Personal income distribution and economic growth: The case of brazilian municipalities

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Abstract: Most of the literature regarding the relationship between economic growth and income distribution is related to the developed countries and, especially, to country-level analyses. Little attention has been paid to examining the way in which this relationship operates in emerging economies when a subnational dataset is used. This paper tries to fill this gap in the existing literature by estimating the relationship between personal income distribution and economic growth using a municipal level dataset for the 5565 Brazilian municipalities. To do that, we estimate different growth equations using the municipal Gini coefficient, municipal Theil Index and top 10 percent income share in a municipal level. The econometric results suggest a negative and statistical robust relationship between personal income inequality municipal economic growth.

Keywords. Inequality; Development; Municipal Economic Growth

JEL Code: D63, O47, O11, R13

1. Introduction

The role of income distribution in modern societies has become a central issue in the public debate after the 2008's crisis. This debate has been boosted by the success of Thomas Piketty's book, "Capital in the Twenty First Century" (Piketty, 2014). An essential part of this debate regards to the role of inequality in the process of development. On the one hand, the income inequality can be interpreted as an economic development process' outcome, since the technical progress tends to generate high monopoly profits which, in the last instance, can cause a more unequal society. On the other hand, the income inequality can drive bad incentives regarding human capital accumulation and technical progress, since this income inequality is generated by a set of bad institutions or taking place in a world of heterogeneity in the talents (CHIU, 2001).

As pointed by Barro (2000), a crucial problem in this literature is the apparent absence of consensus, once the theoretical effect of the income distribution on

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economic growth is ambiguous. Indeed, many different theoretical arguments in terms of market failures can be used to build a narrative connecting economic growth to income distribution (Aghion and Bolton, 1992; Perotti, 1996; Aghion *et al*., 1999; Forbes, 2000; Barro, 2000; Banerjee and Duflo, 2003). Some of these arguments can be summarized as follows. An increase in income inequality can reduce the economic performance in the following circumstances: i) if the income inequality increases the pressure made by the median voter in favor of redistribution policies, resulting in a higher tax rate and an investment reduction; ii) when the capital markets are imperfect, resulting in a permanent wealth inequality; iii) when the increasing returns of technologies make the size of the markets a critical ingredient for the economic performance.

On the other hand, the income inequality can improve the economic performance when: i) the economic inequality makes the agents be willing to increase the labor supply and the investment, taking advantage of the higher rates of return to education. ii) the economic inequality leads to an increase in the aggregate savings and in the capital accumulation, as a consequence of the heterogeneity in the saving rate across different income levels.

One popular empirical approach to study the relationship between economic growth and income distribution consists in the using of a country level panel data growth regression (PEROTTI, 1996; BENABOU, 1996; LI; ZOU, 1998; FORBES, 2000). In a way similar to the theoretical literature, the empirical results are ambiguous. A reduction in income inequality can result in more economic growth as well as in a decrease in economic performance, with different results taking place, depending on the development stage of the economy.

Regarding Brazil, some works analyzing the relationship between economic growth and income distribution include de Jesus *et al*. (2018), who use a time series approach in a country level context, and Santolin and Figueiredo (2017), who analyze the interplay between economic growth and income inequality using a municipal level data set for the 1970-2000 period.

In seeking to contribute to this literature, this paper aims to estimate an econometric model, testing the relationship between personal income distribution and economic growth for a Brazilian municipal level data set for the 1991-2010 period.

Our results suggest a statistical robust negative relationship between personal income inequality and long-run economic growth in the Brazilian context.

In line with a recent literature (BOWLES, 2012), these results support an essential message in terms of public policy: the trade-off between economic performance and redistribution policies do not necessarily take place in the Brazilian context, since the redistribution policies do not imply in slower economic growth. The remainder of this paper proceeds as follows. In Section 2, we present a brief literature review. In Section 3, we present the econometric model as well as the results and discussion. We conclude in Section 4.

