E C O N O M I C S   B U L L E T I N

Convergence in Income Inequality: the Case of Brazilian Municipalities

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Abstract

This paper investigates income inequality convergence among 5507 Brazilian municipalities. Two periods are used, 1991 and 2000, and inequality is measured by the Gini index. For the country as a whole, the results suggest that the Brazilian municipalities are converging to an inequality level greater than the current (year 2000) level. However, when regional differences are controlled for, the South region converges to a lower inequality level while the other four regions remain converging to a higher level.

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1. Introduction

According to the neoclassical growth model, economies converge to their own steady state and the speed of convergence is inversely related to the gap between effective income and its steady state value (Solow, 1956). This proposition, known as conditional convergence, gave rise to an enormous literature on the subject.[1] Another proposition of most versions of the neoclassical growth models is the convergence in distribution (Bénabou, 1996). Instead of focusing on the average income (the first moment), it is possible to examine if countries (or regions) with similar fundamentals tend towards the same invariant distribution of wealth or pre-tax income. Bénabou (1996) and Ravallion (2001, 2003) test if there is evidence in favor of income inequality convergence among various countries. By using international data sets and the Gini index as a measure of inequality, their findings support the convergence hypothesis. Bleaney and Nishiyama (2003) find that inequality convergence amongst (advanced) OECD countries is significantly faster than amongst developing countries. Indeed, in one of their test specifications, the authors do not find evidence in favor of inequality convergence for developing countries.

A common drawback in using international data is the lack of homogeneity. In fact, comparability becomes a greater problem when one wants to study inequality convergence than when the need is to study income convergence, because the surveys that estimate the Gini index are less standardized than National Accounts (Ravallion, 2001). Such lack of homogeneity inevitably casts some doubt on the robustness of results reported by previous papers, despite the effort to use reliable data. In an attempt to overcome this problem, Ezcurra and Pascual (2005) used data of European regions supplied by the European Community Household Panel, and their results support the inequality convergence hypothesis.

Surveys within a country can be used to obtain reliable data sets once they tend to employ the same methodology throughout the entire time series. Another reason to use intra-country data is that the neoclassical model predicts conditional convergence and, restricting the analysis to a single country, the fundamentals are expected to be identical or, at least, similar. Despite these advantages, Panniza (2001) seems to be the only one who explores this possibility in his investigation of the US states. And his results do not reject the inequality convergence hypothesis.

The aim of this paper is to test income inequality convergence among the 5507 Brazilian municipalities, using a reliable data set built by the Brazilian Human Development Report (2003), hereafter BHDR. Therefore, this paper overcomes the problem of data homogeneity across surveys and eliminates the need to control for specific parameters related to different countries. Indeed, in order to interpret the convergence test as a conditional convergence test, we go one step further and control for regional differences of each of the five Brazilian macro regions (South, Southeast, Center-West, North and Northeast). Initially, the results suggest that the Brazilian municipalities are converging to a higher level of inequality. However, when regional differences are controlled for, the South region converges to a lower inequality level while the other four regions remain converging to a higher inequality level.

[1] For an extensive literature review, see Temple (1999) and de la Fuente (2000).

2. Econometric Methodology

As mentioned before, the data set includes all the 5507 Brazilian municipalities and it was extracted from BHDR, which is based on the Brazilian census from 1991 and 2000. It is worth mentioning that in both years the Gini index is based on the household income per capita and the establishment of several towns that occurred in this period is taken into account by the BHDR.

Following Bénabou (1996), Ravallion (2003) and Bleaney and Nishiyama (2003),[2] the test equation is based on Gini level:

$$\frac{G_{i,2000} - G_{i,1991}}{9} = \delta_0 + \delta_1 G_{i,1991} + e_i \qquad (1)$$

where $G_{i,t}$ is the Gini index for municipality i in period t, e_i is the residual term in the municipality i, δ_0 and δ_1 are the parameters. Therefore, the dependent variable is the annual average change in the Gini index, the convergence hypothesis is not rejected if $\delta_1 < 0$ and the long-run equilibrium value of the Gini index is estimated by $-\delta_0 / \delta_1$.

Ravallion (2003) also used the logarithm of the Gini by means of the following estimation:

$$\frac{1}{9}\ln\left(\frac{G_{i,2000}}{G_{i,1991}}\right) = \gamma_0 + \gamma_1 \ln\left(G_{i,1991}\right) + e_i \qquad (2)$$

The dependent variable becomes the annual average growth rate of the Gini index. Besides, $\gamma_1 < 0$ means convergence as before, but the long-run value of the Gini index becomes $\exp(-\gamma_0 / \gamma_1)$. Equations (1) and (2) are estimated by means of ordinary least squares (OLS) and least absolute deviations (LAD).[3] The latter has the advantage to be robust to outliers.

