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How inequality drives growth: an investigation of the transmission channels for OECD countries*

José Carlos Coelho $ José Alves#

Abstract

This paper assesses the relationship between inequality and growth for 34 advanced OECD countries between 1990 and 2019 using recent Gini coefficients from Solt (2020) database and through a dynamic panel technique of two-step system GMM (Generalized Method of Moments). We find that the Gini coefficient of disposable income has a positive and significant impact, at a 10% level of significance, on subsequent economic growth over the five-year period. This result is explained based on the fiscal policy and saving channels, and also through the role of investment. More specifically, inequality translates into lower shares of public consumption and direct taxation on GDP, which boosts economic growth. Furthermore, inequality encourages saving and stimulates investment, which results in greater growth of the income per capita level.

JEL: D63; E21; E22; E62; O47
Keywords: inequality; economic growth; transmission channels; fiscal policy; saving; investment; system GMM

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1. Introduction

The relationship between inequality and economic growth is one of the most studied topics in macroeconomic analysis. Despite the vast literature on this topic, there is disagreement, especially in empirical terms, about the effects of inequality on growth. Over the last few decades there was an in-depth investigation between inequality and growth, although there is no consensus in the relevant literature and a single global pattern has not emerged, i. e., a clear empirical regularity (Neves and Silva, 2014). Still, this analysis is significantly present in recent economic research (Lee and Son, 2016; Brueckner and Lederman, 2018; Gründler and Scheuermeyer, 2018; Woo, 2020).

The main objective of this article is to investigate the impact of inequality on economic growth for OECD countries. More specifically, we intend to assess whether, to what extent, and through what mechanisms, the income disparity existing in these countries influences their growth dynamics. Therefore, we propose to analyse two inequality/growth transmission channels, namely, the fiscal policy channel and the saving channel. We consider that these transmission channels are more important in developed countries, compared to the other transmission channels listed in the literature, namely, the credit market imperfections channel, the sociopolitical instability channel and the fertility/education joint decision channel.

Regarding the fiscal policy transmission channel, both theoretical and empirical literature has found that the income distribution plays an important role in affecting the public sector action and, consequently, economic growth. The contributions of Alesina and Rodrik (1994), Persson and Tabellini (1994), Perotti (1996), Tanninen (1999), Bénabou (2000) and De Mello and Tiongson (2006), among others, points to the several ways that fiscal policy serves as a transmission channel.

In what respects the saving transmission channel, proposed by Kaldor (1956), the empirical literature is scarce about the importance of this macroeconomic variable in driven the effects of inequality on per capita GDP growth rate. In this article, we aim to overcome this gap in the literature. Furthermore, we assess the role of investment on the relationship between inequality and growth. Theoretical literature, for example, Galor and Zeira (1994) and Galor and Moav (2004), establishes that inequality affects investment in human capital and physical capital, either negatively or positively, and this, in turn, positively influences economic growth. Persson and Tabellini (1994) and Barro (2000) also empirically studied the importance of the investment on the relationship between income disparities and growth.

Voitckovsky (2005) and Castelló-Climent (2010) use the system GMM of Arellano and Bover (1995) and Blundell and Bond (1998) to investigate the effect of inequality on growth in developed countries only in the reduced form, not exploring transmission channels. Bartak and Jabłoński (2019) study the impact of income inequality on economic growth for OECD countries in the period 1990-2014. Their analysis focuses essentially on the relationship in reduced form, considering several measures of inequality, in addition to the Gini coefficient. However, the authors also do not investigate the transmission mechanisms between both variables. In this article, we explore this issue by considering the importance of fiscal policy and saving channels as well as the role of investment in understanding the nexus between inequality and growth for OECD countries.

This article contributes to the literature in several ways. First, the analysis covers a recent period, from 1990 to 2019, and considers as an empirical scope the thirty-four advanced OECD countries, which constitute the majority of developed countries. Second, we use version 9.0 of the SWIID – Standardized World Income Inequality Database from Solt (2020) that provides comparable market and disposable Gini coefficients of equivalized households disposable income for 196 countries between 1960 and 2019. Third, we study the relationship between inequality and growth in reduced form, that is, we assume that inequality is a determinant of economic growth together with other factors usually considered in growth regressions. Moreover, we investigate the explanatory potential of fiscal policy and saving channels in the relationship between both variables. The role of investment on the inequality/growth nexus is also examined. Finally, as inequality is a relatively stable variable over time, we use the system GMM to capture cross-country variations in inequality. Additionally, this panel data technique allows us to deal with endogeneity and persistency issues of the relevant variables under study.

The remainder of the paper is organised as follows. Section 2 reviews the literature on the relationship between inequality and growth in a reduced form as well as on the transmission channels. Section 3 presents the data and methodology employed in an empirical analysis. Section 4 reports and discusses the obtained results. Lastly, Section 5 ends the paper with main conclusions and economic policy implications.

2. Related Literature

The empirical literature that estimates the reduce form of the relationship between inequality and growth aims to determine the effect (signal and magnitude) of inequality on economic growth. The articles in this literature differ substantially from each other due to methodological issues, namely in the samples considered (groups of countries and time periods), the measure of inequality used, the sources, structure and quality of data and the estimation method considered in the empirical analysis.

Alesina and Rodrik (1994), Persson and Tabelllini (1994) and Perotti (1996), using cross-country regressions, conclude that income inequality has a negative impact on long run growth. Li and Zou (1998), using fixed and random effects models, and Forbes (2000), using first-difference GMM estimator developed by Arellano and Bond (1991) for a sample with middle and high income economies, find a positive effect in a short and medium run. Using a 3SLS (three-stage least squares) estimator, Barro (2000) reports an inconclusive impact of inequality on growth, albeit negative for poor countries and positive for rich countries. Chen (2003) supports the hypothesis that both variables are not monotonous, but in inverted U. Banerjee and Duflo (2003) find the presence of nonlinearities in the inequality/growth relationship, with net changes in inequality negatively influencing growth. Through system GMM from Arellano and Bover (1995) and Blundell and Bond (1998), Voitchovsky (2005) points out that the effect of inequality at the top of the income distribution on growth is positive, as opposed to the negative effect of inequality at the bottom, although insignificant when the author uses the Gini coefficient. Castelló-Climent (2010) partially support the results of Barro (2000): inequality has a negative effect for the sample as a whole and for low and middle-income economies and a negligible or even positive effect for high income economies. Halter *et al.* (2014) emphasize that the temporal dimension is a determining factor in analyzing the impact of inequality on growth, with a positive impact in the short run and negative in the long run. Using instrumental variables method with panel data, Brueckner and Lederman (2018) show that the relationship between inequality and growth depends on the initial income level: in poor countries, inequality promotes growth; in rich countries, inequality has a negative effect. Finally, Gründler and Scheuermeyer (2018) perform two-step system GMM and find a negative influence of inequality on growth in developing countries and in middle-income economies. In high-income countries, the authors found no correlation between inequality and growth.

