ADDRESSING INEQUALITIES

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Global Thematic Consultation

The optimal rate of inequality: a framework for the relationship between income inequality and economic growth

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Abstract

This paper provides a conciliatory argument to the debate over the relationship between income inequality and economic growth by proposing that the disparities in previous empirical studies derive from the fact that they have not accounted for the level of inequality as a factor that can define the sign of the relationship. An inverted "U" shaped relationship is demonstrated, showing that low levels of inequality exert a positive correlation with economic growth while high levels depict a negative one. Additionally, it is demonstrated the existence of an *Optimal Rate of Inequality* (ORI) that maximizes growth rates in comparison to other inequality levels, and releases the economy from any distortion generated by high inequality or high redistribution (and the associated taxation levels). Moreover, the model proposes the existence of an inequality trap which can explain why some countries are impeded to effectively reduce inequality levels or need more redistributive efforts to do so. Empirical evidence from a broad panel of countries is presented to validate these propositions. The main policy implication is that inequality does matter for growth, policies intended to promote growth should consider the growth enhancing properties of reaching an optimal inequality level.

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Introduction

Over the last two decades there has been a continuous debate over the true relationship between income inequality and economic growth. Empirical studies have found a series of contradictory results, from the ones who affirm a negative relationship (Alesina and Rodrik, 1994; Clarke, 1995; Perotti, 1993; Alesina and Perotti, 1996; Persson and Tabellini, 1994; Perotti, 1996; Kremer and Chen, 2002; Castelló and Doménech, 2002; De la Croix & Doepke, 2003; Josten, 2003; Ahituv and Moav 2003; Viaene and Zilcha, 2003; Josten, 2004; Castello-Climent, 2004; Knowles, 2005; Davis, 2007), the ones who find a positive link (Partridge, 1997; Forbes, 2000; Li and Zou, 1998), a nonlinear correlation (Barro, 2000; Banerjee and Duflo, 2003; Voitchovsky, 2005; Bengoa and Sanchez-Robles, 2005; Barro, 2008; Castello-Climent, 2010), to the studies who assert an inexistent or a non-conclusive one (Lee and Roemer, 1998; Panizza, 2002; Castelló and Doménech, 2002).

While information sources among empirical studies are, in many cases, the same[1] authors have incorporated diverse variations in the characteristics of their works in order to find the "real" relationship between inequality and growth, and conciliate the differences in the literature. Either by improving the quality of the data, by using different methodologies in the estimation of such models[2], reducing or increasing the time horizon of the expected effects from inequality to growth, testing different transmission mechanisms to explain the relationship, or by including dummies in the estimation, none of them have taken into account the level of inequality as a potential cause for the discrepancy in the results.

Before asking if income inequality is positively or negatively related to economic growth we should question if such phenomenon is "natural" or at least expected in the context of a market economy, where it is generally accepted that the income level of its members is determined in some measure by its marginal productivity and by the comparative advantages that it reveals as a result of its economic performance.

If we agree that a certain amount of inequality is natural and even necessary in a market economy, then the question should rather be: *how much inequality is harmful for growth?* To inquire only if inequality is harmful or beneficial for economic growth, as most studies implicitly do, requires to expect a linear answer and to assume that levels of inequality do not play any role in defining the relationship; in other words, it implies the effects of inequality over growth to be the same regardless its magnitude. Moreover, to imply the possibility of agreeing on a general positive or negative relationship would mean either to reach policy recommendations (regardless of the specific context, i.e. the current inequality level or the democratic status) for actively promoting an increment in inequality levels or the opposite if it were the case.

[1] Among the most influential are the databases from Deininger and Squire (1996), more recently the one compiled by the World Income Inequality Database (WIID) and, for the socio-economic variables, the database from Barro and Lee (1993).

[2] Such as ordinary least squares (OLS), generalized method of moments (GMM), Three stage least squares (3SLS), seemingly unrelated regression (SUR), fixed or random effects estimation, Arellano and Bond (1991) type estimations, among others.

Only a few studies (Barro, 2000; Banerjee and Duflo, 2003; Voitchovsky, 2005; Bengoa and Sanchez-Robles, 2005; Barro, 2008; Castello-Climent, 2010) have found a nonlinear relationship between inequality and growth. Nevertheless, these studies attribute the change in the tendency to causes which are exogenous to the level of inequality[3] and, in most cases, directly related to the determinants of economic growth or to the income level of the country.

Barro (2000) and (2008) finds, after estimating for different income levels, a positive and significant relationship between income inequality and growth for wealthy countries[4] and a negative for poor countries. These results imply that in a country with low income levels, more redistribution and less inequality is associated with higher economic growth, with the opposite relation in countries with high per capita income (above a break point level).

We may wonder whether the non-linearity could be sustainable at any level, at both sides of the relationship, this is, if such underprivileged countries will need to virtually eliminate inequality (with all the implications of this extreme and improbable case) in order to reach the higher growth rates, or on the other hand, if rich countries making an effort to maximize growth or maintain the income level should promote increasingly high levels of inequality.

The question which most of the previous studies on the effects from income inequality to economic growth have been trying to answer, specifically: *Is inequality bad or good for growth?,* might be incorrectly stated. Moreover, the answer provided in the case of the income dependent non-linear relationship, namely, *inequality is bad for the poor and good for the rich*, defies some of the basic foundations of any society, which rely on the existence of inequalities in the form of economic and social differentiation of individuals and in the incentives for achieving such differentiation.