Equations (1) and (2) are also re-estimated, including dummies for the 5 macro Brazilian regions: South, Southeast, Center-West, Northeast and North. The dummies are: 1) $D_1 = 1$ for the Center-West and zero otherwise; 2) $D_2 = 1$ for the Northeast and zero otherwise; 3) $D_3 = 1$ for the North and zero otherwise; 4) $D_4 = 1$ for the Southeast and zero otherwise. These intercept dummies are included in equations (1) and (2) in order to take into consideration some effects which are specific to each region. Besides, we multiply the initial inequality measure by each dummy in order to allow a specific γ_1 for each region. These are important steps in order to interpret the convergence test as conditional convergence test.

Table 1 reports the descriptive statistics. During the period under analysis, there was an increase, from 52.595 to 56.073, of the Gini index, which also had both its maximum and the minimum values increased. While the standard deviation implies a rise in the dispersion, the

[2] Indeed, Bleaney and Nishiyama (2003) used an equality index given by 100 minus Gini.

[3] Bénabou (1996) and Bleaney and Nishiyama (2003) applied only the OLS estimator. Ravallion (2003) applied OLS and IV estimators, but the results were very close. To apply the IV estimator, one needs at least a three-period information of the Gini index in order to use the first period as an instrument.

variation coefficient indicates a minor decrease. Both the mean annual average change and growth rate of the Gini index are positive, indicating that inequality within each municipality increased. In fact, inequality increased in 3654 municipalities (66.35%). The correlation between the average change in the Gini index and the Gini initial value is -0.5533. The average growth of Gini and its respective initial inequality measure show a correlation of about -0.5879. These results are a first indication of inequality convergence. If confirmed, Brazilian municipalities are likely to be converging to a higher level of inequality.

3. Results

Table 2 presents the results for equations (1) and (2). Equation (1) shows that the parameters of both estimators (OLS and LAD) are significant, at 1% significance level, and the sign of the initial inequality variable is negative. As a consequence, the convergence hypothesis is not rejected. The implied long-run value of Gini is approximately 58 for the OLS regression and 57 for the LAD regression. Estimations of Equation (2) yield similar results and, as a consequence, the inequality convergence hypothesis is not rejected.

To visualize the empirical findings, Figure 1 displays the Kernel Density related to the Gini index in both periods (1991 and 2000) and it also displays a vertical line in the mean value of the implied long-run Gini index (57.5978).[4] The distribution is moved to the right, towards the long-run value of the Gini index. Indeed, in 1991, 4489 municipalities (81.51%) had a Gini index lower than 57.5978 whereas in 2000 the total decreased to 3414 (61.99%).

Equations (1) and (2) are also estimated with controls for regional differences. Both estimators (OLS and LAD) and both equations (1 and 2) have coefficients significant at the 1% level. There is strong evidence of convergence: the initial inequality measure and its interactions with the dummies have a negative coefficient, in all cases. For each macro region the long-run implied Gini index is similar across estimators and equations. The average long-run value of the Gini index is displayed on Table 4, together with basic information for each region. It is clear that such value is greater than the average observed Gini in 2000 for all regions, with an exception for the South region. The number of municipalities with an observed Gini index below its long-run value is greater in 1991 than in 2000 for all regions, except for the South region. These results mean that, controlling for regional differences, the South region converges to a lower inequality level while the other four regions converge to a higher inequality level.

Figures 2 to 6 display the Kernel Density of the Gini index in 1991 and 2000, together with a vertical line in the mean value of the implied long-run Gini index, for each region. For the Center-West, Northeast, North and Southeast the distribution is moved to the right, towards the long-run value of the Gini index. For the South, the densities related to both periods (1991 and 2000) are very close to each other, and the distribution does not seem to become worse. Lastly, it is worth mentioning that the regions with the higher mean income (South, Southeast and Center-West) have also a relatively lower long-run Gini.

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[4] The density is estimated using the Epanechnikov kernel. The mean long-run Gini is the average of the LR Gini from Table 2.

4. Conclusions

This paper investigates, and it does not reject, the income inequality convergence hypothesis for Brazilian municipalities. As we are restricted to a single country, and we controlled for regional differences, it is possible to interpret the empirical tests as conditional convergence tests, differently from other papers. The results indicate that the Brazilian municipalities are converging to a higher level of inequality, with an exception for the municipalities located in the South region.

