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Inequality and growth in the context of the Mexican economy: Does inequality matter for growth?*

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Abstract

This paper contributes to the debate over the relationship between inequality and inclusive growth by testing the proposition of a kinked-non linear relationship between income inequality and economic growth in a country specific context. The proposition is first confirmed with a wide panel dataset of 138 countries, using the Kuznets hypothesis as a vehicle of validation. Then, the non linearity is contrasted for the Mexican economy using a highly disaggregated dataset at the municipal level. An inverted "U" shaped relationship is demonstrated, showing that low levels of inequality exert a positive correlation with economic growth, while high levels have a negative one. Additionally, and more importantly, it is demonstrated the existence of an optimal rate of inequality (ORI) that maximizes growth rates and releases the economy from any distortion generated by elevated inequality or taxation. It is confirmed that inequality does matter for growth, governments that wish to promote economic growth should incorporate redistributive policies not only as a part of the social agenda but as an important element of the growth strategy.

Keywords: Inequality, Growth, Redistribution, Optimal Rate of Inequality.

JEL Classification: O15, D31, D33, E25.

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Introduction

While most of the debate over the relationship between income inequality and economic growth during the largest part of the last century was focused on the effects of growth and development over inequality levels, the last two decades have seen the development of a new debate oriented to understand the other side of the relationship, namely the effects that income inequality might have over economic growth. Perhaps the enormous disparities between countries, or the inconsistencies found with the expected inequality among countries and their level of development have motivated this new approach in an effort to better understand this phenomenon.

The results of this series of studies have not yet come to converge into one generalized position over the sign of the inequality-growth relationship. Furthermore, the remarkable disparities in the results, both in theoretical and empirical studies, have derived into a complex debate, with four main positions: the studies which affirm a positive relationship (Partridge, 1997; Li and Zou, 1998; Forbes, 2000; Nahum, 2005), a negative one (Perotti, 1993; Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Clarke, 1995; Alesina and Perotti, 1996; Ahituv and Moav, 2003; De la Croix and Doepke, 2003; Josten, 2003; Viaene and Zilcha, 2003; Castelló-Climent, 2004; Josten, 2004; Knowles, 2005; Davis, 2007; Pede et al., 2009). The ones that suggest a sign changing non linear relationship (Barro, 2000; Banerjee and Duflo, 2003; Pagano, 2004; Voitchovsky, 2005; Bengoa and Sanchez-Robles, 2005; Barro, 2008; Castelló-Climent, 2010). And an additional group who find no correlation at all or find inconclusive evidence of one (Lee and Roemer, 1998; Panizza, 2002; Castelló and Domenech, 2002). In addition, the different positions have also generated different methodological and conceptual approaches that try to explain both, the mechanisms by which the relationship works as well as the reasons why other studies have not reached the same conclusions.

Unfortunately, the discrepancies in the literature are evidence of this debate to be far from moving towards to convergence. The following are some of the arguments proposed by some authors to explain the reasons for this divergence of results:

a. Ehrhart (2009)
   - Omitted variables in the regression specification may result in different results
   - Sensibility to the inclusion of regional dummies may change the sign of the relationship.
   - Low quality data or non comparability due to differences in the calculation methods could potentially affect results.

b. Knowles (2005)
   - Inconsistency in the data distorts the results.

c. García-Peñalosa and Turnovsky (2006)
   - Endogeneity of both variables which may result in ambiguous results due to movements in their common determinants.

d. García-Peñalosa (2008)

- Inequality affects most growth determinants (human capital, physical capital, technology, labor, etc.) so "anything goes".

e. Garbis (2005)
- The time horizon is determinant in the sign of the relationship.

f. Lee and Roemer (1998)
- Different assumptions in the model may provide different outcomes. In their model, the assumption that private investment is more efficient than public investment results in a negative effect of inequality on growth. The opposite effect results from assuming public investment to be more efficient than private investment.

g. De Dominicis et al. (2008)
- Estimation methods:
  - Controlling for fixed effects and estimating via GMM report higher coefficients.
  - Controlling for fixed effects or incorporating regional dummies reduces the negative impact of inequality over growth in cross section datasets.
  - Controlling for fixed effects or including regional dummies emphasizes the positive effect in pooled datasets.
  - As the length of the growth period gets bigger, the coefficient decreases.
- Data quality
  - If the quality of the data is low, the magnitude of the effect is also lower (regardless of the sign) in comparison to high quality data.
- Sample coverage

These arguments lead to believe that the relationship between income inequality and economic growth may still be far from being understood. The very existence of a debate with three contrasting views (positive, negative and non-linear) might strengthen that idea even more. It seems that a general consensus may be distant from being reached and, even though the non linear propositions could act as a conciliatory argument, a complete framework for understanding both the causal relationship as well as the embedded mechanisms by which the relationship takes place is still missing.

Perhaps a reformulation of the initial question might be the starting point for reaching a generalized solution; 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 may lead to a new approach for this interesting and most relevant topic. This paper proposes and explores a new framework for understanding the complex relationship between income inequality and economic growth.

Consider an economy in which there is a tradeoff between the negative effects of too much redistribution (and high taxation) and the negative effects of high inequality (and low redistribution) on economic growth. High levels of inequality affect directly and indirectly the determinants of 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 growth1 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).

The previous arguments derive into three possible scenarios, the first with an economy with high levels of inequality and low redistribution that affect negatively the growth rate; an economy with low levels of inequality and high redistribution and taxation that affect negatively the growth rate, and finally; An economy with a level of inequality and redistribution in which both effects 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). Here the growth rate of the economy will be maximized in comparison to any other level of inequality.

At the ORI, any movement in the rates of redistribution and inequality, positive or negative, will lead to a lower rate of growth. However, if a country is at the ORI and its levels of inequality rise, the empirical 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.