Another study which reveals a nonlinear relationship is the one developed by Banerjee and Duflo (2003) who measure the effects of changes in inequality on economic growth in the short run. They find that movements, in any direction, are associated with reduced growth in the subsequent period. Under this consideration, if an economy could reach a circumstance in which no distributional conflicts were in place, economic growth would be optimized. At this point, any change in redistribution (either positive or negative) would lower the growth rate.

Only one study can be found to suggest a relationship between inequality and growth that could be determined by the level of inequality, this is, that accounts for the fact that different levels of inequality can exert different types of effects it the study developed by Cornia et al. (2004), nevertheless, this hypothesis is presented only at a theoretical level and has not been proven empirically.

The purpose of this paper is twofold; first, to demonstrate the fact that the main variable determining the effects of inequality over growth is inequality itself, specifically, the level of

[3] Banerjee and Duflo attribute the negative relationship to changes in inequality but the effect comes from the economic distortions generated by distributive decisions at any level of inequality.

[4] In Barro (2000) the breakpoint occurs at an income level of approximately $2,000 (1985 US dollars), and in Barro (2008) around $11,900 (in 2000 US dollars).

inequality is the one determining the sign of the relationship; second, to prove the existence of an *Optimal Rate of Inequality* (ORI) in which growth is optimized and the economy is bailed out from the negative effects of too high inequality and/or too high taxation (and the associated low inequality). Additionally, this research proposes the existence of an inequality trap in which countries with low marginal efficiency of redistribution and underdeveloped tax systems are unable to reach the ORI and achieve optimal growth. This inequality trap can, in theory, account for the inability of some countries to lower the levels of inequality and/or generate significant growth.

The paper is structured as follows: on the following section a simple political economy model is presented to depict the relationship between redistribution, inequality and growth; the next section develops an empirical study composed by a broad panel of countries over four decades in order to test the nonlinear relationship. A discussion over the results and implications of this study are presented on the final section of the paper.

The model

Consider an economy in which the level of inequality is determined by the amount of redistribution. Higher levels of redistribution will lead to lower levels of inequality, conditioned to the marginal efficiency of redistribution (MER), which is defined by the level of development of the tax system both on the revenue as in the redistributive expenditure side. An efficient redistributive system in which institutions and social programs are able to transfer resources efficiently to the lower brackets of income, as well as a progressive tax system with low levels of evasion and informality, will result in a higher MER; in other words, higher changes in the levels of inequality as a response to changes in redistribution. Additionally, this situation will result in a lower value relation between inequality and redistribution, where lower levels of redistribution will be enough to achieve a lower level of inequality in comparison to an economy with a less developed tax system.

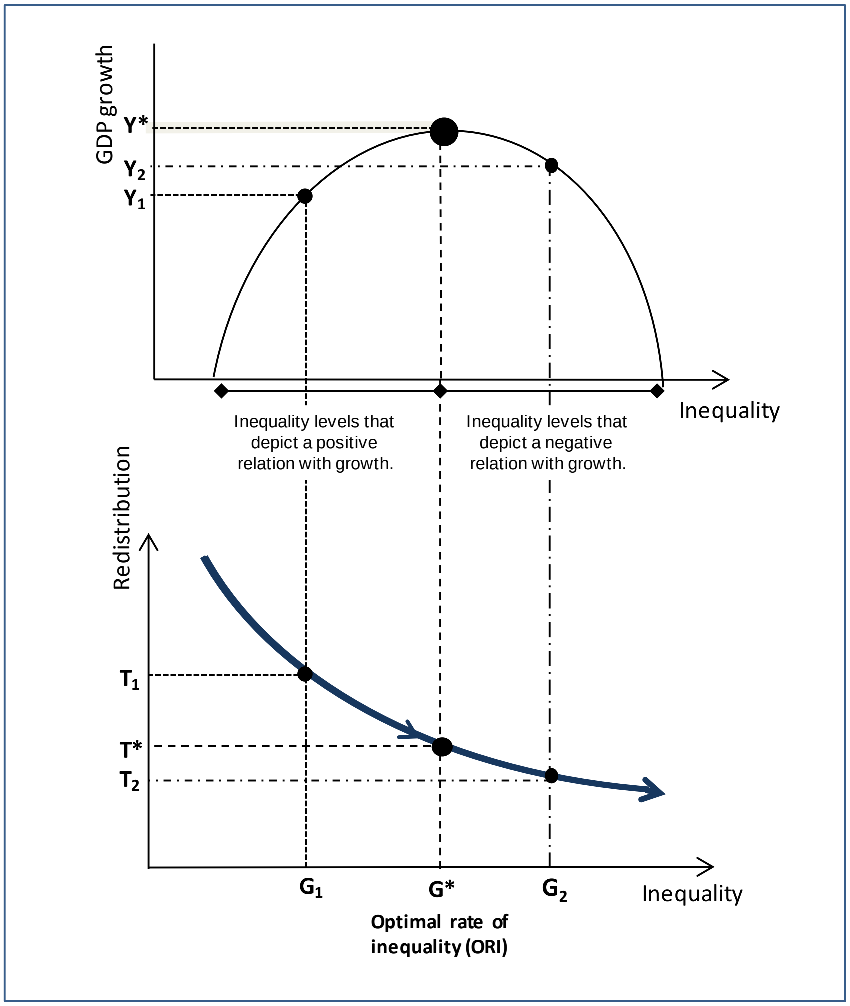
In this economy there is a tradeoff between the negative effects of high inequality (and low redistribution) and the negative effects of too much redistribution (and high taxation), on economic performance. High levels of inequality affect directly and indirectly the determinants of economic growth through its effects on investment, human capital, fertility and other variables that distort the potential of the economy. On the opposite side, high levels of redistribution, and the associated high levels of taxation, also affect economic growth[5] by discouraging economic agents to pursue productive activities, by limiting the accumulation of productive capital, by restraining investment due to elevated taxation and by "preventing individuals from the appropriation of the returns of their productive activities" Persson and Tabellini (1994).