The fiscal policy channel has two perspectives: the traditional perspective, summarized by Perotti (1996) and developed by authors such as Alesina and Rodrik (1994) and Persson and Tabellini (1994), and the alternative perspective advanced by Béanabou (2000). The first perspective holds that, in more unequal societies, there is a greater demand for redistributive policies, through the use of taxation and transfers (political link). This, in turn, results in negative effects on economic incentives, in terms of labor supply and saving and investment decisions, which jeopardizes the accumulation of physical capital and human capital and, consequently, economic growth (economic link). Bénabou (2000), in turn, considers a political economy framework combined with the presence of credit market imperfections and concludes for the possibility of the existence of multiple steady states. In more developed countries, in particular, inequality translates into greater influence of the richest on the political process and it is possible that greater inequality results in less redistribution. Consequently, in these countries, a higher level of inequality translates into a lower share of redistributive policies by taxes and transfers, that is, results into a lower level of fiscal progressivity and lower expenditures and social transfers.

The classical perspective of the saving channel proposed by Kaldor (1956) postulates that a greater concentration of income increases the aggregate saving rate, given the greater propensity to save by the richest compared to the poorest. A higher savings rate encourages investment and, consequently, fosters growth. This perspective is counterbalanced within the scope of the credit market imperfections channel by the seminal contribution of Galor and Zeira (1993). Through a model of overlapping generations, the authors show that the existence of fixed costs and invisibilities in education prevent, in unequal societies and where there are indebtedness restrictions, the poorest from acquiring human capital, which hinders economic growth. Galor and Moav (2004) unify both perspectives and advance the existence of multiple steady states between inequality and growth during the development process. In early stages, physical capital accumulation is the main driver of growth; in this context, inequality contributes to growth by enabling greater accumulation of physical capital. In advanced stages, the main driver of growth is human capital accumulation. Thus, a more equal distribution of income allows for a greater investment in education. With borrowing restrictions eased and credit markets more developed, the impact of inequality on growth may become negligible.

3. Empirical Framework

3.1. Data

This empirical analysis is based on a sample of high income thirty-four OECD countries, namely the Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), the Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), New Zealand (NZL), the Netherlands (NLD), Norway (NOR), Poland (POL), Portugal (PRT), the Republic of Korea (KOR), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), the United Kingdom (GBR) and the United States (USA). The analysis uses panel data during the period between 1990 and 2019 and considers six non-overlapping intervals of economic growth: 1991-1995, 1996-2000, 2001-2005, 2006-2010, 2011-2015 and 2016-2019.

Our explanatory variable is the growth rate of real GDP per capita, and it is calculated based on data of GDP per capita measured as expenditure-side real GDP at chained PPPs in 2017 USD millions and population, taken from the Penn World Table (PWT) version 10.0 (Feenstra *et al.*, 2015). According Perotti (1996) and Forbes (2000), among other authors, we include the following explanatory variables: (i) the natural logarithm of initial GDP per capita (lnGDPpc); (ii) the human capital index, based on years of schooling and returns to education (HC); (iii) the price level of capital formation, price level of United States expenditure-side GDP at chained PPPs in 2017 USD millions in 2017=1 (PI), from Feenstra *et al.* (2015); and (iv) the Gini index of inequality, equivalized (square root scale) households disposable (post-tax, post-transfer) income (GINID), from Solt (2020) database (version 9.0 of SWIID)[1]. Moreover, we admit three control variables: (v) the share of elderly population, the population ages 65 and above as a percentage of total population (POP65); (vi) the urbanization rate, people living in urban areas as a percentage of total population (URB); and (vii) the natural logarithm of the average life expectancy at birth (lnLIFEEX). The data for these three variables are retrieved from the World Development Indicators (WDI) of the World Bank. The fiscal policy variables that represent transmission channels between inequality and economic growth are as follows: (viii) the share of public consumption on GDP, defined as the general government final consumption expenditure in percentage of GDP (GOVC), from the WDI; (ix) the share of taxes on income and social contributions on GDP, i.e., the sum of the share of taxes on income, profits and capital gains on GDP with the share of social security contributions on GDP (TINSC), being calculated using OECD data (Public Sector, Taxation and Market Regulation, Taxation, Global Revenue Statistics Database,

[1] Solt (2020) database reports hundred different imputations for every observation, generated via Monte Carlo simulations. We consider the mean of these imputations for each observation.

from OECD.Stat); (x) the share of social spending on GDP (SSPEND), from OECD.Stat (Social Protection, Social Expenditure – Aggregated data); and (xi) redistribution, calculated as the difference between the Gini coefficient of market income and Gini coefficient of disposable income (REDIST), based in Solt (2020). Furthermore, we consider: (xii) the saving rate, constructed as the ratio between the saving net and the net national disposable income, assessed at current prices, constant PPPs, OECD base year, USD millions 2015 (SAV), taken from OECD.Stat data (Annual National Accounts, Disposable income and net lending - net borrowing); and (xiii) the investment rate, assumed as the gross capital formation in percentage of GDP (INV), from the WDI.

The per capita income, the human capital index, the price level of investment, the Gini coefficient and the three control variables are measured at the beginning of each five years growth period in order to mitigate the reverse causality, that is, the feedback from GDP dynamics to inequality. In addition, the share of public consumption on GDP, the share of taxes on income and social contributions on GDP, the share of social spending on GDP, redistribution, the saving rate and the investment rate are assessed as averages corresponding to the five years growth periods[2].