Accordingly, 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. Hence when a country reaches the ORI (the maximum in the kinked relationship) the correlation between inequality and growth will become insignificant.

This paper provides a series of validity tests for the existence of the previously described kinked non-linear relationship between income inequality and economic growth that is positive at low levels of inequality but that changes sign as it is increased, as well as to the existence of a rate of inequality that maximizes growth in relation to the potentially distortive effects of high inequality or high taxation.

First validity test: The Kuznets curve

We first turn to an additional, and perhaps les orthodox, validation for the proposal of the existence of an optimal rate of inequality (ORI), in which growth rates are enhanced due to the absence of any distortion from either high inequality or high redistribution/taxation (low inequality). For this, a comprehensive panel dataset of 138 countries over 50 years (1955-2005) is used in order to validate the propositions.
This alternative test is meant to use the widely known and generally accepted Kuznets (1955) hypothesis as the vehicle for validating the hypothesis that countries will grow faster if they are at the ORI. The idea is quite straightforward; it first assumes that the Kuznets relationship between inequality and development is an empirical regularity; this relationship predicts that any country in its path to development would necessarily pass through a period of high inequality before they decrease when reaching high levels

[1] 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.

of development. If the Kuznets hypothesis is valid, then the implications of the model and the predictions of the Kuznets curve would allow proposing the following:

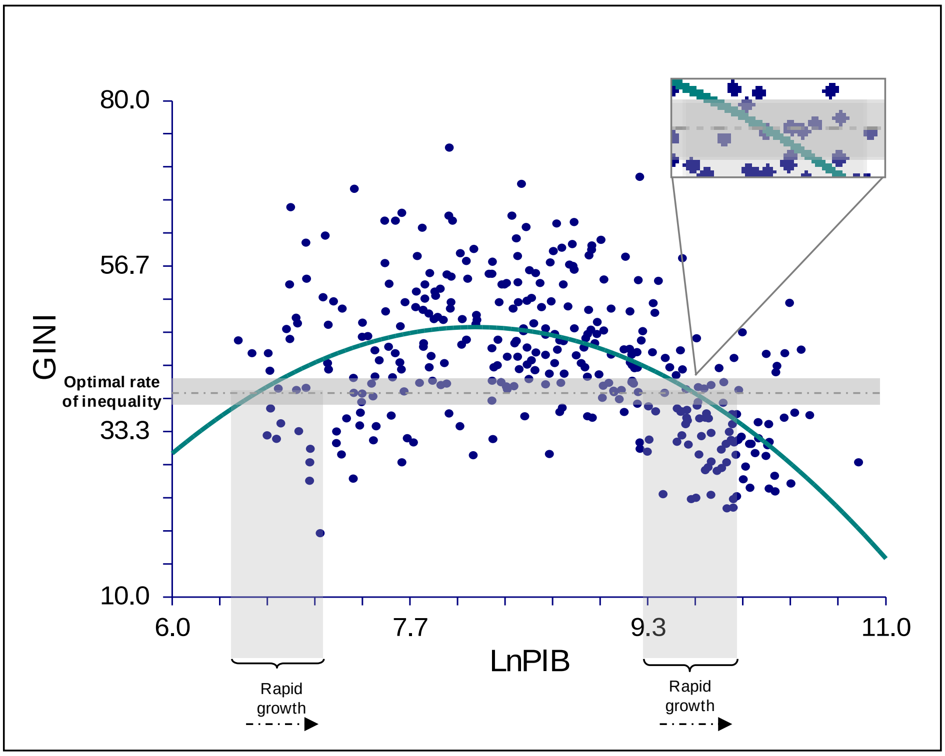
Proposition 1: A country in its path to development will grow faster when it passes through inequality levels within the optimal rate of inequality, during the transition predicted by the Kuznets inverted "U" hypothesis, both in the initial and the later stages of development.

The previous can be expressed in the context of a sample of countries depicting the Kuznets relationship:

Proposition 2: Within a set of countries that follow the Kuznets inverted "U" relationship, the ones with inequality levels at the ORI will grow faster than the rest, both in the initial as in the later stages of development.

The first step is to confirm the validity of the Kuznets relationship in the context of the available data set. Graphically it can be seen in Figure 1 that the inverted "U" predicted by Kuznets (1955) performs quite clearly in the tendency line depicted for the same dataset employed in the previous model estimations.

Figure 1. Validation of the ORI trough the Kuznets curve



Results

Table 1 presents the estimations for the Kuznets hypothesis. Following Barro (2000) an estimation via the Seemingly unrelated regression is performed with the value of the Gini coefficient as dependent variable and the log of the average per capita GDP and its square value as independent variables, along with others such as life expectancy, the total fertility rate as well as geographical dummies for Latin America and the Sub-Saharan Africa. The results confirm the Kuznets relationship in all cases, with a positive and statistically significant sign for the per capita GDP and a negative and also significant sign for its square value. This demonstrates the fact that at initial levels of development inequality will tend to grow in order to later be reduced after reaching a per capita income of around $3,700 UDS. Including the additional explanatory variables does not change the tendency and does not affect the sings or significance of the per capita GDP.

Table 1. The Kuznets relationship

Variables / Equations	1	2	3	4
Ln(p/c GDP)	**42.64**	**48.53**	**30.82**	**39.3**
	0.0000	0.0000	0.0002	0.0000
Ln(p/c GDP)^2	**-2.78**	**-3.07**	**-1.9**	**-2.33**
	0.0000	0.0000	0.0001	0
1/life expectancy at birth			**1022.87**	**634.4**
			0	0.0115
Log(Total fertility rate)				**6.84**
				0.0051
Dummy: Latin America			**9.71**	
			0.0000	
Dummy: Sub-Saharan Africa		**-142.96**		
		0.0000		
Intercepts	(117.3), (116.7), (113.3), (113.5)	(146.5), (146.1), (142.9), (142.9)	(102.0), (101.1), (97.1), (97.9)	(143.9), (142.6), (138.0), (137.0)
Number of Observations	71, 80, 96, 64	71, 80, 96, 64	69, 77, 93, 64	68,76,92,63
R-squared	0.30, 0.30, 0.31, 0.36	0.32, 0.33, 0.33, 0.33	0.46, 0.44, 0.38, 0.59	0.42, 0.37, 0.32, 0.35

Dependant variable: Inequality measured by the Gini coefficient; estimation made by Seemingly Unrelated Regression (SUR) technique. Independent variables are: the log of per capita GDP as well as its square value, Latin American dummy, sub-Saharan Africa dummy, the log of the total fertility rate and the reciprocal of life expectancy at birth.