[5] Castelló-Climent (2001) shows that the relationship between taxes on capital and growth rates behave as an inverted U, initially, capital taxation incentivizes growth, but after a certain level it starts generating negative effects over growth.

The economy tends to the concentration of income and higher levels of inequality (Sen, 1992). In this sense, constant redistribution is needed in order to maintain or reduce the levels of inequality in the economy. The previous arguments derive into three possible scenarios:

- An economy with high levels of inequality and low redistribution that affect negatively the growth rate (y^2 in upper part of Figure 1).
- An economy with low levels of inequality and high redistribution and taxation that affect negatively the growth rate (y^1 in upper part of Figure 1).
- An economy with a level of inequality and redistribution in which both effects (the negative of high inequality and the negative of high redistribution) are minimized and the economic performance is released from any distortion to its growth potential. We will call this the optimal rate of inequality (ORI). At this level, the growth rate of the economy will be maximized in comparison to any other inequality level (y* in upper part of Figure 1).

Fig. 1 The optimal rate of inequality and the relationship between redistribution, inequality and growth



At the optimal rate of inequality, any change in the level of redistribution and inequality, positive or negative, will lead to a lower rate of economic growth. Nevertheless, lowering inequality will result in a positive relationship between inequality and growth as it will mean that in order to increase the growth rate to its maximum (and return it to the ORI) more inequality, and less redistribution/taxation which is the one affecting growth, will be needed.

Accordingly, if a country is at the ORI and inequality levels rise, the relationship between inequality and growth will turn negative, meaning that in order to maximize the growth rate, a reduction in the level of inequality (a rise in redistribution) will be needed. Hence, when a country reaches the ORI (the maximum in the kinked relationship) the correlation between inequality and growth will become insignificant. The intensity of the relationship between inequality and growth, in any direction, will be indicative of the distance of the current level of inequality from the ORI, the farther away from it, the stronger the relationship.

It is important to point out that this model does not explain how much will the economy grow at different levels of inequality. That is the job of conventional growth models. What it shows is that, *ceteris paribus*, there are certain levels of inequality that affect negatively the growth determinants in the economy and that there is a level of inequality that does not, releasing the growth determinants from any distortion from inequality or redistribution and maximizing the growth rate.

Marginal efficiency of redistribution

In this model, redistribution is defined ambiguously as the process of gathering resources (taxation) and allocating them at the lowest brackets of income (redistributive expenditure). This means that the decisions of lowering or increasing income inequality are affected both by the efficiency of the tax revenue system and of the redistributive expenditure programs.

A more efficient redistributive system, in which resources are effectively allocated to the lowest brackets of income in the way of monetary and in kind transfers, access to education, health and other determinants of income homogeneity, will result in a higher MER. A higher elasticity in the effects on inequality levels, as a response to a change on redistribution, graphically represented as a steeper curve. As an economy increases the MER, it will be easier to reach the optimal rate of inequality because less redistributive effort will be necessary to achieve significant changes in the level of income inequality (see lower part of Figure 1).

The other determinant of the slope of the relationship between inequality and redistribution is the level of development of the distributive system on the revenue side. A country with a developed tax system in which the principles of vertical and horizontal justice are fulfilled[6], where evasion has been minimized, and informal economy is limited, will tend to have more efficient redistributive programs. Additionally, for each level of redistribution there will be a

[6] Broadly speaking, vertical justice in the context of taxation means that different incomes pay progressively different taxes. Horizontal justice means that individuals in a same income level should pay the same amount of taxes.

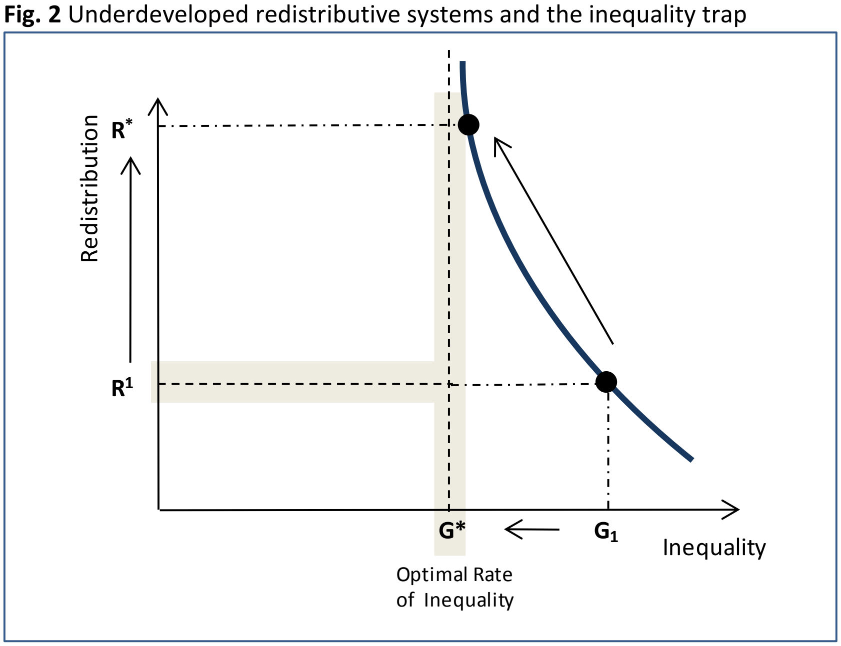
lower associated level of inequality in comparison to a country with a less developed tax system.