2. A Brief Literature Review

As pointed by Cingano (2014), despite the fact that the household incomes have been growing over the 25 years before the 2008/2009 crisis in all OECD countries, in this period the inequality has increased as a result of the faster growth in the top 10 percent incomes, in comparison to the poorest 10 percent incomes. As mentioned by Cingano (2014), this pattern in the inequality trend was interrupted only in the years after the so-called great recession. In the previous period, the Gini coefficient, for which there are long time series available to Cingano (2014), has grown from 0.29 in 1980 to 0.32 in 2011/2012. Indeed, during this time the inequality increased in 17 out of 22 of the countries analyzed by this author, particularly from the 1980's.

This inequality pattern, as well as the 2008/2009 recession's impact, triggered a revival in the interest of income inequality. Nevertheless, many economists, like Kuznets (1955) and Kaldor (1961), had paid attention to this subject during the 20th century. A Keynesian argument connecting economic inequality and economic growth is related to this seminal literature. Based on a keynesian growth model, the bigger the income inequality the bigger the total savings will be, since richer agents have a bigger saving rate. In consequence, we have two possible channels by which inequality can impact growth. If the aggregate consumption drives economic growth, more inequality causes a reduction in economic performance. On the other hand, if the short-run consumption doesn't have any impact in the capital accumulation, a bigger saving rate will impact the economic growth positively, and the rise in the inequality will have a positive effect on growth.

Based on a microfounded literature, Perotti (1996) pointed four different channels through which the income inequality can impact the economic growth; i) the endogenous fiscal policy channel, ii) the social-political instability channel, iii) the imperfect capital markets assumption and iv) the endogenous fertility channel.

According to the endogenous fiscal policy assumption, income inequality could affect economic growth through its effects on the government budget and the tax rate. In front of increasing inequality, movements in favor of redistributive policies make the government increase its expenses and taxes. In the last instance, this process causes a disincentive to save and to invest.

Income inequality can also affect economic performance through the social-political instability. The more unequal a society is, the more conflicts and instability will be generated. This process eventually results in; a) growing uncertainty in the political and legal environment and b) business environment fragilization with negative effects on investment and productivity.

In relationship to the imperfect capital markets, the market failure in the mechanism connecting lenders and borrowers could generate an inefficient investment level. Indeed, as pointed out by Perotti (1996), when the agents do not have free access to the capital markets, the initial endowments affect investment since agents with a small level of wealth cannot run many investment projects.

Finally, Perotti (1996) has pointed out the fecundity channel as an important link between economic performance and inequality. Apparently, more equal societies have low fecundity rate, while low fecundity rate generally results in more investment in education and more human capital accumulation which contribute to economic growth.

Most of these arguments are based on some market failure, something frequently very hard to test directly. In the face of this empirical issue, many papers are based on a structural approach, attempting to test the link between economic performance and growth through an extended Solow growth equation. A work in this agenda is Barro (2000).

From a panel data estimation with a country level data set, Barro (2000) analyzed the interplay between income inequality and economic performance from 1965 to 2000. This paper pointed some evidence in favor of Kuznets' curve across countries. In short, income inequality apparently has a negative impact on economic growth across poor countries and has a positive effect on economic growth across rich countries. Nevertheless, this Kuznets U-shaped curve doesn't explain a large fraction of the observed income inequality variation, and there are no apparent income inequality impacts on investment.

Barro (2008) actualize his previous paper confirming the presence of the U-shape inverse relationship between inequality and per capita GDP that is relativity stable from the 1960s into the 2000s. This paper reveals evidence about a negative effect from income inequality on economic growth, pointing that this effect diminishes as per capita GDP rises and may be positive for the richest countries.

Forbes (2000) finds results that suggest a positive and statistically significant relationship between income inequality and economic growth in the short and medium run. According to Banerjee and Duflo (2003), these relationships emerged from misspecification of the empirical model, since the real interplay between economic growth and inequality is nonlinear.