Once the Kuznets curve has been proven as an empirical regularity, we can now continue with the empirical confirmation of the propositions stated previously. First, with simple statistical evidence, obtained from identifying the observations with optimal inequality levels from both sides (less developed and more developed) of the Kuznets curve, as well as the rest of the observations and calculating the average growth rate of the three groups of data. The result of this preliminary approximation is that the average per capita GDP growth rates for both sides of the curve are higher, with 2.63% for the low income group and 2.90% for the high income group. The average GDP per capita growth rate for the rest of the observations in the inverted “U” curve are of 2.06% percent.

Table 2 presents the results of two sets of estimations intended to test for proposition No. 2. The first set of (equations 1 to 3) develop growth regressions estimating via 3SLS and including the values of the Gini, its square value, as well as other variables standard for this type of growth models.

Table 2. Validation of the Optimal rate of inequality (ORI) through the Kuznets relationship

Variables / Equations	1	2	3	4*	5*	6*	7*
Gini	**0.16**	**0.19**	**0.17**				
	0.0500	0.0156	0.0371				
(Gini)^2	**-0.002**	**-0.002**	**-0.002**				
	0.0268	0.0074	0.0254				
Dummy: Optimal rate of inequality (ORI)	**0.71**	**0.74**	**0.67**				
	0.0090	0.0064	0.0139				
Dummy: ORI low PIB				**1.26**		**0.8**	
				0.0032		0.100	
Dummy: No ORI (rest of sample)					**-1.2**	**-1.01**	**-1.08**
					0.0001	0.0029	0.0159
Dummy: ORI high PIB				**1.06**			**0.31**
				0.0009			0.5301
1/life expectancy at birth	**-87.21**		**-132.86**				
	0.1649		0.0443				
Log(Total fertility rate)	**-1.54**	**-1.67**	**-1.3**				
	0.0157	0.0061	0.0427				
Investment ratio	**5.78**	**6.08**	**5.28**	**10.72**	**10.11**	**10.08**	**10.96**
	0.0052	0.0031	0.0099	0.0000	0.0000	0.0000	0.0000
Log(per capita GDP)	**-1.12**	**-0.99**	**-1.07**	**-0.64**	**-0.63**	**-0.58**	**-0.69**
	0.0000	0.0000	0.0000	0.0005	0.0007	0.0024	0.0001
Dummy: Latin America			**-0.53**				
			0.0413				
Intercepts	11.8, 10.4, 10.4, 10.5	8.71, 7.33, 7.33, 7.39	11.67, 10.26, 10.25, 10.32	6.02, 4.68, 5.03	7.26, 6.17, 6.31	6.65, 5.36, 5.63	7.49, 6.34, 6.63
Number of Observations	46, 62, 69, 87	46, 62, 69, 87	46,62,69, 87	44,61,73	47, 64, 73	45, 62, 73	45, 62, 72
R-squared	0.28, 0.37, 0.30, 0.09	0.25, 0.37, 0.29, 0.14	0.25,0.41, 0.32, 0.09	0.17, 0.42, 0.23	0.15, 0.38, 0.11	0.13, 0.43, 0.14	0.17, 0.41, 0.21

Independent variable is average GDP growth for each 10 year period (70s, 80s, 90s, and 00s). Estimation made by three stage 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); a dummy variable in which observations where the Gini coefficient is in the Optimal rate of inequality (around 0.39) have a value of 1; the log of per capita GDP; 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 is expressed as the average for each decade; a Latin American dummy; a dummy variable that takes the value of 1 for observations below the Kuznets breakpoint (around $3,700) with Gini around 39; a dummy that takes the value of 1 for observations above the Kuznets breakpoint; finally, a dummy that takes the value of 1 for observations whose value is not in the ORI in the whole sample. Probabilities for the T-statistics are shown in parenthesis.

The instruments are: 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.

* Final period (2000`s) was removed due to data unavailability.

The feature here is the addition of a dummy variable that assigns the value 1 to the observations, within the Kuznets curve, that have inequality levels in the ORI, in both ends of the curve[2] (see Figure 1). The results confirm that, regardless of in which end of

[2] Having confirmed the existence of the Kuznets relationship, we know there must be observations in with inequality in the ORI that are situated at the lower and higher income side of the curve.

the curve the observations are, they will have a positive relation with growth, even at the negative side of the curve. Still with the inclusion of the Latin American dummy (sometimes accounted for the positive effects of inequality on growth in those regions); the coefficients remain positive and statistically significant. The other level and control variables perform as expected; the reciprocal of life expectancy and the log of the total fertility have a negative coefficient, although the inclusion of the Latin American dummy appear to affect their significance. The investment ratio has a positive and significant coefficient, and the per capita GDP (level variable) as expected has a negative and significant sign, depicting the convergence phenomenon.

The second set of estimations (equations 4 to 7) try to further validate the proposition by now identifying separately the observations with inequality at the ORI in the low and high income ends of the Kuznets curve. For this, it was first identified the income level at which the break in the development-inequality relationship occurs in the inverted "U" curve, finding it to be at around $3,700 US dollars. With this information it was possible to generate a dummy variable that identifies only the observations with inequality at the ORI in the lower income side of the curve (below $3,700 US dollars) and another one for the ones at the higher income side of the curve (above $3,700 US dollars). Finally, a third dummy variable that captures the observations with inequality levels different from the ORI in the curve in order to use as control variable.