Empirically, the arguments presented before can explain why different countries have different levels of inequality at similar levels of redistribution, why some countries with similar levels of inequality have different levels of redistribution, as well as why some countries have to apply more intense redistributive policies in order to reduce inequality.

The inequality trap

Consider a worst case scenario in which there is a country with a very low marginal efficiency of redistribution and a highly underdeveloped tax system. This country is characterized by having low tax revenue due to high evasion and a large informal sector in the economy. Additionally, the redistributive system is highly inefficient; the resources are poorly allocated and any redistributive effort yields very low effects on the levels of income inequality. Consequently, this country sustains high levels of income inequality that distort the determinants of economic growth and limit the potential of the economy (See Figure 2).

Fig. 2 Underdeveloped redistributive systems and the inequality trap



Given these circumstances, this country would find itself facing an inequality trap in which any effort to reach the ORI would be insufficient. The level of redistribution needed in order to reach the optimum will be too high to achieve and it would mean additional distortion to the economy[7].

Any country that finds itself in this situation will not be able to reach the ORI with a distributive strategy. In order to achieve the desired level of income inequality, first it would be necessary to develop the conditions for a higher marginal efficiency of redistribution and a more developed tax revenue system. Achieving this will result in lower levels of inequality with the same or even inferior levels of taxation and redistribution.

A practical implication of this example is that a country determined to reach the ORI should be aware that increasing redistribution is not the only way to reach the desired level of inequality and economic growth. The first strategy for lowering income inequality should be to make sure that the redistributive system (both on the revenue as in the redistributive expenditure side) is fully developed, this will automatically generate a reduction in the level of income inequality as the value relation between redistribution and growth will decrease automatically, as well as better results in further lowering the levels of income inequality and approaching them to the ORI.

Empirical evidence

The following section addresses empirically the main propositions of this paper, namely:

- The existence of a nonlinear relationship between inequality and growth, with a negative relationship at high levels of inequality that attenuates as inequality is reduced, until it turns positive at low levels of inequality.
- The existence of a level of inequality that maximizes the growth rate of the economy.

Data

Inequality data measured by the GINI coefficient is similar to the one used by Barro (2008), which was compiled from the United Nations World Income Inequality Database (WIID) and complemented by additional high quality observations from the Deininger & Squire database. The original data before filtering covered 138 countries for the period 1960 – 2000 with a total of 595 observations. At the end, the availability and correspondence of data for inequality and the dependant variable resulted in a sample of 112 countries with at least one combination of observations. Four additional ex-communist economies were excluded, leaving a total of 108 countries.

The dependant variable was obtained from the Penn World Table mark 6.3 and is expressed in international 2005 prices (see Table 1). The variable was calculated as the average growth rate of per capita GDP for each decade; the four periods (70, 80, 90 and 2000) were calculated averaging the values around each of the four period years so for the 1970`s the values from the

[7] In this example it would mean extremely high tax rates to the few contributors who pay. This elevated taxation could be interpreted as incentives to evade or to disengage from productive activities, resulting in even less revenue for the government.

years 1965 to 1975 were averaged, and so on for the following periods. The data for initial GDP per capita and the investment ratio were calculated from the Penn World Table 6.3.

Total fertility rate (TFR) was compiled from the Barro and Lee (1993) dataset for the period 1960 -1985 in five year intervals and complemented with information from the United Nations data system (UNdata) for the years 1990 and 2000. Life expectancy at birth was also extracted from the Barro and Lee (1993) dataset but complemented by information from the World Bank world databank. The sum of secondary and tertiary total school attainment was obtained from the new Barro and Lee (2010) dataset on educational attainment.

Finally, tax revenue expressed as percentage of GDP was obtained in order to use as proxy for discriminating between countries with developed and underdeveloped tax revenue systems. The model specification is of the following type:

$$\Delta Y = \beta_1 + \beta_2 \mathrm{Gini}_i + \beta_i \mathrm{Gini}_i^2 + \beta_i X_i + \varepsilon$$