The inclusion of the initial per capita income allows to account the conditional convergence and the human capital index is a proxy for the stock of human capital. The price level of capital formation is the PPP value for of the investment deflator and it is a proxy for market distortions (e. g., tariffs, government regulation and corruption).

In Appendix, we report the usual descriptive statistics and the correlation matrix between the variables under study.

3.2. Methodology

Regarding our methodological approach, we consider the following five-year non-overlapping panel data specification[3]:

$$ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta ln(y_{it-} \ ) + \gamma Inequality_{it-1} + \delta X_{it-1} + \theta_i + \mu_t + \varepsilon_{it} \qquad (1)$$

where $ln(y)_{it}$ is the natural logarithm of real GDP per capita in country i (i = 1, …, N) and period t (t = 1, …, T); $Inequality_{it-1}$ is the measure of income inequality in country i and period t; X_{it-1} is a vector with control variables; θ_i denotes country-specific effect of country i; μ_t is a time effect of period t; and ε_{it} is the random disturbance error of

[2] Note that the last period, 2016-2019, has just four years.

[3] Commonly in the literature, economic growth is defined as the difference between two levels of income in natural logarithms, $(ln(y)_{it} - ln(y)_{it-1})$.

country i and period t. The country dummies are included to control for time-invariant omitted-variable bias. The period dummies, in turn, are included to control for global shocks which may affect aggregate growth in any period, although are not captured by the explanatory variables.

The equation (1) can be rewrite as:

$$ln(y_{it}) = \alpha + (1+\beta)\ln(y_{it-1}) + \gamma Inequality_{it-1} + \delta X_{it-1} + \theta_i + \mu_t + \varepsilon_{it} \quad (2)$$

A parsimonious expression of the growth equation is sufficient to examine the impact of inequality on economic growth, as is usual in the literature (Cingano, 2014; Bartak and Jabłoński, 2019; Woo, 2020).

The parameter β is related to the convergence rate and the variable $ln(y_{it-1})$ is the control variable for convergence. The marginal effect of the measure of income inequality is captured by the coefficient γ. In particular, the estimate of this coefficient gives us the contemporaneous effect of the measure of income inequality on the natural logarithm of GDP per capita. The long-run effect is, in turn, given by: $-\gamma / \beta$.[4]

The estimation method used is the two-step system GMM with forward orthogonal deviations and the Windmeijer (2005) finite sample corrected estimate of the variance in order to reduce finite simpe bias. System GMM exploits variation in inequality both between and within-country over time, considering variation in inequality across countries and accounting for other potentially relevant country-specific explanatory factors. This method allow us to lead with the persistence and endogeneity issues of the lagged income per capita and also of the income inequality measure. Income inequality can affect economic growth, but it simultaneously affected by this. In addition, the methodology chosen combines the equation in levels with the equation with forward orthogonal deviations and uses internal instruments (endogenous variables are instrumented with its own lags). Thus, the instruments of the endogenous variables of the levels equation are the lagged forward orthogonal deviations and the instruments of the equation with forward orthogonal deviations are the lagged levels variables. The two-step variant of system GMM weights the moment conditions by a consistent estimate of their covariance matrix. Although this procedure be asymptotically more efficient, in small samples the standard errors may be downward biased. The use of orthogonal deviations

[4] In the long-run, level of GDP per capita corresponds to a level of steady state. Solving the first-order difference equation and differentiating with respect to inequality, we obtain: $\partial ln(y) / \partial Inequality = -\gamma / \beta$. As β in modulus is less than 1, a permanent increase in inequality has a permanent effect on the steady state per capita income level.

is justified by the sample size of this study: thirty-four countries and six periods of economic growth, albeit without gaps in the data. Hayakawa (2009) through Monte-Carlo experiments concludes that, in many cases, the GMM estimator using forward orthogonal deviations perform better than that of the first-differencing method. The test statistics of the Hansen test of overidentifying restrictions (with the null hypothesis of the validity of instruments) and the number of instruments are reported. To avoid the problem of "instrument proliferation", we follow instrument collapsing proposed by Roodman (2009), which consists of reducing of the number of instruments through horizontal squeezing of the instruments matrix (collapsed instrument matrix).[5] The human capital index and the price level of investment are treated as predetermined variables. The share of elderly population, the urbanization rate and the average life expectancy at birth are considered exogenous variables. The remainder variables, including the lagged income per capita and the Gini coefficient, we assume they are endogenous.

The estimates obtained by OLS (Ordinary Least Squares) are inconsistent, as some sources of bias are present, namely the omitted-variable bias and the endogeneity problem. A fixed-effects transformation allow us to eliminate the unobserved individual (time-invariant and country) effects θ_i, usually correlated with the explanatory variables of the model, which generates the "dynamic panel bias" (Nickell, 1981). Therefore, a growth regression estimated by a FE (Fixed Effects) model is also inconsistent. Blundell and Bond (1998) demonstrate in separate simulations that if the dependent variable is close to a random walk, difference GMM perform poorly since past levels convey little information about future changes. In this context, untransformed lags are weak instruments for transformed variables. Under an additional assumption and to increase efficiency, the authors, as suggested by Arellano and Bover (1995), advance an alternative strategy against dynamic panel bias. Instead of transforming the regressors to expunge the fixed effects, it transforms the instruments to make them exogenous to the fixed effects. Changes in any instrumenting variable are uncorrelated with the fixed effects. Thus, the expected value of the any instrumenting variable together with the individual fixed effect is time-invariant. In particular, the initial deviations of output from steady state are not correlated with the fixed effects. The forward orthogonal deviations transformation eliminate the fixed effects subtracting the average of all future available observations of a variable, instead of subtracting the previous observations from the

[5] Many instruments can overfit endogenous variables and fail to expunge their endogenous component.

contemporaneous one (first differencing) or the mean from each observation (within transformation). This methodology avoids serial correlation of the transformed error terms and makes it possible to maintain the uncorrelatedness of these (for more details about this methodology, see Roodman, 2009).