Equation 4 includes both the low and high income dummies and finds that they are both positive and statistically significant, while equation 5 includes the dummy for the non ORI observations and results with a negative and also significant coefficient. The important results comes from comparing both estimations, we can clearly see how the countries with inequality levels in the ORI have a positive influence on growth, while the ones with inequality levels different from the ORI have in fact a negative effect on growth rates, thus validating proposition No. 2.

Equations 6 and 7 compare separately each of the ORI dummies with the control non-ORI variable in order to further confirm this relationship. In the first estimation (Equation 6) it is found once again that the observations in ORI levels for the low income part of the Kuznets relationship are positively related to growth (although barely significant to the 10%), while the rest of the observations are negatively related. The last equation confirms the same for the high income side of the curve; nevertheless, here the dummy turns out statistically insignificant while the control non-ORI dummy remains negative and significant, perhaps because of the limited number of observations within the ORI in both sides of the curve. It is worth mentioning that when attempting to include all three dummies in one equation they perform quite poorly, this, is assumed to be the result of the fact that, together, the three dummies account for all the observations in the curve and for not having a control variable left out from the estimation.

Country specific study: the case of México

The following section is intended to provide an additional validity test to the model developed in this research, specifically, to the propositions of a kinked non-linear relationship between income inequality and economic growth that is positive at low levels of inequality but that changes sign as it is increased, as well as to the existence of a certain rate of inequality that maximizes growth in relation to the potentially distortive effects of high inequality or high taxation. This specific inequality level, at which the economy reaches the optimal rate of inequality (ORI), is expected to be subject to the particular context of the economy and its dynamics. This way, a country specific study can illustrate how in an economy there is a defined inequality level at which growth rates are optimized. Because of this, the ORI is not expected to correspond with the one found in the panel study.

The policy oriented attractive of this kind of tests is evident due to its potential for determining the direction and intensity that redistributive efforts should follow in a specific country. Additionally, the higher it is the geographical disaggregation of the data, the more reliable will be the diagnostic on the inequality-growth relationship. In this sense, the following country specific test on the Mexican economy, presents a detailed municipality level test for the inequality-growth relationship.

The evolution of income distribution in Mexico has been characterized (as in most Latin American countries) by persistent high levels of income inequality that have determined the socioeconomic structure of the country, with millions of persons living in poverty conditions, a scarce but growing medium income class and a minority of families that concentrate enormous amounts of wealth. Figure 2 depicts the overall inequality and growth trends for the Mexican economy over the period of 1955 to 2005. It is easy to see that inequality levels have not varied significantly in the last 55 years, with Gini coefficient values around .50 and growth rates that could appear to follow in some periods a tendency with the inequality trends. This is, in fact, improbable due to the well known lagged effects of inequality over growth.

Figure 2. Inequality and growth trends in Mexico (1950-2005)

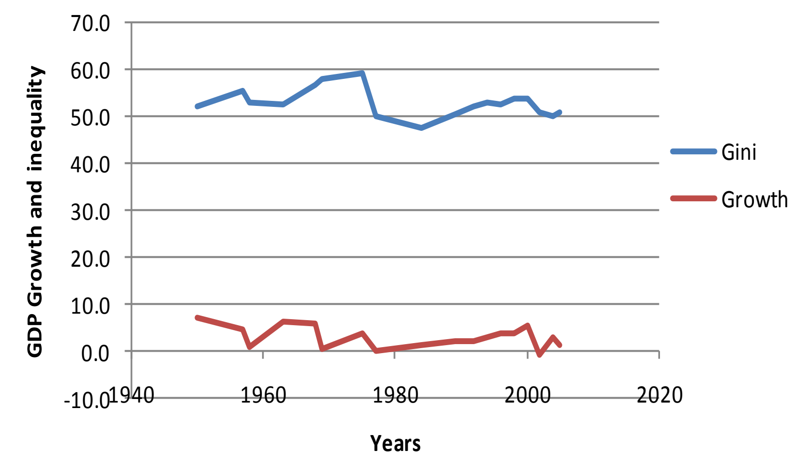
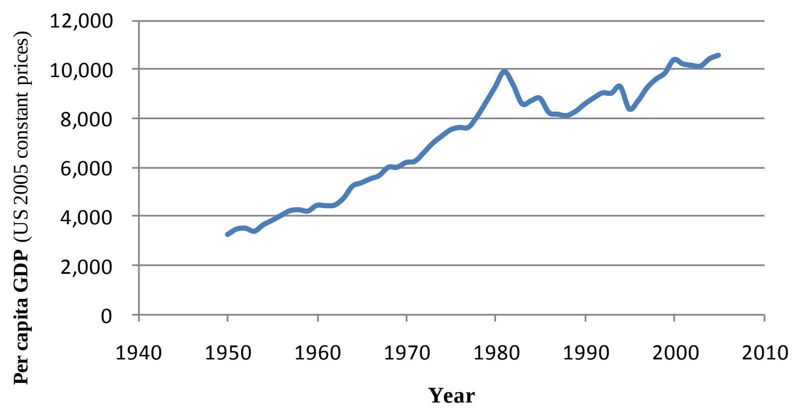


Figure 3 illustrates the evolution of the real GDP in the same period, showing how the economy has maintained a modest but steady growth path, reaching an average per capita income above the $10,000 dollars per year level. Notice negative breaks in growth trends around the years 1982 and 1995, corresponding to the economic crises faced on those periods.