Table 1. Descriptive statistics of main variables

	Definition	Source	Year	Mean	Max.	Min.	Std. Dev.	Obs.
Investment Ratio	Ratio of real domestic investment (private pus public) to real GDP	Barro & Lee[a]	1960	0.17	0.44	0.01	0.10	105
			1970	0.18	0.40	0.02	0.10	107
			1980	0.18	0.39	0.01	0.09	108
			1990	0.18	0.41	0.02	0.09	108
			2000	0.19	0.46	0.04	0.10	108
Inequality	Inequality measured by the GINI coefficient	Barro	1960	.4397	.6410	.1890	.1061	66
			1970	.4261	.6820	.2370	.988	74
			1980	.4110	.6370	.2240	.998	80
			1990	.4456	.7730	.2370	.1119	97
			2000	.4147	.5986	.2370	.1013	64
Redistribution	Ratio of education expenditure over GDP	Barro & Lee[a] / UNdata	1960-65	0.03	0.06	0.01	0.01	95
			1970-75	0.04	0.37	0.01	0.04	83
			1980-85	0.05	0.42	0.01	0.04	90
			1990-95	0.04	0.09	0.01	0.02	87
			2000-04	0.05	0.11	0.01	0.02	90
Fertility	Total Fertility Rate	Barro & Lee[a] / UNdata	1960	1.66	2.08	0.71	0.37	101
			1970	1.57	2.08	0.60	0.42	101
			1980	1.42	2.08	0.36	0.52	101
			1990	1.27	2.09	0.26	0.54	106
			2000	1.11	2.03	0.18	0.53	106
Income	Ln of real GDP per capita expressed in 2005 international prices	Penn W.T. Mark 6.3	1955	8.16	9.64	6.33	0.85	66
			1965	8.07	9.95	6.18	0.98	101
			1975	8.34	10.12	6.43	1.03	107
			1985	8.46	10.34	6.39	1.11	107
			1995	8.57	10.81	6.41	1.22	108
PPPI	Price level of investment. PPP of investment over exchange rate relative to the U.S.	Penn W.T. Mark 6.3	1970	69.05	362.99	13.79	51.41	107
			1980	112.55	1707.9	19.96	169.19	107
			1990	81.66	472.55	16.35	62.02	108
			2000	64.58	315.65	19.08	39.95	108
Education	Sum of secondary	Barro &	1965	0.88	4.57	0.00	0.92	100

	plus tertiary total school attainment	Lee[b]	1975	1.32	5.82	0.03	1.16	100
			1985	1.86	6.25	0.07	1.31	100
			1995	2.40	6.38	0.10	1.50	100
			2000	2.62	7.07	0.12	1.58	100
GDP Growth	Average GDP per capita growth expressed in 2005 international prices	Penn W.T. Mark 6.3	1960	2.68	15.67	-4.95	3.00	101
			1970	2.79	14.78	-7.13	2.59	107
			1980	1.26	7.14	-4.91	2.44	107
			1990	1.44	8.03	-6.53	2.29	108
			2000	1.89	7.55	-5.47	1.99	108

Results

Table 2 reports the results of an initial set of estimations via the Seemingly Unrelated Regression methodology where the Gini and its square value as well as other explanatory variables[8] were included.

Equation 1 demonstrates the fact that the majority of the observations and correspondence between inequality and growth data of the complete sample are located on the negative range of the relationship. In this general case, a 5% decrease in the Gini coefficient would raise the GDP per capita growth rate in 1.3%.

Equations 2 to 4 test for the non-linearity between inequality and growth by incorporating the square value of the Gini coefficient. The estimation results show that the coefficients for both variables are significant, especially when introducing the Latin American dummy. The sign of the Gini coefficient is positive, while the square Gini is negative, demonstrating the fact that at low levels of inequality (lower than the ORI) the relationship is positive, and at high levels of inequality, the relationship is negative. The level of inequality at which the relationship changes, is at an approximate Gini value of 0.39. At this level, the economy grows higher than at any other level. These results verify the existence of an optimal rate of inequality, at which the economy is released from any distortion from either high inequality or high taxation/redistribution (and low inequality).

As expected, the reciprocal of life expectancy at birth as well as the religion dummies (Catholic, Protestant and Muslim) show a negative effect on growth rates. Equation 4 includes the price level of investment as a measure of price distortions in the economy, this variable appeared to account for some of the effects previously captured by the religion dummies and the reciprocal of life expectancy, while increasing the effects of both Gini and Gini^2.

Equation 5 adds an interaction term between inequality measured by the Gini coefficient and redistribution in order to further validate the non-linearity of the relationship between inequality and growth. The results confirmed that at low levels of redistribution the relationship between inequality and growth is negative, but as redistribution increases, and inequality decreases, this relationship will attenuate and will eventually turn positive when reaching a level of redistribution equivalent to approximately 11% of GDP.

[8] The variables included in the system had the objective of giving more explanatory power to the overall equation while trying to achieve non-endogeneity and low correlation with the Gini coefficient.

Table 2. Inequality and growth relationship (SUR estimation)

Variables / Equations	1	2	3	4	5
Gini	**-0.022**	**0.10**	**0.13**	**0.15**	**-0.03**
	(0.036)	(0.109)	(0.05)	(0.0200)	(0.0283)
Gini^2		**-0.001**	**-0.0016**	**-0.002**	
		(0.049)	(0.026)	(0.012)	
Latin American dummy			**-0.67**	**-0.8**	
			(0.0448)	(0.0169)	
1/life expectancy at birth	**-194.12**	**-182.61**	**-189.87**	**-162.41**	**-140.56**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0017)
Catholic dummy	**-1.67**	**-1.59**	**-1.14**	**-0.97**	
	(0.0000)	(0.0000)	(0.009)	(0.0289)	
Protestant dummy	**-2.45**	**-2.27**	**-2.16**	**-1.71**	
	(0.0000)	(0.0001)	(0.0001)	(0.0027)	
Muslim dummy	**-1.03**	**-1.05**	**-1.06**	**-1.02**	
	(0.0164)	(0.0139)	(0.012)	(0.0141)	
PPPI				**-0.007**	
				(0.0039)	
Gini x Redistribution					**0.39**
					(0.0359)
Intercepts	8.4, 6.7, 6.8, 7.1	5.6, 3.9, 4.0, 4.3	5.0, 3.2, 3.4, 3.7	4.6, 2.9, 3.06, 3.4	5.9, 4.2, 4.5, 4.8
Number of Observations	63, 69, 76, 92	63, 69, 76, 92	63, 69, 76, 92	59, 67, 74, 91	42, 39, 51, 69
R-squared	0.3, 0.20, 0.25, 0.01	0.3, 0.18, 0.24, 0.07	0.27, 0.17, 0.27, 0.08	0.33, 0.18, 0.30, 0.08	0.15, 0.1, 0.1, 0.13