Using a cross-country dataset, Deininger and Squire (1998) find a negative and robust relationship between land-income inequality and long-run economic growth. Nevertheless, these authors pointed that these results do not take place in rich countries. In short, they argue that income inequality can reduce the economic growth only in poor countries.

As pointed by Benhabib (2003), excessive income inequality can disrupt the business environment by inviting political interference through rent-seeking behavior. On the other hand, some modest inequality can positively affect economic growth taking advantage from productivity differences. An additional way to study this nonlinear interplay between income inequality and economic performance is taking into account the shape of the income distribution, as done by Voitchovsky (2005). In this sense, using a country-level panel data, this author also finds a nonlinear relationship between economic growth and income inequality: at the top end of the distribution, this relationship is positive, while in the lower part of the income distribution it is negative.

Cingano's (2014) results suggest that income inequality has a negative effect on economic growth. This author also suggests that redistributive policies do not result in a weak economic performance and the income inequality in the lowest 10 percent has a key role in the economic performance. Indeed, expressive income inequality among the lowest 10 percent could create barriers to investment and human capital accumulation among the poor population.

Regarding Brazil, Santolin and Figueiredo (2017), using a spatial panel data model, find a nonlinear relationship between economic growth and income inequality for the Brazilian municipalities in the period of 1970-2000. This non-linearity results from the economic development stage in these municipalities.

According to their evidence, when physical capital accumulation is the essential ingredient in the economic development process, inequality does not cause weak economic performance. On the other hand, when the service sector becomes a crucial drive in the economic development process, the relationship between income inequality and economic growth turns negative.

Other works using a regional level dataset to study this topic for Brazil are Ataliba *et al*. (2017), Castro and Porto Júnior (2007) and Assis *et al*. (2016). Ataliba *et al*. (2017) find a negative relationship between economic growth and inequality for the Brazilian northeast region states during the period of 1970-1998, and Castro and Porto Júnior (2007) finds similar results using the approach suggested by Banerjee and Duflo (2003). Finally, Assis *et al*. (2016) studied the income inequality effect on growth using the Jackknife Model Averaging (JMA) approach, which takes into account the uncertainty regarding the correct model specification typical in parametric models. Using a data set of 1486 Brazilian municipalities during the period of 2000-2009, these authors tested 4095 different models, and their main conclusion provided by these models is that there is no evidence in favor of a relationship between income inequality and growth in this sample.

3. Econometric Model, Results, and Discussion

We analyzed the relationship between personal income inequality and economic growth using a growth equation in a cross-section OLS model context. In this section, we present the econometric model, and we provide a brief description of the data. Finally, we present the econometric results and a sensitivity analysis regarding the model.

3.1 Method and Data Description

We depart from a basic growth equation a la Barro (1991), in which we incorporate the income inequality argument. This equation is similar to the equations used by Alesina and Rodrik (1994), Perotti (1996), Li and Zou (1998), Forbes (2000), and Barro (2000, 2008). The dependent variable is the 2010 municipal income/1991 municipal income ratio, expressed in natural logs. This ratio is a measure for the period economic growth. The model independent variables are the 2010 municipal income (expressed in natural logs), expected years of schooling (at age 18) in 1991 (as a proxy for human capital) and the income inequality in 1991 (measured by the Gini Coefficient, the Theil Coefficient and the top 10 percent income share). The reason to adopt different measures for personal income inequality concern to the uncertainty about the best choice concerning inequality measure. The income level at the initial period seeks to measure the across municipalities conditional income convergence assumption. The additional independent variables are taking at the initial period, once the inequality effect on growth as well the human capital impact, are supposed to be lagged. An additional advantage to take this variable at the initial period is the endogeneity problem gets less pronounced. All income data are in constant 2010 Brazilian Reals.