Figure 3. Real per capita GDP of Mexico (1950-2005)



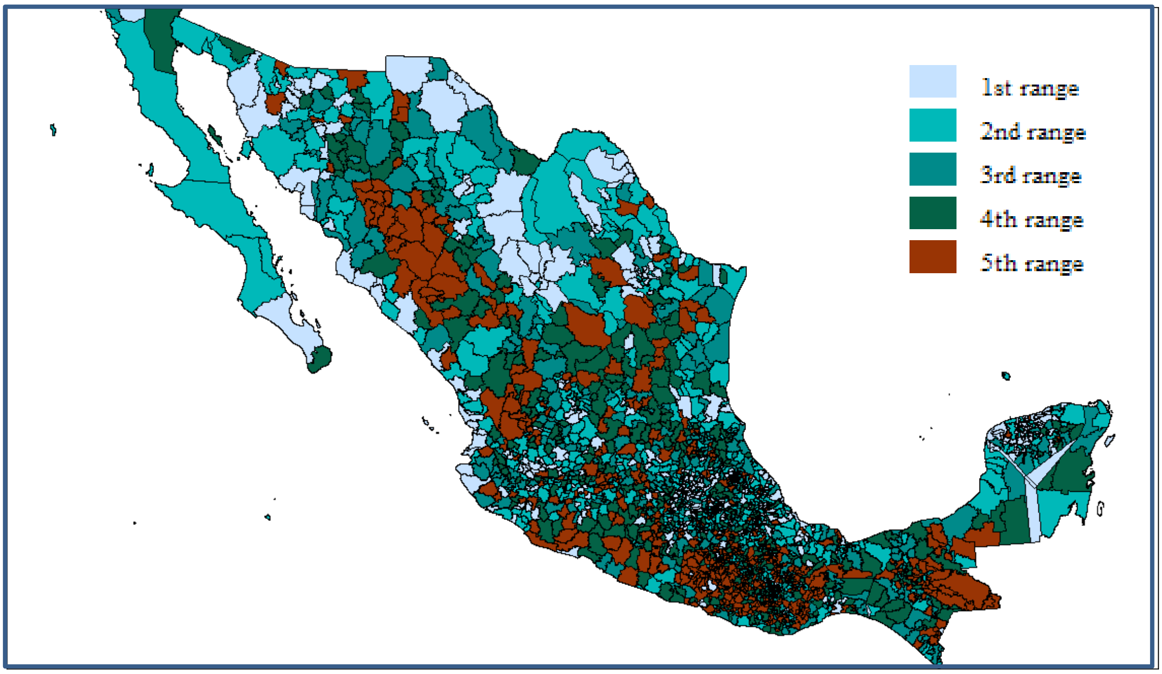
The Mexican republic is comprised of 32 states and 2,456 municipalities, being this political division, the second smallest only after localities, which account for any formally established population settlement, regardless of its size.

To describe the status of the income distribution from a municipality level of disaggregation allows appreciating better the heterogeneities among regions. From the developed northern states, who develop most of the activities related to manufacturing; the industrial and service oriented center; the Gulf region which performs most of the Oil industry related activities; to the poor and rural south and south east, that depend mainly on agriculture and touristic activities. The closer look, provided by a more disaggregated analysis, allows seeing how, even within those specific regions, there are differences in the way income is distributed among the populations. Figure 4 illustrates this, depicting the distribution of inequality, measured by the Gini coefficient, across the country and among municipalities[3]. The first of the five colors ranges show, with a lighter blue, the municipalities with lower levels of inequality, the following ranges show, consequently, the places according to their level of inequality, in an increasing order. The fifth range, in brown, corresponds to the most unequal places in the country.

With this information and a broad dataset of socio economic variables, it is possible to evaluate the inequality-growth relationship in the context of the Mexican economy, in order to find if the propositions of the model are consistent in a country specific context. We start with the description of the data and follow with the model specifications, the results of the estimations and finally the inference and conclusions.

[3] See Szekely et al. (2007) for a better description of income distribution and poverty at the municipal level.

Figure 4. Inequality in Mexico at the municipal level. Gini (2005).



Data

The inequality data consists in Gini coefficient estimations developed through the income imputation methodology proposed by Elbers et al. (2003) consisting in the association of a welfare indicator, defined as a distribution function of a relevant income or expenditure variable, with a set of explanatory variables from statistical sources. In this case using the 2000 census from the Instituto Nacional de Estadistica y Geografía (INEGI) and the 2005 income and expenditure household survey (ENIGH) also developed by the INEGI. This data was obtained from the United Nations Development Program (UNDP) in Mexico, and complemented from the estimations of the Consejo Nacional de Población (CONAPO) and from Yúnez et al. (2009).

Table 3 reports the descriptive statistics of the main variables employed in this test, as well as their description, sources and periods. Most of the dataset was constructed with variables gathered from the INEGI, the rest were obtained from the UNDP and in some cases, enhanced from other datasets found in literature.

The test is developed by estimating the effects of income inequality over a five year growth period of 2000 to 2005. As seen above, inequality is measured by the Gini coefficient, and the dependent variable is the average yearly per capita GDP growth rate of the period. One of the main disadvantages of the income imputation methodology for estimating inequality levels is that it is subject to the specification of a set of criterions that can vary according to data availability and preferences of the researcher. This creates difficulties when trying to compare inequality datasets from different sources. For this reason, and even though there is available data on inequality for up to 1990, this empirical test limits to the use a single five year growth period, sacrificing, to some degree, potential robustness of a broader study.