4. Analysis and discussion of the results

4.1. Inequality/growth reduced form relationship

Through the estimation of reduced form relationship between income inequality and economic growth for the high-income OECD economies, in Table 1, we can observe that the initial Gini coefficient of the disposable income has a positive and significant impact, at a 10% level of significance, on the subsequent economic growth in the period of five years. This result is in line with the conclusions of Barro (2000) and Castelló-Climent (2010) for rich countries, nevertheless, in opposite with the evidence found by Lee and Son (2016) for advanced economies, Brueckner and Lederman (2018) for high income countries and Bartak and Jabłoński (2019) for OECD countries. More specifically, a variation of the Gini coefficient of disposable income in one unit results in the contemporaneous variation in the same direction of the level of income per capita in 0.01928 pp, ceteris paribus. The permanent effect (or the long-run effect) in the period of nearly five years is: 0.01928 / (1 - 0.499) = 0.03848 pp.

The share of elderly population, the rate of urbanization and the average life expectancy are included as additional explanatory variables, in estimations (2), (3) and (4), respectively, following Perotti (1996). These variables influence and are influenced by the existing levels of inequality and produce effects on economic growth. The introduction of the share of elderly population results in an increase of the estimate of the Gini coefficient and its level of significance. In general, inequality is lower among retired people compared to the total population, but so is their average income. Additionally, the greater the share of the population aged 65 or more, the greater the share of social security expenditures, which can translate into less growth. Then, the omission of the age structure of the population can skew the coefficient of the measure of inequality downward. In turn, the inclusion of the urbanization rate leads to a decrease in the estimate of the Gini coefficient. Urban areas are characterized by greater income disparities but also by higher levels of income per capita. In the early stages of the development process, urbanization is associated with an increase in inequality; in the later stages, inequality falls (Kuznets, 1955). Finally, the consideration of average life expectancy as a control variable also contributes to the reduction of the estimate of the Gini coefficient and has a positive and significant effect on growth. A more equitable income distribution produces important gains in terms of average life expectancy and this, in turn, results in a greater investment on education and skills, in improving the health status of the population and, therefore, increases productivity and economic growth.

The human capital index has a positive and significant impact on economic growth at a 5% level of significance in the estimations (1) and (3), however it becomes non-significant in the estimations (2) and (4), after including the share of elderly population and the average life expectancy, respectively. In this regard, Perotti (1996) advanced that the share of the population aged 65 or more may be a proxy for the fertility rate. In advanced countries, low birth rates correspond to higher proportions of the elderly population and greater investment in human capital, especially by the female population. As mentioned above, a higher average life expectancy results in higher levels of education. Thus, the coefficient of this variable may be capturing the effect of human capital on growth dynamics. The price level of investment has, as expected, a negative effect on growth, although not significant.

Table 1. Inequality/growth reduced form relationship estimates, 1990-2019

	(1)	(2)	(3)	(4)
$lnGDPpc_{it-1}$	0.499***	0.530***	0.497***	0.554***
	(0.135)	(0.116)	(0.119)	(0.131)
HC_{it-1}	0.596**	0.352	0.596**	0.061
	(0.260)	(0.286)	(0.240)	(0.122)
PI_{it-1}	-0.089	-0.045	-0.076	-0.061
	(0.080)	(0.132)	(0.084)	(0.104)
$GINID_{it-1}$	1.928*	1.943**	1.803*	1.828*
	(0.991)	(0.863)	(0.967)	(1.020)
$POP65_{it-1}$		1.877		
		(1.405)		
URB_{it-1}			0.118	
			(0.416)	
$lnLIFEEX_{it-1}$				2.659**
				(1.125)
Observations	203	203	203	203
Countries	34	34	34	34
Hansen *p-value*	0.295	0.214	0.330	0.215
Instruments	31	32	32	32

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) The dependent variable is the ln of GDP per capita; (c) Robust standard errors in brackets; (d) Constant term estimated but omitted for reasons of parsimony; (e) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

4.2. The role of fiscal policy channel

In this subsection, we analyse the role of fiscal policy channel in explaining the obtained positive impact of income inequality on economic growth. In specific, through two structural equations, we analyse: i) the effects of inequality on chosen fiscal policy channel variables, namely the share of public consumption on GDP, the share of taxes on income and social contributions on GDP, the share of social spending on GDP and also on redistribution (first link), and ii) the effects of these fiscal policy variables on the economic growth rate (second link). The fiscal policy variables considered seek to capture a notion of fiscal progressivity and the effects of redistributive policies and associated tax financing. From a theoretical point of view, we can expect that these variables negatively affect the dynamics of economic growth, given the distortions created on the decisions of economic agents.

In the first structural relationship, the fiscal policy variable is a function, in addition to the Gini coefficient of disposable income, of the initial level of per capita income and the percentage of elderly population. The inclusion of the initial level of per capita income is intended to capture the intuitive assumption that richer countries redistribute more income. The percentage of the population aged 65 and over determines whether a greater number of elderly people implies higher redistributive expenditure. In the second structural relationship, economic growth is explained considering the determinants identified above as well as the chosen fiscal policy variable, according to Perotti (1996), a proxy of the economic distortions caused by the tax financing of redistributive expenditure.

Table 2 presents the estimates obtained when we consider the role of public consumption. The initial Gini coefficient has a negative and significant impact at a 5% level on the average share of public consumption on GDP (estimations 1 and 2). Although no country in the sample had an initial ln of the per capita income for each growth period of 12.0652, the effect can be positive from this threshold, as shown in estimation (2). The effect of the initial per capita income on the share of public consumption is negative, nevertheless, from the threshold of the Gini coefficient of 0.3623, it becomes positive, at a 10% level of significance. The share of elderly population is not significant but has a positive signal. Regressions (3) and (4) estimate the influence of the share of public consumption on growth. In both regressions, the impact of the share of public consumption is negative and highly significant, and the Gini coefficient is not significant. Due to distortions caused in the private sector, public consumption decreases the steady state level of output. Then, the initial inequality promotes subsequent growth, via a negative impact on the share of public consumption on GDP.