The equation which describes the model follows:

$$\log\left(\frac{y_{i,t+T}}{y_{i,t}}\right) = \beta_0 + \beta_1 y_{i,t} + \beta_2 D_{i,t} + \beta_3 Educ_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where the subscribe i indicate the municipality unit, t is the initial period (1991), $t + T$ is the final period (2010), y is the municipal income, D is an inequality measure, *Educ* is a proxy for human capital, and $\varepsilon_{i,t}$ is the error term independent and identically distributed.

We collected all the data in the Atlas of Human Development in Brazil1. This Atlas is an online platform with socioeconomic indicators in different levels of aggregation including a dataset for 5565 Brazilian municipalities. This online Atlas extract all the data from the Brazilian Institute of Geography and Statistics (IBGE) population Census to 1991, 2000 and 2010.

Regarding our primary aim, which is testing the income inequality impact on growth, the beta two parameter is the central one. For all of three inequalities measures, an increasing means an increase in the municipal personal income inequality. In short, if the parameter beta two is positive (negative) an increase in income inequality will be associated with a weaker (stronger) economic performance concerning economic growth.

3.2 Results

The following Table 1 summarizes econometrics results for three econometric specifications, namely specification 1, specification 2 and specification 3. In the specification 1, we set the Gini coefficient as the inequality variable. In the specification 2, we set the Theil coefficient as the inequality variable. In the specification 3, we set the top 10 percent income share as the inequality variable.

The initial income coefficient has the negative expected signal in all of three specifications, confirming the conditional convergence assumption. The education variable presents a positive impact on growth in all of three specifications. In all of three specifications, the inequality variable affects economic growth negatively. Our results indicate a negative and statically significant relationship between income inequality and economic growth in our dataset. This result supports the idea that the trade-off between economic growth and redistributive policies does not take place in all of the situations.

Although we recommend reading this interpretation with some parsimony degree, it is in line with several microeconomic arguments (for a brief summary about this literature see Bowles, 2012). This result deserves special attention in the context of a developing economy, in which income inequality results more frequently from bad economic incentives in contrast with developed economies, in which income inequality can arise from competition and innovation process. Frequently, quantile regressions are useful to verify the heteroscedasticity problem and the presence of outliers in the dataset. We report the outcomes for the quantile regression (median regression) in the following Table 2. The outcomes from 10 percent to 90 percent quantiles are available under request.

Table 1 – OLS regressions

Dependent Variable: Economic Growth			
Model	(1)	(2)	(3)
Constant	2.8	2.7	2.8
Initial Income	-0.44	-0.44	-0.43
Gini	-0.37		
Theil		-0.14	
Top 10 percent income			-0.49
Education	0.07	0.07	0.07
Prob. (F-Stat)	0.00	0.00	0.00
Adjusted R-Squared	0.48	0.48	0.49
Observations	5565	5565	5565

Note: All coefficients significant at 1 % level.

Table 2 – Quantile regressions

Dependent Variable: Economic Growth			
Model	(1)	(2)	(3)
Constant	2.8	2.7	2.8
Initial Income	-0.45	-0.44	-0.44
Gini	-0.27		
Theil		-0.11	
Top 10 percent income			-0.39
Education	0.07	0.07	0.07
Adjusted R-Squared	0.30	0.30	0.30
Observations	5565	5565	5565

Note: All coefficients significant at 1 % level.

All OLS results which we reported previously do not change when we re-estimate the model using a quantile regression approach.

3.3 Sensitivity Analysis

In this sub-section, we provide a sensitivity analysis to seek out figure out if the previous results persist in the cases of inclusion of different variables, re-estimation in sub-dataset and the case of new estimations methods. Our first robustness exercise is to add three new measures of education, namely i) gross elementary school attendance rate (GEAR); ii) gross lower secondary school attendance rate (GLAR); and iii) gross secondary school attendance rate (GSAR).

We present the results for this new econometric model in the following Table 3. In all of these models, the parameter related to inequality remains statistically significant at 1 percent level, and, once again the parameters associated to human capital are statistically significant at 1 percent level. In short, the model is not sensitive to changes in the human capital variable definition.