Independent variable is average GDP growth for each 10 year period (70s,80s, 90s, and 00s). Estimation made by the Seemingly Unrelated Regression technique. Explanatory variables are: Gini, Square Gini, Latin American dummy, the reciprocal of life expectancy at birth, three religion dummies that equals one if the majority of the population profess either Catholic, Protestant or Muslim religion, and the price level of investment (PPPI). Intercepts from equations 1-4 are significant at the 1 and 5 percent, the remaining are significant to the 1 percent.

An additional set of systems were estimated via 3SLS based on Barro (2008) in which economic indicators were included as explanatory variables. The three stage least squares (3SLS) estimator, proposed by Zellner and Theil (1962), considers the specific error term as random and provides asymptotical efficient estimations that come from exploiting nonzero cross equation covariation.[9]

The results are reported in Table 3. The systems incorporate typical explanatory variables employed in standard growth models such as the log of per capita GDP and the investment ratio. These level variables resulted in all cases as expected, the first one with a negative coefficient that confirm conditional convergence and the second one with a positive and significant one depicting the contribution of investment to GDP growth.

Equations 1 and 2 of Table 3 test for the overall effects of inequality over growth. The results are consistent with the ones in Equation 1 of Table 2. In this case, lowering inequality from a Gini level of 0.40 to 0.39 would increase the GDP per capita growth rate in 1.73%. This result

[9] See Belsley (1988) for an analysis of the advantages and disadvantages of this econometric methodology.

and the fact that the average Gini for the four decades is .43 demonstrate once again the fact that the sample as a whole is located predominantly in the negative spectrum of the relationship between inequality and growth.

Equations 3 to 6 report the results of testing for the non-linearity of the relationship between inequality and growth. In all cases, a positive sign for the Gini coefficient and a negative one for its square value were found. As in the SUR estimation, Gini value of 0.39 is the breakpoint where the growth rate is maximized and where the sign of the relationship changes from a positive one to a negative (see Figure 3). Equation 4 incorporates a dummy that accounts for the level of development of the tax system, as well as a dummy for Latin America in order to control for the effects of a tendency for some Latin American countries of having high inequality combined with high growth rates. Both variables turned to be statistically insignificant, nevertheless, when the price level of investment is included in Equation 5, the Latin American dummy turns statistically significant with a negative sign. Price distortions seem to capture whatever was making the L.A. dummy statistically insignificant.

Table 3. Inequality and growth relationship (3SLS estimation)

Variables / Equations	**1**	**2**	**3**	**4**	**5**	**6**	**7***
Gini	**-0.04**	**-0.02**	**0.22**	**0.23**	**0.23**	**0.022**	**-0.06**
	(0.0341	(0.0502)	(0.0076)	(0.0045)	(0.0044)	(0.0074)	(0.003)
Gini^2			**-0.002**	**-0.003**	**-0.003**	**-0.003**	
			(0.003)	(0.0022)	(0.002)	(0.0023)	
Log(per capita GDP)	**-1.56**	**-1.48**	**-1.19**	**-1.39**	**-1.002**	**-1.11**	**-1.68**
	(0.0000	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
Log(Total fertility rate)	**-1.67**	**-1.51**	**-1.61**	**-1.59**	**-1.27**	**-1.5**	**-2.07**
	(0.0253	(0.0153)	(0.0151)	(0.0179)	(0.0515)	(0.0212)	(0.0062)
1 / life expectancy at birth	**-166.11**	**-153.32**	**-89.58**	**-88.4**	**-108.5**	**-70.76**	
	(0.0736)	(0.0183)	(0.1618)	(0.2087)	(0.1086)	(0.2889)	
Investment ratio	**7.89**	**4.46**	**6.12**	**8.52**	**5.78**	**6.63**	**9.37**
	(0.0023)	(0.0419)	(0.0038)	(0.0001)	(0.0043)	(0.0013)	(0.0017)
Political instability variable	**0.0086**	**0.01**					**0.007**
	(0.0015)	(0.0005)					(0.0092)
PPPI (Price level of investment)		**0.001**			**-0.005**	**-0.002**	
		(0.3748)			(0.1993)	(0.5218)	
Secondary and tertiary school attainment		**0.12**					
		(0.3748)					
Dummy: developed tax revenue system				**0.19**			
				(0.4231)			
Dummy: Latin America				**-0.28**	**-0.64**		
				(0.3241)	(0.0181)		
Gini x Redistribution							**0.52**
							(0.006)
Intercepts	21.1,19.6 19.8,19.8	19.8,18.3 18.1,18.0	11.4,10.1 , 9.9,10.1	12.2,10.8 10.9,10.9	9.8,8.5, 8.4,8.5	10.4,9.1, 9.0,9.1	18.34,18. 6, 18.76
Number of Observations	28,53,47, 49	46,61,66, 82	46,62,69, 87	45,58,65, 82	46,62,69, 87	46,62,69, 87	44,39,40
R-squared	0.25,0.47 0.57,0.05	0.21,0.4, 0.38,0.03	0.25,0.32 , 0.3,0.1	0.23,0.41 0.31,0.14	0.27,0.3, 0.33,0.1	0.28,0.31 0.29,0.11	0.53,0.53 , 0.16