Table 2. Estimated regressions for the role of public consumption, 1990-2019

	(1)	(2)	(3)	(4)
	GOVC	*GOVC*	*lnGDPpc*	*lnGDPpc*
$lnGDPpc_{it-1}$	-0.003	-0.050*	0.471***	0.483***
	(0.011)	(0.028)	(0.085)	(0.088)
HC_{it-1}			0.684***	0.618***
			(0.164)	(0.187)
PI_{it-1}			0.033	0.076
			(0.089)	(0.101)
$GINID_{it-1}$	-0.292**	-1.665**		0.590
	(0.111)	(0.809)		(0.907)
$lnGDPpc_{it-1} \times GINID_{it-1}$		0.138*		
		(0.078)		
$POP65_{it-1}$	0.175	0.206		
	(0.140)	(0.140)		
$GOVC_{it}$			-4.183***	-3.955***
			(0.668)	(0.726)
Observations	203	203	204	203
Countries	34	34	34	34
Hansen *p-value*	0.280	0.906	0.400	0.798
Instruments	32	47	31	46

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) The dependent variable is the ln of GDP per capita; (c) Robust standard errors in brackets; (d) Constant term estimated but omitted for reasons of parsimony; (e) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

By Table 3, income inequality has a negative and highly significant impact on the share of taxes on income and social contributions on GDP. The share of elderly population has a positive signal, and the initial income level has a negative signal, both highly significant (regression 1). Although, according to regression (2), the share of taxes on income and social contributions does not influence economic growth, regression (4) points to a negative impact, given the threshold value found, *lnGDPpc* = 18.515 / 2.184 = 8.478, at a 10% level of significance. The joint consideration of the Gini coefficient with the share of taxes on income and social contributions on the growth regression results in the decrease in the estimate of the measure of inequality, given the initial estimate obtained in Table 1, 1.928 . This result is not surprising, since inequality affects the share of taxes on income and social contributions.

Table 3. Estimated regressions for the role of taxes on income and social contributions, 1990-2019

	(1)	(2)	(3)	(4)
	TINSC	*lnGDPpc*	*lnGDPpc*	*lnGDPpc*
$lnGDPpc_{it-1}$	-0.032***	0.480***	0.528***	0.804***
	(0.012)	(0.125)	(0.105)	(0.195)
HC_{it-1}		0.759***	0.583***	0.961***
		(0.216)	(0.190)	(0.167)
PI_{it-1}		-0.055	-0.099	-0.128*
		(0.087)	(0.111)	(0.072)
$GINID_{it-1}$	-0.518***		1.793*	
	(0.160)		(0.990)	
$POP65_{it-1}$	0.741***			
	(0.169)			
$TINSC_{it}$		-1.195	-0.453	18.515*
		(1.239)	(1.175)	(10.073)
$TINSC_{it} \times lnGDPpc_{it-1}$				-2.184**
				(1.040)
Observations	203	204	203	204
Countries	34	34	34	34
Hansen *p-value*	0.346	0.214	0.836	0.856
Instruments	32	31	46	46

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) Robust standard errors in brackets; (c) Constant term estimated but omitted for reasons of parsimony; (d) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Regarding the results on the role of social spending, presented in Table 4, the Gini coefficient of disposable income has a negative effect, however not significant, on the share of social expenditure on GDP (see estimation 1). The effect of the share of elderly population is positive and highly significant and the effect of the initial income level is negative and not significant. In turn, the share of social spending has a negative impact on growth at 10% level of significance (estimation 2). The estimate of the measure of inequality is reduced when the share of social expenditure is included in the growth regression (estimation 3), which may indicate that the Gini coefficient and the share of social expenditure are related in some way, although this effect is not captured by estimation 1.

Table 4. Estimated regressions for the role of social spending, 1990-2019

	(1)	(2)	(3)
	SSPEND	*lnGDPpc*	*lnGDPpc*
$lnGDPpc_{it-1}$	-0.009	0.499***	0.512***
	(0.020)	(0.138)	(0.083)
HC_{it-1}		0.773***	0.632***
		(0.231)	(0.151)
PI_{it-1}		0.089	0.028
		(0.093)	(0.093)
$GINID_{it-1}$	-0.243		1.377*
	(0.258)		(0.742)
$POP65_{it-1}$	0.929***		
	(0.282)		
$SSPEND_{it}$		-2.700*	-1.692
		(1.435)	(1.106)
Observations	199	200	199
Countries	34	34	34
Hansen *p-value*	0.314	0.339	0.849
Instruments	32	31	46

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) Robust standard errors in brackets; (c) Constant term estimated but omitted for reasons of parsimony; (d) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Lastly, when we analyse the role of redistribution (see the results in Table 5), income inequality has a negative effect, however not significant, on redistribution. The effect of the share of elderly population is positive and significant at a 5% level and the effect of the initial income level is negative and not significant. Redistribution has no significant impact on the economic growth, as found by Cingano (2014), Thewissen (2014), and Berg *et al.* (2018) for the subsample of OECD countries, but its signal is negative. Hence, redistribution is neutral to growth. In this regard, Gründler and Scheuermeyer (2018) conclude that redistribution is harmful for growth in rich countries and Woo (2020) find the same result for the subsample of OECD countries. The estimate of the Gini coefficient maintains when redistribution is introduced in the growth regression, which may indicate that the Gini coefficient and redistribution are not related.

On the one hand, the negative impact of the inequality on the share of public consumption and on the share of taxes on income and social contributions could verify the hypothesis of Bénabou (2000) that, in contrast to the political link stated in the traditional perspective of the fiscal policy channel, advances that, in more unequal countries, taxation and redistribution are less, not greater. Also De Mello and Tiongson (2006) for the sample of high-income countries and both Muinelo-Gallo and Roca-

Sagalés (2013) and Islam *et al.* (2018) for OECD countries conclude by this result. On the other hand, the negative impact of the share of public consumption, share of taxes on income and social contributions and share of social spending on growth corroborates the economic link from the traditional perspective of the fiscal policy channel, which sustains that taxation and a greater use of redistributive policies creates economic disincentives to work, saving and investment and thus hinders growth. Earlier, Tanninen (1999) reports a negative impact of public consumption on economic growth, but non a statistically significant effect of inequality on the public consumption. Then, the initial inequality promotes subsequent growth, via a negative impact on the share of public consumption and on the share of taxes on income and social contributions on GDP.