Table 3. Descriptive statistics of main variables (Mexico sample)

	Definition	Source	Year	Mean	Max.	Min.	Std. Dev.	Obs.
Investment Ratio	Ratio of average real domestic investment (private pus public) to real GDP of period 2000-2005	INEGI*	2000	44.79	81.27	0.00	8.03	2422
Inequality	Inequality measured by the GINI coefficient	UNDP, CONAPO	2000 / 2005	44.79	81.27	0.00	8.03	2422
Redistribution	Ratio of govt. subsidies + transfers over GDP	INEGI	1999 / 2000	0.30	3.00	0.00	0.52	2039
Fertility	Ln of Total Fertility Rate	INEGI	2000 and average from 00-05	1.11	1.63	0.16	0.15	2423
Income	Ln of real GDP per capita	UNDP	2000	10.12	12.31	0.00	1.28	2423
Education	Average years of schooling	INEGI	2000	5.91	11.76	0.00	1.11	2423
GDP Growth	Average GDP per capita growth	Estimated from UNDP data	2000-2005	9.69	59.84	-12.77	9.94	2392
Expenditure ratio	Ratio of Government expenditure over GDP	Estimated from INEGI and UNDP data	2000	0.04	1.36	0.00	0.05	2423

The estimations also include other relevant explanatory variables, standard in this type of growth regression, as educational attainment, total fertility rates, income ratio, expenditure ratio, rule of law (approximated by the amount of convicted criminals per every thousand inhabitants), and the level variable initial GDP.

Results

The model specification is developed as a growth regression of the following type:

$$\Delta Y = \beta_1 + \beta_2 \mathrm{Gini}_i + \beta_3 \mathrm{Gini}_i^2 + \beta_i X_i + \varepsilon$$

Where inequality is generally expressed at the initial year, and the rest of the explanatory variables are either averages of the period or also initial period values. Table 4 presents the results of the five estimations developed; see the notes below the table for details on methodology, model specification and instruments.

The overall relationship between income inequality and growth is defined in Equation 1, here the Gini variable is included, as well as most of the previously described explanatory variables. Additionally, dummies for the northern border and center states are included in order to control for specific characteristics of this areas. The results confirm an overall negative (-0.18) and statistically significant relationship between inequality and growth in Mexico (see Appendix 1), showing that, perhaps, the majority of the observations are in fact located on the negative side of the kinked non-linear relationship.

Initial per capita GDP and total fertility rates depict a negative and significant value, the first one confirming convergence between more and less developed municipalities; The expenditure ratio, school attainment, rule of law and the dummy for the northern states are all positive and significantly related to growth, the last one significant to a 5%; The dummy for the center region is negatively related, possibly capturing also some degree of convergence effect from the highest income region in Mexico. There is, however, one disconcerting result: The investment ratio, which depicts a negative sign and is barely significant to the 10%.

It is important to point out that, as in most empirical studies of this kind, the intention of these estimations is not to define the determinants of growth, only to evaluate the effects of inequality and its possible non linearity. Because of this, a high value for the R^2 is neither expected nor necessary to achieve the objectives of this test.

Equations 2 and 3 report the results of testing for the kinked non-linear relationship proposed in the model. As in the cross country panel study, the way to achieve this is to include the squared value of the Gini coefficient.

The results confirm the prediction that at low levels of inequality the relationship between this variable and economic growth is positive, but as the inequality levels increase, a shift in the sign occurs, changing to a negative relationship. In this case, the inequality level turns to be at a Gini value of around .42, somewhat higher than the one found in the cross country panel estimation (of around .39). These results also confirm that in this non-linear relationship there is a maximum in which growth rates are optimized in relation to the already mentioned negative effects of high inequality or high taxation (see Appendix 2). In other words, the existence of an *Optimal Rate of Inequality* (ORI) for the Mexican economy is confirmed.

Table 4. Inequality and growth relationship for Mexican municipalities

Variables / Equations	1	2	3	4	5
Intercept	**159.76**	**156.73**	**161.2**	**135.36**	**131.82**
	0.0000	0.0000	0.0000	0.0000	0.0000
Inequality	**-0.18**	**1.03**	**1.08**	**-0.88**	**-0.97**
	0.0002	0.0001	0.0003	0.0037	0.0027
Inequality^2		**-0.01**	**-0.01**		
		0.0003	0.0007		
Inequality (SQRT)				**12.84**	**13.1**
				0.0017	0.0013
Ln(per capita GDP)	**-15.14**	**-17.22**	**-14.54**	**-17.16**	**-16.94**
	0.0000	0.0000	0.0000	0.0000	0.0000
Expenditure ratio	**22.91**	**24.93**	**25.83**	**24.99**	**24.25**
	0.0001	0.0000	0.0000	0.0000	0.0000
Investment ratio	**-3.41**	**1.79**	**1.28**	**1.31**	**1.24**
	0.0933	0.0009	0.0203	0.005	0.007
Ln(Total fertility rate)	**-7.38**	**-12.81**	**-27.01**	**-12.99**	**-12.71**
	0.0002	0.0000	0.00000	0.0000	0.0000
School attainment	**3.32**	**2.94**		**2.96**	**2.99**
	0.0000	0.0000		0.0000	0.0000
Rule of law	**0.7**	**0.4**		**0.34**	
	0.0002	0.0236		0.0579	
Dummy: North	**1.46**	**5.09**	**5.52**	**4.46**	**4.93**
	0.0328	0.0000	0.0000	0.0000	0.0000
Dummy: Center	**-1.5**	**-1.74**	**-2.29**	**-2.36**	**-2.06**
	0.0002	0.0000	0.0000	0.0000	0.0000
Dummy: South east				**-0.75**	
				0.099	
Number of Observations	2391	2391	2391	2391	2391
R-squared	0.33	0.46	0.45	0.49	0.49

Independent variable is average yearly per capita GDP growth for the period 2000-2005. Estimations are made by the Generalized Method of Moments. The instruments are: For the Gini coefficient, in equation 1 employs its lagged value of the previous period; For equations 4 and 5 the instruments are the same variables, plus the income ratio of the richest 10% over the poorest 10% as well as its square root value, this additional variables are meant to address endogeneity issues. For equations 2 and 3 the instruments for the Gini and its square value are the unadjusted values of the year 2005 which were found to adjust better to the expected relationship (it appeared not to generate significant autocorrelation problems), as well as the previously described income ratios; The investment ratio and the total fertility rate have as instruments are their initial period values; The remaining instruments coincide with the independent variables.