Independent variable is average GDP growth for each 10 year period (70s, 80s, 90s, and 00s). Estimation made via three stages least squares (3SLS). Explanatory variables are: Gini and Squared Gini corresponding to the prior period in relation to the growth rate period (i.e. for the growth period of 1970 corresponds the Gini value of 1960); the log of per capita GDP and the sum of secondary plus tertiary school attainment are expressed in values for the initial year; the log of the total fertility rate and the reciprocal of life expectancy at birth, both expressed in values for the years 1970, 80, 90 and 2000; the value for the investment ratio, the price level of investment (PPPI) and the variable that proxies political instability by measuring Battle-related deaths are expressed as the average for each decade; a dummy that equals one if the country has a developed tax revenue system; a Latin American dummy and finally an interaction term that multiplies the Gini times the redistribution value for the period corresponding to each of the estimated growth period.

The instruments are: the value of the initial year of the period for the price level of investment; the value of the prior period for the log of the total fertility rate, the investment ratio and the log of the initial GDP per capita. For the other variables, instruments coincide with the explanatory variable.

* Initial period (70`s) was removed from equation due to data unavailability.

Lastly, Equation 7 includes the interaction term between inequality and growth (Gini x Redistribution). Once again it was verified the fact that as redistribution increases, the relationship turns from being initially negative to positive, in this case, when reaching a level of redistribution equivalent to approximately 5.8% of GDP. This value is considerably lower than the one obtained in the SUR estimation, perhaps because Equation 5 of Table 2 did not include economic variables which could capture a portion of the effects of redistribution on inequality and ultimately on growth.

Fig. 3 The non-linearity in the effect of inequality over growth, the optimal rate of inequality and the level of redistribution necessary to reach it.

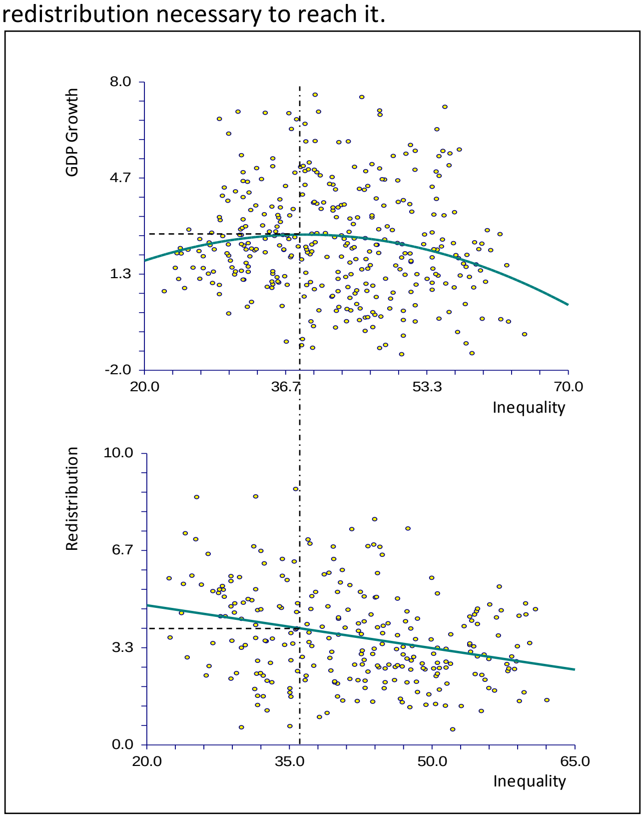


Table 4 reports the results of a set of dynamic panel models estimated via system GMM. This methodology has been proposed to be one of the most reliable estimation techniques by some relevant studies of the inequality-growth relationship (Castelló-Climent, 2004; Castelló-Climent, 2010; Voitchovsky, 2005, among others). The reason is that such methodology, developed by Arellano and Bover (1995) and Blundell and Bond (1998), improves the also well-known first-difference GMM estimation, developed by Arellano and Bond (1991) and provides a better estimation by exploiting more efficiently the variation in the data as well as the time series information. The technique consists in estimating a system of equations in first differences, with lagged explanatory variables as instruments, and including the original equation in levels.

The validity of the system GMM is tested by confirming the absence of second order serial correlation, as well as with the tests of over identifying restrictions of Sargan (1958) and Hansen (1982). Additionally, with the difference Hansen test for the validity of the additional moment conditions for the level equation.

A series of growth equations similar to those in the 3SLS estimations were performed. All equations confirm the kinked nonlinear relationship between inequality and growth; in this case, the breakpoint level of inequality is reached at a Gini level of 0.40, differing only by one point with the previous estimations via SUR and 3SLS. In equations 1, 2 and 4 these variables result less significant, the Gini to the 5% and its squared value to the 10%, without an evident reason, unless school attainment affected the Gini coefficients in equations 2 and 4 and life expectancy did as well in equations 1 and 2. There could be some theoretical arguments supporting this, as they are proxies of human capital, which has been proposed to be part of the transmission channel by which inequality affects growth. In all equations the log of the total fertility rate depicts the expected negative and statistically significant coefficient, reflecting the deflating effects on GDP growth of a bigger population. Equations 1, 3 and 5 include the investment ratio, which even though results with the expected positive sign, it never achieves statistical significance.