Table 5. Estimated regressions for the role of redistribution, 1990-2019

	(1)	(2)	(3)
	REDIST	*lnGDPpc*	*lnGDPpc*
$lnGDPpc_{it-1}$	-0.029	0.409***	0.527***
	(0.022)	(0.144)	(0.108)
HC_{it-1}		0.869***	0.580***
		(0.187)	(0.165)
PI_{it-1}		-0.078	-0.091
		(0.091)	(0.088)
$GINID_{it-1}$	-0.043		1.931*
	(0.158)		(0.981)
$POP65_{it-1}$	0.831**		
	(0.319)		
$REDIST_{it}$		-0.781	-0.725
		(1.994)	(1.837)
Observations	199	200	199
Countries	34	34	34
Hansen *p-value*	0.314	0.339	0.849
Instruments	32	31	46

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) Robust standard errors in brackets; (c) Constant term estimated but omitted for reasons of parsimony; (d) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

4.3. The role of saving channel

Among the transmission channels identified in the literature, the saving channel is the one that is least explored empirically. Barro (2000) studies this channel, albeit superficially. The author tests whether the investment rate, influenced by the aggregate savings rate, is determined by income inequality, and concludes that the Gini coefficient has no impact on the investment rate.

In this subsection, we analyse the effects of income disparities on growth through the saving channel, considering two fundamental mechanisms: i) the effect of inequality on the saving rate, and ii) the impact of the saving rate on economic growth. The use of national saving rather than investment makes it possible to exclude external saving flows from investment financing, which are not subject to domestic income inequality. The variable that captures the saving mechanism refers to the nation's average net saving rate and can be interpreted as a proxy for the share of investment financed entirely using domestic savings.

In addition to the effect of the inequality measure on the saving rate, we also assess the effects of the share of public consumption and of the share of taxes on income and social contributions on it.[6] The purpose is to determine whether, in fact, these fiscal policy variables have an impact on the saving rate, given that they produce distorting effects at the level of economic agents' saving decisions.

The results are presented in Table 6. As we can see in detail, regression (1) points to a positive and statistically significant impact at a 5% level of income inequality on the average saving rate. The initial level of per capita income is positive, albeit non-significant, and the human capital index has a negative signal at a 10% level of significance. The share of public consumption on GDP is included as an explanatory variable for the saving rate, without and with the simultaneous presence of the Gini coefficient (estimations 3 and 4, respectively). In both, the effect of share of public consumption is negative and highly significant on the saving rate. The share of taxes on income and social contributions on GDP has a negative and significant effect at 10% level on the saving rate. The joint consideration of the Gini coefficient with the share of taxes on income and social contributions on GDP results in the loss of significance of the measure of inequality and in the absence of significance of the share of taxes on income and social contributions (estimations 4 and 5). These results verify the economic link from the traditional perspective of the fiscal policy channel: greater share of public consumption on GDP and share of taxes on income and social contributions creates disincentives to save. In turn, regressions (6) and (7) estimate a positive and highly significant effect of the average saving rate on the economic growth of the period. Furthermore, our findings corroborate the perspective of Kaldor (1956), who suggested

[6] We also estimate the effects of the share of social expenditure and redistribution on the saving rate and we conclude that they are identical to those obtained using the share of public consumption and the share of taxes on income and social contributions. These results are available upon request.

that, since the propensity to save of the richest is higher than of the poorest, the increase in inequality increases the aggregate saving rate, promotes investment, through the accumulation of physical capital, and thus stimulates economic growth.

In conclusion, inequality, measured by the Gini coefficient of disposable income, results in a higher aggregate saving rate and, consequently, contributes to the economic growth. Moreover, inequality promotes the saving rate, via effects of the share of public consumption and share of taxes on income and social contributions on the saving rate.

Table 6. Estimated regressions for the saving channel, 1990-2019

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	SAV	*SAV*	*SAV*	*SAV*	*SAV*	*lnGDPpc*	*lnGDPpc*
$lnGDPpc_{it-1}$	0.092	-0.000	-0.005	0.100*	0.063	0.425***	0.445***
	(0.059)	(0.041)	(0.037)	(0.055)	(0.048)	(0.088)	(0.068)
HC_{it-1}	-0.163*	0.059	0.030	-0.092	-0.105	0.720***	0.695***
	(0.080)	(0.090)	(0.067)	(0.067)	(0.074)	(0.211)	(0.176)
PI_{it-1}						0.062	0.035
						(0.071)	(0.073)
$GINID_{it-1}$	1.578**		0.530		1.301*		0.102
	(0.619)		(0.521)		(0.671)		(1.042)
$GOVC_{it}$		-2.890***	-2.366***				
		(0.590)	(0.485)				
$TINSC_{it}$				-0.857*	-0.306		
				(0.490)	(0.428)		
SAV_{it}						1.283***	1.268***
						(0.317)	(0.315)
Observations	193	193	193	193	193	193	193
Countries	33	33	33	33	33	33	33
Hansen *p-value*	0.418	0.519	0.949	0.263	0.906	0.263	0.865
Instruments	31	31	46	31	46	31	46

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) Robust standard errors in brackets; (c) Constant term estimated but omitted for reasons of parsimony; (d) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

4.4. The role of investment

In open economies, internally generated saving do not cover the entirety of investment expenditures made in the economy and recourse to international financial markets makes it possible to cover the difference. Consequently, saving and investment are dissociated, which justifies that we study separately the effects of inequality on both and their effects on economic growth.

In this subsection, we have analysed how inequalities can influence economic performance through investment. In this analysis, similarly to what was done in the scope of the saving channel, we also consider two structural equations, namely: i) the impact of the inequality measure on the investment rate, and ii) the impact of the investment rate on economic growth. Furthermore, we examine the effects of the share of public consumption and of the share of taxes on income and social contributions on the investment rate, in order to capture the distorting effects of these fiscal policy variables on investment decisions.[7] The overall results of the role of investment are presented in Table 7.

