty. On economic growth, income inequality has a negative effect.	84 countries
De La Escosura (2008)	Descriptive analysis	For the inequality behavior, first, it was the effect of the gap between property and labor returns, then from the 50s, skilled labor increased their share of employment, and the dispersion of returns became the main force driving inequality, During periods of political instability inequality grew, whereas during periods of economic growth it decreased; Fits the Kuznets curve.	Spain (1850-2000)
Huang *et al.* (2009)	Simultaneous equation model (SEM)	Positive effect of growth on inequality, and negative effect of inequality on growth, with high inter-relation.	83 countries
Kim *et al.* (2011)	Cross sectional and time-series data;	Long run, cointegrating and U-shaped relationship between inequality and development.	48 US states (1945-2004)

	Pooled mean group estimator of Pesaran, Shin, and Smith (1999)		
Zhou and Li (2011)	Nonparametric and semi-parametric unbalanced panel data models with fixed effects	Kuznets' inverted-U relationship between development and inequality is confirmed only from a certain threshold, not confirmed below; Policy instruments and economic performance play a larger role in reducing inequalities in more developed countries.	75 countries (1962-2003)
Gallup (2012)	Nonparametric fixed effects trend; Stochastic kernel model	U shaped relationship between inequality and economic growth.	87 countries
Shin (2012)	Heterogenous agent growth model that considers households, government, production and Market clearance	Both positive and negative relations between income inequality and economic growth are possible using a theoretical model that depends on state of development of the country; Higher inequality can slow growth in the early stages of development, but it can also encourage growth when near the steady state.	
Rubin and Segal (2015)	Two-stage instrumental variables approach; Dynamic model which changes in both income inequality and GDP per capita growth are determined simultaneously (GMM estimator)	Income is sensitive to both GDP per capita growth and market returns; Top 1% is the most sensitive to current GDP growth and the future expected growth, making the relation between market return and income changes less important if capital gain is excluded; Changes in inequality do not affect US GDP per capita growth, changes in inequality are positively affected by US GDP per capita growth and the market return, and the income share of the lower 90% group decreases with stock market return while the income share of the top 1% group increases with it.	USA
Cheng and Wu (2016)	National time series ARDLand provincial panel data (fixed effects)	Inverted-U shaped between income inequality and economic development; Urbanization as an important factor driving the Kuznets process; Dualism and inflation significantly contribute to income inequality.	China (1978-2011)
Costantini and Paradiso (2018)	Li *et al.* (2016)'s PPC estimation method; First, a nonparametric estimation technique, then a semiparametric fixed effects estimator	S-shaped relationship between real GDP per capita and inequality	US states
Alvaredo *et al.*(2018)	Trend analysis	Even with the decrease in inequalities in emerging countries, the top 1% has increased their share of income more than the bottom 50% and it is 100 times higher.	North America, Europe, China, India and Russia
Blanco and Ram (2019)	Pooled OLS estimator and two-way fixed effects model for spillover effects	For conventional models, U-shaped relation between income and inequality; With spillover effects: lack of significant relation.	US states
Vo *et al.* (2019)	System GMM; Granger Causality Test	Bidirectional causality between income inequality and economic growth; Negative impact of income inequality on economic growth; Positive impact of labor force participation on agriculture and service sectors to economic growth.	158 countries (1960-2014)
Martinez-Navarro *et al.* (2020)	Cochrane-Orcutt; System GMM	Kuznets curve is found for the whole set of countries; For non-OECD countries, Kuznets hypothesis is still valid; OECD countries sometimes follow the opposite pattern of Kuznets.	187 countries (1970-2016)
Sayed (2020)	Interactive fixed effects	U-shaped relationship between income inequality and economic growth; Education, urbanization and openness affect positively the inequalities.	12 Arab countries (1990 – 2015)

Table A2. Descriptive Statistics, 1990-2019.

Variable	Obs	Mean	Std. Dev.	Min	Max
gini mrkt	1127	46.969	4.413	32.4	56.3
gini disp	1127	31.617	6.937	17.1	53.1
redist	1127	15.352	6.2	0.7	25.8
Palma	1140	1.528	0.865	0.685	7.093
bottom40	1140	19.481	3.775	6.888	27.299
top10	1140	26.784	5.764	18.438	48.86
S80S20	1140	5.616	3.041	2.505	32.481
ln(gdppc)	1140	10.286	0.524	8.931	11.635
ln(gnipc)	968	10.112	0.738	8.153	11.371
infl	1094	8.613	54.068	-4.478	1020.621
open	1109	84.917	50.175	15.81	380.104
urban	1140	75.348	11.139	47.915	98.041
invest	1120	23.235	4.375	10.123	44.794
hc	1140	3.106	0.427	1.802	3.892
gcons	1109	18.679	4.066	8.12	30.324

Table A3. Correlation Matrix, 1990-2019.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) gini_mrkt	1.000														
(2) gini_disp	0.475	1.000													
(3) redist	0.193	-0.771	1.000												
(4) Palma	0.419	0.923	-0.726	1.000											
(5) S80S20	0.394	0.881	-0.698	0.979	1.000										
(6) bottom40	-0.459	-0.967	0.747	-0.910	-0.895	1.000									
(7) top10	0.465	0.967	-0.742	0.970	0.919	-0.947	1.000								
(8) ln(gdppc)	-0.101	-0.557	0.548	-0.613	-0.592	0.510	-0.596	1.000							
(9) ln(gnipc)	-0.138	-0.555	0.519	-0.578	-0.563	0.499	-0.569	0.939	1.000						
(10) infl	0.046	0.379	-0.389	0.471	0.458	-0.361	0.438	-0.582	-0.537	1.000					
(11) open	-0.114	-0.356	0.314	-0.315	-0.320	0.373	-0.329	0.344	0.156	-0.138	1.000				
(12) urban	0.110	0.093	-0.024	0.069	0.047	-0.089	0.081	0.291	0.379	-0.157	-0.121	1.000			
(13) invest	-0.418	-0.077	-0.216	-0.083	-0.088	0.129	-0.088	-0.141	-0.140	0.149	0.013	-0.138	1.000		
(14) hc	-0.257	-0.510	0.383	-0.583	-0.563	0.516	-0.578	0.603	0.553	-0.441	0.137	0.184	0.054	1.000	
(15) gcons	0.093	-0.594	0.730	-0.512	-0.456	0.575	-0.574	0.243	0.263	-0.230	0.034	0.152	-0.223	0.246	1.000