Table 3 – Sensitivity analysis I

Dependent Variable: Economic Growth									
Constant	2.4	2.5	2.7	2.2	2.3	2.5	2.4	2.4	2.64
Initial Income	-0.30	-0.31	-0.32	-0.3	-0.31	-0.33	-0.29	-0.30	-0.31
Gini	-0.52	-0.52	-0.49						
Theil				-0.20	0.19	-0.17			
Top 10 %							-0.65	-0.65	-0.61
GEAR	0.3			0.31			0.3		
GLAR		0.35			0.36			0.34	
GSAR			0.38			0.38			0.40
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-sq (adj)	0.38	0.38	0.38	0.37	0.37	0.38	0.39	0.39	0.39
Observations	5565	5565	5565	5565	5565	5565	5565	5565	5565

Note: All coefficients significant at 1 % level.

In sequence, we added to the model the percentage of the population in domiciles with electric power in 1991 (Electric Power) variable as a proxy for the investment. In a different specification, besides the Electric Power variable, we also added to the model the aging rate in the population in 1991 variable (Aging Rate). In this model, with five independent variables, coefficients for inequality and human capital remain as in our baseline model. Besides, all of the new variables have the expected signal (positive for investment and negative for aging rate variable) and are significant at 1 percent level.

We report the outcomes for this new version of the model in Table 4. These results do not change if we use different proxies for human capital in the model (outcomes for this estimation are available under request).

Our subsequent step was to re-estimate the previous models by adding the population growth rate variable during this period, defined as the ratio between the population level in 2010 and 1991, in logs. Now, we have a model with six independent variables, which the results we report in Table 5. Once again, the main results remain unaltered and with a negative relationship between income inequality and growth. In line with the economic intuition, population growth has a negative impact on per capita economic growth.

Table 4 – Sensitivity analysis II

Dependent Variable: Economic Growth						
	Without Aging Rate			With Aging Rate		
Constant	2.9	2.8	2.9	2.9	2.8	2.9
Initial Income	-0.47	-0.48	-0.46	-0.48	-0.49	-0.47
Gini	-0.30			-0.29		
Theil		-0.11			-0.11	
Top 10 percent income			-0.43			-0.43
Education	0.06	0.06	0.06	0.07	0.07	0.06
Electric Power	0.14	0.15	0.13	0.15	0.16	0.14
Aging Rate				-0.47	-.48	-0.41
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00	0.00
Adjusted R-Squared	0.49	0.48	0.49	0.49	0.48	0.49
Observations	5565	5565	5565	5565	5565	5565

Note: All coefficients significant at 1 % level.

We also consider the possibility of the changes in the model results in the face of a change in the span of estimation. In respect to this issue, we re-estimate the model using two different spans. We estimate a model considering the economic growth from 1991 up to 2000 as the dependent variable, taking the independent variables at the initial period (1991). We repeat the same exercise for the span from 2000 to 2010. We report this two outcome's estimation in Table 6.

Table 5 – Sensitivity analysis III

Dependent Variable: Economic Growth			
Constant	2.9	2.8	2.9
Initial Income	-0.46	-0.46	-0.44
Gini	-0.35		
Theil		-0.13	
Top 10 percent income			-0.48
Education	0.06	0.06	0.06
Electric Power	0.15	0.16	0.15
Aging Rate	-0.82	-0.81	-0.77
Population Growth	-0.09	-0.09	-0.10
Prob (F-Stat)	0.00	0.00	0.00
Adjusted R-Squared	0.50	0.49	0.50
Observations	5565	5565	5565

Note: All coefficients significant at 1 % level.

From the estimations using this two sub-samples, the econometrics outcomes remain qualitatively the same. The coefficients related to the initial income remains negative, the coefficients related to education remain positive, and the coefficients associated with the inequality variables remain negative. All coefficients are statistically significant at 1 percent level. We also proceed this subsample estimation using a quantile approach (outcomes for this estimation are available under request), and all results remain qualitatively unaltered.