Table 1. Estimated regressions for the role of investment, 1990-2019

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	INV	*INV*	*INV*	*INV*	*INV*	*lnGDPpc*	*lnGDPpc*
$lnGDPpc_{it-1}$	-0.074**	-0.049	-0.062**	-0.079**	-0.070**	0.503***	0.577***
	(0.028)	(0.036)	(0.024)	(0.039)	(0.027)	(0.158)	(0.106)
HC_{it-1}	0.058	0.041	0.040	0.104	0.068	0.729***	0.527***
	(0.041)	(0.058)	(0.049)	(0.063)	(0.042)	(0.244)	(0.183)
PI_{it-1}	-0.020	0.012	0.008	-0.027	-0.032	-0.047	-0.061
	(0.022)	(0.026)	(0.019)	(0.024)	(0.022)	(0.085)	(0.078)
$GINID_{it-1}$	0.603**		0.400		0.382		1.402
	(0.265)		(0.246)		(0.301)		(0.838)
$GOVC_{it}$		-0.806**	-0.459*				
		(0.320)	(0.263)				
$TINSC_{it}$				-0.626*	-0.531**		
				(0.358)	(0.254)		
INV_{it}						1.108*	0.790
						(0.654)	(0.531)
Observations	203	204	203	204	203	204	203
Countries	34	34	34	34	34	34	34
Hansen *p-value*	0.335	0.298	0.917	0.383	0.835	0.253	0.810
Instruments	31	31	46	31	46	31	46

Notes: (a) Two-step system GMM estimations with robust standard errors, small sample correction and forward orthogonal deviations; (b) Robust standard errors in brackets; (c) Constant term estimated but omitted for reasons of parsimony; (d) *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Estimation (1) shows that the initial Gini coefficient has a positive and statistically significant effect on the average investment rate at a 5% level of significance. Conversely, Persson and Tabellini (1994) found that the share of the third quintile has a positive effect on the investment rate, especially in democracies, and, thereby, more equality translates into the higher investment rate. In addition, Barro (2000) concluded by a weak effect of income inequality on the investment rate. The share of public consumption on GDP, in turn, negatively affects the investment rate at a 5% level, which points to the occurrence

[7] We also estimate the effects of the share of social expenditure and redistribution on the investment rate and we conclude that they are identical to those obtained using the share of public consumption and the share of taxes on income and social contributions. These results are available upon request.

of a crowding-out effect of public consumption on private investment. When simultaneously we consider the Gini coefficient and the share of public consumption on GDP as explanatory variables, the effect of the first on the investment rate is not significant and the estimate of the second is reduced in modulus and loses significance. The share of taxes on income and social contributions on GDP has a negative and significant effect on the investment rate at a 10% level; when we consider the Gini coefficient, the estimate in modulus decreases, but becomes significant at a 5% level. The signal of the level of initial per capita income is negative and significant at a 5% in the estimations (1)-(5), except in the estimation (2). In fact, in the richest countries, GDP per capita and investment rate are negatively correlated. Regressions (6) and (7) assess the impact of the investment rate on economic growth, without and with the inclusion of the measure of inequality in parallel, respectively. Without the presence of the Gini coefficient, the investment rate has a positive influence on growth at 10% level of significance. In turn, Persson and Tabellini (1994) do not found statistical signficance, although the signal be positive. With the presence of the Gini coefficient, the impact becomes non significant. These results, although weaker, are consistent with the evidence found within the scope of the saving channel.

In short, empirical evidence suggests that income inequality enhances economic growth through the positive impact on the investment rate as well as through an impacts of the share of public consumption and the share of taxes on income and social contributions on the investment rate.

5. Conclusions and policy implications

By resorting the two-step system GMM, we analyze the impact of inequality on economic growth as well as the interpretive potential of fiscal policy and saving channels and also the role of investment for a sample of thirty-four advanced OECD countries between 1990 and 2019. Our article overcomes a gap in the literature by studying these transmission channels considering a sample of developed countries. The robustness of the system GMM allows, on the one hand, to incorporate the fact that inequality is relatively constant over time and that a large part of its variation is cross-sectional. On the other hand, it allows us to deal with the endogenous and persistent nature of some explanatory variables, namely the initial level of per capita income and the measure of inequality, and with unobservable individual effects. When comparable with other estimation methods, the outcomes of such panel data technique are less biased and more efficient.

We find evidence pointing to a positive impact of disposable income inequality on subsequent economic growth of the five-year period, albeit only at a 10% level of significance. This result is explained in the scope of fiscal policy and saving channels. The perspective of Bénabou (2000) who argues that a higher level of inequality corresponds to a lower share of redistributive policies is corroborated: higher inequality results in a lower shares of public consumption and direct taxation on output. The economic link associated with the traditional perspective of the fiscal policy channel is also verified. Greater shares of public consumption, direct taxation and social expenditure have negative effects on growth. However, for redistribution, we find no evidence. The classical saving channel approach, advanced by Kaldor (1956), has empirical support: a higher level of inequality results in a higher savings rate and this, in turn, fosters growth. Additionally, we confirm the role of investment in the inequality/growth relationship. In particular, inequality stimulates the investment rate, which is beneficial to the performance of the economy. Finally, we report that the fiscal policy variables mentioned above have distorting effects on saving and investment, as predicted by theory.

These empirical results obtained seem to confirm the efficiency/equity trade-off as suggested by Okun (1975). A greater income disparity among advanced OECD countries translates into faster growth. Thus, countries with a more equal distribution of income grow more slowly. Barro (2000) states that in developed countries, aspects of inequality that promote growth, such as economic incentives and savings, are more relevant. Marrero and Rodríguez (2013) argue that differences in opportunities are less important in developed countries. Thus, the effect of inequality on growth can be more attenuated in this way.