As in the 3SLS estimations, the reciprocal of life expectancy and secondary and tertiary school attainment come out statistically insignificant, nevertheless, in the case of education, when including an alternative measure in the form of male secondary school enrollment in equations 5 and 6, this new variable comes out positive and statistically significant to the 1%. Speculating a bit, one might argue that the reason for this difference of results could come from the fact that male/female school attainment captures the inequalities of access to education for women in some countries, which can be growth detrimental.

Equation 5 performs better in general, but specifically in the inequality variables, the additional feature, apart from the shift in the school variable, is that it was estimated with two lags in the instruments of the equation, correcting somewhat more the endogeneity of the specification. Finally, equation 6 presents the most reliable equation, with all variables statistically significant, including life expectancy (although to the 10%).

All equations confirm the absence of second order serial correlation, AR(2), and favorable results for both Hansen's tests of overidentifying restrictions and the test for the validity of the additional moment conditions for the level equation.

Table 4. Inequality and growth relationship (System GMM)

Variables / Equations	1	2	3	4	5*	6
Intercept	**20.9**	**16.50**	**15.50**	**17.00**	**16.95**	**17.72**
	(0.0020)	(0.0050)	(0.0080)	(0.0020)	(0.0000)	(0.0010)
Inequality	**0.31**	**0.35**	**0.40**	**0.34**	**0.40**	**0.32**
	(0.049)	(0.0430)	(0.01)	(0.052)	(0.001)	(0.008)
Inequality^2	**-0.003**	**-0.003**	**-0.004**	**-0.003**	**-0.004**	**-0.004**
	(0.0700)	(0.0790)	(0.0200)	(0.0820)	(0.0020)	(0.0110)
Ln (per capita GDP)	**-2.06**	**-2.07**	**-2.11**	**-2.04**	**-2.36**	**-2.12**
	(0.0010)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Investment ratio	**1.27**		**2.28**		**4.30**	
	(0.7340)		(0.544)		(0.158)	
Ln (Total fertility rate)	**-4.71**	**-5.05**	**-4.73**	**-5.00**	**-4.43**	**-2.69**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Secondary and tertiary school attainment		**0.37**	**0.40**	**0.30**		
		(0.1870)	(0.1580)	(0.2810)		
Life expectancy	**-169.96**	**17.61**				**-193.47**
	(0.2040)	(0.886)				(0.088)
Male secondary school enrollment					**2.86**	**3.45**
					(0.001)	(0.0000)
AR(2) test	0.771	0.998	0.952	0.936	0.614	0.781
Hansen J test	0.25	0.554	0.525	0.388	0.603	0.708
Diff Hansen	0.89	0.99	0.985	0.974	0.729	0.88
Wald Chi2	65.49	80.85	64.72	64.03	73.07	88.49
Prob. Chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Independent variable is average yearly per capita GDP growth for the period 1960 -2000. Estimations are made by system GMM. Explanatory variables are: Gini and Squared Gini corresponding to the prior period in relation to the growth rate period (i.e. for the growth period of 1970 corresponds the Gini value of 1960); the log of per capita GDP and the sum of secondary plus tertiary school attainment, as well as the male secondary enrollment rate are expressed in values for the initial year; the log of the total fertility rate and the reciprocal of life expectancy at birth, both expressed in values for the years 1970, 80, 90 and 2000; the value for the investment ratio. The instruments correspond with the explanatory variables and are expressed, according to the methodology, in levels and differences.

* Instruments lagged two periods

Discussion

This paper suggests that there could be a fundamental weakness in the way the debate over the relationship between inequality and growth has been developed, and proposes a reformulation of the initial question it is trying to answer: *Is inequality harmful of beneficial for growth?,* as an initial step for reaching a generalized solution. This reformulation would lead to establishing new research questions: *should we expect inequality to exert any single effect over economic performance? Is it acceptable to expect every level of inequality to affect growth in* *the same manner?*, these and other questions, that take us back to the starting point of a new inequality-growth debate.

The main proposition of this study is that the level of inequality is the one determining the sign of the relationship. At low levels of inequality the relationship is positive and, as inequality increases, the sign of the relationship changes to a negative effect of inequality over growth. Additionally, the model developed above proves the existence of an *Optimal Rate of Inequality* (ORI) in which growth is optimized and the economy is liberated from the negative effects of high inequality or high taxation/redistribution.

The results of the empirical study provide cross country evidence and confirmed the validity of the model. Countries with inequality levels below a Gini index of inequality of 0.39 depict a positive relationship in their inequality and growth relationship. Accordingly, economies with income inequality above that level have a negative relationship with growth, meaning that more inequality affects negatively the growth performance of the economy. The overall relationship turned to be negative, consistently with other studies that employed similar datasets, as the result of having the majority of the observations in the negative range of the relationship. These results also evidence the existence of an ORI, situated at the breakpoint inequality level of 0.39, in which growth rates are maximized, in relation to the negative effects of different inequality levels.

The policy implications are clear, *inequality does matter for growth*. The objective for a country should be to identify and reach the level of inequality that maximizes growth. Policy makers who intend to develop the conditions for enhanced economic growth should take into account the prevailing income inequality levels.

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