Additionally, equation 2 finds similar results on the other explanatory variables, as to the previous estimation, with the feature of having the investment ratio now a more theoretically coherent positive sign and statistical significance, in fact, the overall explanatory power of the equation was also enhanced.

Equation 3 removes the rule of law and the school attainment variables, the last one well known to be an associated effect of income inequality, in order to see if there is any change in the inequality variables. Although the coefficient for the Gini improves marginally (from 1.03 to 1.08) the results are fairly similar and the kinked relationship persists.

Because of the prevailing characteristics in the distribution of income in Mexico, there is a real possibility of having the majority of the observations in the right side of the kinked relationship, in other words, it is possible to think that the immense majority of the municipalities are situated within the negative side of the relationship, this situation might distort the effects of testing for the non linear relationship with the squared value of the Gini. In order to address this situation, an additional set of equations where estimated, this time, testing for the non linearity by introducing the square root value of the Gini coefficient instead of the square. The idea is to do the opposite and move backwards the value of the Gini instead of forward, this way, if the supposition of a predominant high and negatively related inequality is true, we can evaluate the non linearity from this perspective. The equation specification is now as follows:

$$\Delta \mathrm{Y} = \beta_1 + \beta_2 \mathrm{Gini_i} + \beta_3 \sqrt{Gini_i} + \beta_\mathrm{i} \mathrm{X_i} + \varepsilon$$

Equations 4 and 5 present the results of this alternative test, the results show that, when introducing the root value of the Gini coefficient, a kinked relationship is also corroborated between inequality levels and economic growth. In this case, the relationship changes sign from a positive to a negative relationship at a Gini level of .45. This inequality level represents also the ORI, as it is the point at which the economy’s growth rate is maximized regarding inequality levels (see Appendix 3).

Perhaps proof of the validity of this specification are the fact that the overall explanatory power of the regression is even higher than the one of equations 2 and 3 and the consistency in the coefficient signs, intensity and significance of the other explanatory variables, which are basically the same, with the exception of equation 4 which includes a dummy for the south east region of the country, and encounters a negative but barely significant coefficient.

Discussion

The previous estimations are an attempt to test the validity of the main propositions of the model developed in this research. Specifically the ones related to the existence of a kinked non-linear relationship in which low levels of inequality exert a positive relationship with growth, and high levels a negative one, as well as the existence of an optimal rate of inequality in which growth is maximized.

The development of a country specific test additionally offers the possibility of confirming the fact that every country has a specific ORI according to the specific context and characteristics of the economy and its dynamics. In the case of Mexico, the ORI was found to be at levels between .42 and .45. These levels are lower than the current levels in the Mexican economy, thus reflecting the necessity for redistributive policies intended to lower the inequality levels, especially at the municipal level. For this, according to the precepts of the model, it is necessary to start by evaluating the efficiency of the redistributive system both on its revenue as in its expenditure side. Appendix 4 shows the relationship between redistribution and income inequality for the Mexican economy.

The use of a highly disaggregated sample for the Mexican case study provides additional relevance to this test, as it captures not only the inter-state inequality, which implicitly assumes homogeneity in the distribution within each state, but also the intra-state distribution, specifically, at a municipal level. The limitation of this test relates to the impossibility of employing a broader dataset covering more periods (i.e. a panel structured dataset), due to the specific characteristics of the income imputation methodology used for estimating the inequality indicator.

A methodological feature of this test is the alternative estimation for the non linearity in the relation by introducing the square root value of the Gini coefficient, in order to take the relationship to the left of the relationship and search for the initial positive sign and posterior shift to negative. This specification was successful and demonstrated that the majority of the municipalities in Mexico have inequality levels situated in the negative side of the relationship, in line with the national average.

Finally, the results of this empirical study additionally demonstrate the fact that it is the level of inequality the one determining its effects on growth. This strengthens the proposition that any country, regardless of its income level, can depict a positive or negative relationship between inequality and growth, and, in fact, they do both. Mexican municipalities with lower than .42 inequality levels (measured by the Gini) will have a positive empirical relationship between their inequality levels and their growth performance, such as the places with inequality levels higher that .45 will have a negative one.