Finally, we reset the model to use a panel data estimation as a sensitivity test. When we use a panel data estimation, we are trying to take into account the idiosyncratic characteristics of the municipalities units which we did not take into account in the cross-section estimation.

Table 6 – Sensitivity analysis IV

Dependent Variable: Economic Growth						
	1991-2000 Subset			**2000-2010 Subset**		
Constant	1.6	1.6	1.6	2.1	1.8	1.8
Initial Income	-0.27	-0.28	-0.26	-0.29	-0.29	-0.27
Gini	-0.32			-0.8		
Theil		-0.14			-0.31	
Top 10 percent income			-0.45			-0.78
Education	0.05	0.05	0.05	0.05	0.05	0.05
Adjusted R-Squared	0.26	0.26	0.27	0.43	0.40	0.43
Observations	5565	5565	5565	5565	5565	5565

Note: All coefficients significant at 1 % level.

We estimate a panel using as dependent variables the per-capita income growth from 1991 up to 2000 and from 2000 up to 2010. We take the independent variables (initial income, human capital, and inequality) at the initial periods (1991 and 2000). Thus, we have a panel data estimation with i = 1, 2, ..., 5565 and t = 1, 2. Using the three different inequalities variables, we re-estimate the model using fixed effect approach as well as the random effect approach. We report the panel outcomes in Table 7.

Table 7 – Sensitivity analysis V - Panel Data Regression

Dependent Variable: Economic Growth						
	F.E. Panel			R.E. Panel		
Constant	1.5	1.5	1.5	1.4	1.4	1.4
Initial Income	-0.09	-0.09	-0.08	-0.06	-0.06	-0.06
Gini	-0.16			-0.09		
Theil		-0.08			-0.04	
Top 10 percent income			-0.22			-0.11
Education	0.01	0.01	0.01	0.01	0.01	0.01
Observations	11,130	11,130	11,130	11,130	11,130	11,130

Note: All coefficients significant at 1 % level.

For the panel data estimation, all outcomes result in the same qualitative message which we provide in our cross-section model (using fixed effect and random effect). The initial income presents a negative impact on economic growth, education presents a positive impact on growth, and the different inequalities variables present a negative impact on economic growth. In all panel data estimations, all the coefficients associated with the independent variables are statistically significant at 1 percent level.

In summary, the econometric result, that indicates a negative relationship between economic growth and personal income inequality in the context of the Brazilian municipalities, survives to several different econometric specifications, remaining the same qualitative message.

4. Concluding remarks

In this paper, we investigate the relationship between economic growth and personal income distribution using a municipal level data set for Brazil. We use a data set of 5565 Brazilian municipalities, and our dependent variable was the rate of economic growth in the period from 1991 to 2010. We take into account three different personal income inequalities measures: The Gini coefficient, the Theil coefficient, and the top 10 percent income share. We also take into account the impact the initial income on economic growth (convergence assumption), the education impact on economic growth, as well as, different independent variables in the context of the sensitivity tests.

We estimate different econometric specifications, using a cross-section OLS approach, using a cross-section quantile approach and, finally, a panel data analysis approach. All the econometrics outcomes suggest a negative and statistical robust relationship between income inequality economic growth. This result survives to different sensitivities tests.

The first qualitative message in this paper is pretty apparent. According to our econometric outcomes, the bad incentives which drive poor economic performance are taking place in the Brazilian context. From a purely theoretical perspective, these results are compatible with different sort of market failures arguments.

The second qualitative message regards to the economic policy. Our outcomes suggest that the trade-off between economic performance and redistribution policies do not necessarily take place in the Brazilian context, once the redistribution policy does not imply in having to bear a cost concerning smaller economic growth. It is not redundant to advertise that we have to interpret this message with parsimony, in particular regarding what kind of public policy could be more effective regarding decrease the income inequality without generating negative economic incentives and distortions.

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