Nevertheless, from a point of view of economic policy recommendations, we do not suggest, in the context of advanced OECD countries, the increase in income inequality, which has occurred in recent decades, and/or that the government reduces public consumption, especially productive and distributive spending on education and health, and cut direct taxation and social spending and transfers to promote greater economic growth. On the one hand, increasing inequality and cutting social expenditure can jeopardize social cohesion, increase poverty levels, result in the emergence of sociopolitical movements that threaten social stability and contribute to the delegitimization of the democratic system and block its functioning. In this scenario, economic growth itself would suffer. On the other hand, there may be inequality effects on growth that are not captured in our analysis. For example, investment in education, especially in higher education, and social protection can be carried out in developed countries through household debt. Whether private debt assumes high values could compromise macroeconomic stability, provoke financial crises and negatively affect economic growth.

As suggestions for future research on the transmission channels between inequality and growth in developed countries, we propose to study the effects of inequality on investment in human capital, especially in higher education, and on the use of private credit and consequently their role on economic growth.

Our paper uses a more recent inequality data set from Solt (2020), in particular, the disposable Gini coefficient. This is the measure of inequality most commonly used in the empirical literature; however, it is a measure of average inequality. Some effects of inequality on growth may not be captured using it. Thus, the use of other measures of inequality, namely measures that reflect different parts of the income distribution, is recommended in future research on the transmission channels between inequality and growth.

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Appendix

Table A2. Descriptive Statistics, 1990-2019

Variable	Mean	Std. Dev.	Maximum	Minimum	Obs.
lnGDPpc	10.3931	0.4607	11.6346	9.0139	238
GINID	0.2984	0.052	0.5077	0.1754	204
HC	3.2023	0.3555	3.8915	1.94	238
PI	0.6814	0.1944	1.2531	0.1972	238
POP65	0.1519	0.0355	0.28	0.0523	238
URB	0.7592	0.1144	0.9804	0.4792	238
lnLIFEEX	4.35	0.0455	4.4284	4.1956	204
GOVC	0.1945	0.036	0.2646	0.0983	204
TINSC	0.2082	0.0521	0.3185	0.0562	204
SSPEND	0.1977	0.0544	0.315	0,0277	200
REDIST	0.1669	0.048	0.2546	0.0111	203
SAV	0.0829	0.0858	0.2882	-0.4152	193
INV	0.2337	0.0389	0.3902	0.1233	204

Table A2. Correlation matrix, 1990-2019

	lnGDPpc	***GINID***	***HC***	***PI***	***POP65***	***URB***	***lnLIFEEX***	***GOVC***	***TINSC***	***SSPEND***	***REDIST***	***SAV***	***INV***
lnGDPpc	1												
GINID	-0.2153	1											
HC	0.5015	-0.14	1										
PI	0.6414	-0.142	0.4312	1									
POP65	0.3813	-0.209	0.2059	0.3169	1								
URB	0.3774	0.1211	0.2348	0.4474	-0.0016	1							
lnLIFEEX	0.8044	0.0591	0.348	0.6502	0.3853	0.4402	1						
GOVC	-0.0306	-0.508	-0.004	0.1268	0.2556	0.1884	-0.0433	1					
TINSC	0.3253	-0.716	0.0993	0.2647	0.4609	0.0625	0.1518	0.6102	1				
SSPEND	0.2957	-0.474	-0.038	0.2384	0.588	0.0442	0.3033	0.5775	0.8147	1			
REDIST	0.2678	-0.579	0.0362	0.1541	0.4742	-0.071	0.0699	0.6196	0.7118	0.7565	1		
SAV	0.4418	-0.001	0.1796	0.2836	-0.1951	0.2756	0.4012	-0.346	-0.009	-0.217	-0.191	1	
INV	-0.1559	-0.031	0.0698	-0.051	-0.256	-0.149	-0.21	-0.259	-0.224	-0.4222	-0.3226	0.342	1

Methodological Issues

The relationship in a reduced form between inequality and growth as well as the transmission channels that operate between both variables were, from an empirical point of view, pioneering tested using a sectional data structure (Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Perotti, 1996). Hereafter, the use of panel data methodologies was considered by researchers who studied this topic and supplanted the use of cross-section data.

While cross-country estimations are based on differences between countries, studying the inequality/growth relationship over a long period of time, panel estimations allow us to investigate this relationship within countries over time, generally in short periods of economic growth (five or ten years).

Sectional economic growth regressions suffer from inconsistency in not controlling for specific, unobservable characteristics of countries. In particular, this omission results in biased estimates of the explanatory variables. By construction, cross-section estimations do not allow correcting the bias caused by the omission of time-invariant variables, through the estimation of country-specific effects. Panel estimates, on the other hand, allow controlling specific characteristics, by removing the bias resulting from the correlation of country-specific effects with the explanatory variables. The second source of inconsistency is related to the endogenous nature of some explanatory variables that usually appear as regressors in cross-section analyzes of economic growth. In this regard, sectional regressions do not seem adequate in the treatment of these variables. Standard panel data methodologies (fixed effects and random effects) do not allow to overcome this problem either. Therefore, as in cross-country estimations, the problem of endogeneity of explanatory variables in panel regressions remains.

Moreover, standard panel estimation methods are inadequate for estimating the relationship between inequality and growth, as Li and Zou (1998) done. On the one hand, the explanatory variables used in typical economic growth regressions are generally correlated with country-specific effects, which makes the random effects estimator inconsistent, even this estimator being more efficient, since it incorporates information both from the sectional units individually and from the time periods. On the other hand, the use of a fixed effects estimator can lead to biased results in the presence of variables that are constant over time or whose variation is especially cross-sectional, as is the case of income inequality. In addition, a fixed effects model eliminates sectional information from the data.

Forbes (2000) used the first-difference GMM estimator in this analysis, however, the estimates obtained lack consistency. When variables are persistent, as in the case of measure of inequality, the lagged variables of the explanatory variables are weak instruments for the variables in first differences. Even the lagged explanatory variable does not perform well in the regressions. Moreover, making a first differences eliminates most of the variation in the data.

The system GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) was then used by researchers to overcome this issue of instrument quality. This method has clear advantages, since reflects cross-country variations in inequality and allows for dealing with common sources of bias, namely: the omitted-variable bias, resulting from correlation between country specific fixed effects and the regressors; the endogeneity problem, due to potential correlation between the regressors and the error term; measurement errors in the independent variables; and dynamic panel bias.