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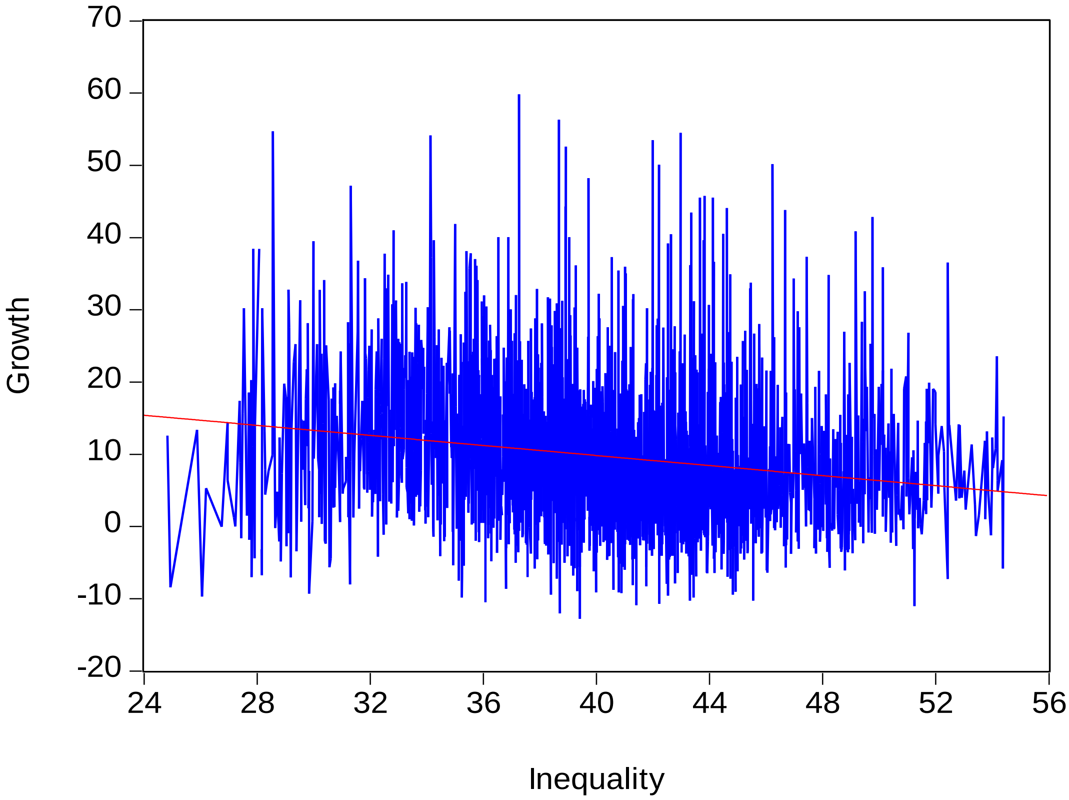
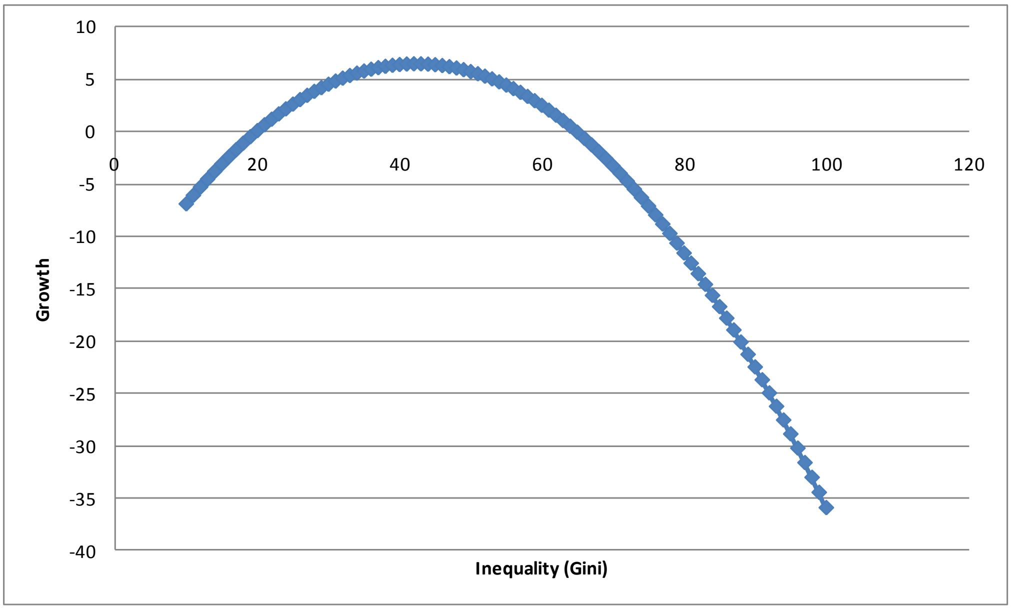
Appendix

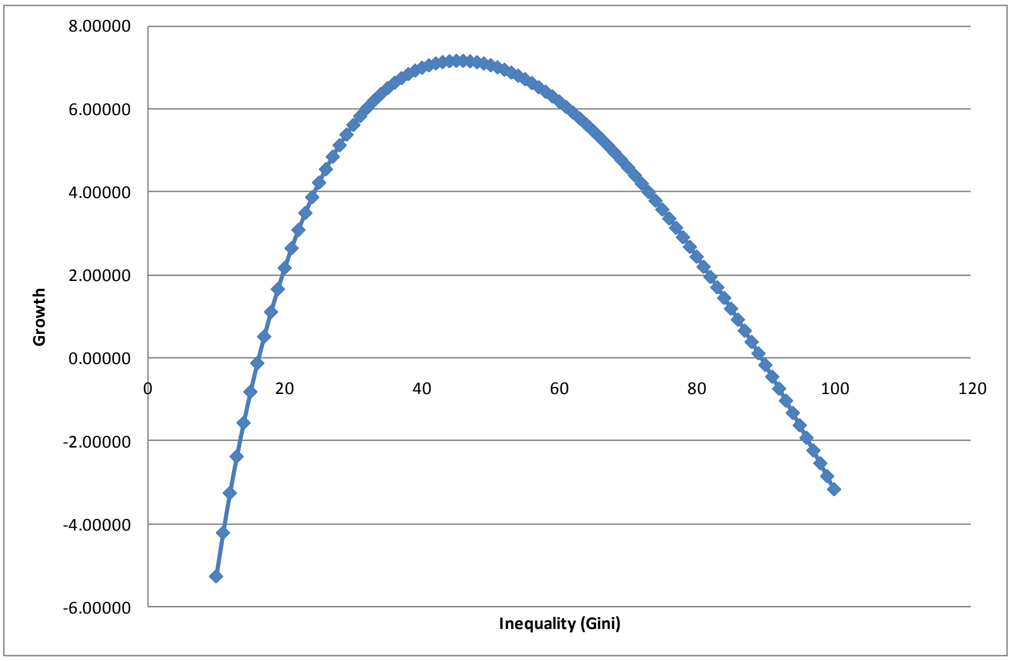
Appendix 1. Overall negative relationship between inequality and growth



Appendix 2. Inequality and growth relationship in México (Eq. 3) Estimated by coefficients



Appendix 3. Inequality and growth relationship in México (Eq. 5) Estimated by coefficients



Appendix 4. Negative relation between redistribution and growth in Mexico