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Table 1 – Descriptive Statistics

Variable	Mean	Standard Deviation	Variation Coefficient	Maximum	Minimum
G_{1991}	52.595	5.659	0.108	79.000	35.000
G_{2000}	56.073	5.866	0.105	82.000	36.000
$(G_{2000} - G_{1991})/9$	0.386	0.736	1.904	3.333	-2.222
$\ln(G_{2000}/G_{1991})/9$	0.007	0.013	1.877	0.060	-0.039

Table 2 – OLS and LAD applied to equations (1) and (2)

Independent Variables	Equation (1)		Equation (2)	
	OLS	LAD	OLS	LAD
Constant	4.1703*	3.9861*	0.2977*	0.2883*
	(0.0843)	(0.0984)	(0.0059)	(0.0067)
G_{1991}	-0.0719*	-0.0694*		
	(0.0016)	(0.0019)		
$\ln(G_{1991})$			-0.0734*	-0.0712*
			(0.0015)	(0.0017)
R^2	0.3061	0.1582	0.3456	0.1831
N	5507	5507	5507	5507
LR Gini	57.9670	57.4000	57.6422	57.3818

Note: Parenthesis reports the standard error and * indicate significant at 1%. N is the number of observations. LR Gini is the implied long-run value for the Gini index.

Table 3 – OLS and LAD applied to equations (1) and (2) plus regional dummies

Independent Variables	Equation 1		Equation 2	
	OLS	LAD	OLS	LAD
Constant	2.9047*	2.5694*	0.2046*	0.1876*
D_1	1.1555*	1.0265*	0.0816*	0.0669*
D_2	1.8319*	2.0037*	0.1302*	0.1388*
D_3	2.7094*	3.1898*	0.1778*	0.2087*
D_4	0.6674*	0.4861*	0.0566*	0.0438*
G_{1991}	-0.0545*	-0.0486*		
D_1G_{1991}	-0.0137*	-0.0120*		
D_2G_{1991}	-0.0237*	-0.0274*		
D_3G_{1991}	-0.0344*	-0.0440*		
D_4G_{1991}	-0.0096*	-0.0069*		
$\ln(G_{1991})$			-0.0515*	-0.0472*
$D_1 \ln(G_{1991})$			-0.0186*	-0.0151*
$D_2 \ln(G_{1991})$			-0.0302*	-0.0325*
$D_3 \ln(G_{1991})$			-0.0409*	-0.0488*
$D_4 \ln(G_{1991})$			-0.0135*	-0.0105*
R^2	0.4553	0.2664	0.4941	0.2918
N	5507	5507	5507	5507
LR Gini				
South	53.2550	52.8571	52.9562	53.0002
Center-West	59.5334	59.3333	59.2143	59.3446
Northeast	60.5080	60.1538	60.0972	60.0002
North	63.1300	62.2000	62.6833	62.0002
Southeast	55.6736	55.0000	55.4715	55.0002

Note: * indicate significant at 1%. N is the number of observations. LR Gini is the implied long-run value for the Gini index.

Table 4 – Regional Analysis

Region	Number of Municipalities	Mean Income	Mean Gini		Mean LR Gini	Municipalities below the LR Gini			
			1991	2000		1991		2000	
						N	%	N	%
South	1159	233.69	53.33	53.29	53.02	591	50.99	598	51.60
Southeast	1666	222.25	52.51	54.34	55.29	1205	72.33	1039	62.36
Center-West	446	209.16	54.42	57.56	59.36	376	84.30	295	66.14
North	449	120.47	54.14	61.34	62.50	407	90.65	291	64.81
Northeast	1787	85.16	51.35	57.80	60.19	1667	93.28	1271	71.12

Note: LR Gini means implied Long-Run Gini.

Figure 1 - Kernel Density: Brazil

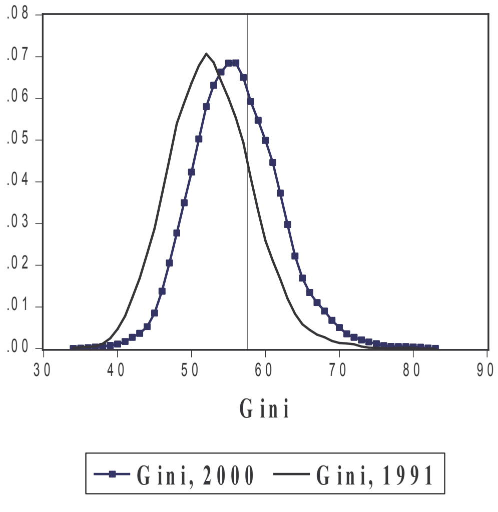

Figure 2 - Kernel Density: Center-West

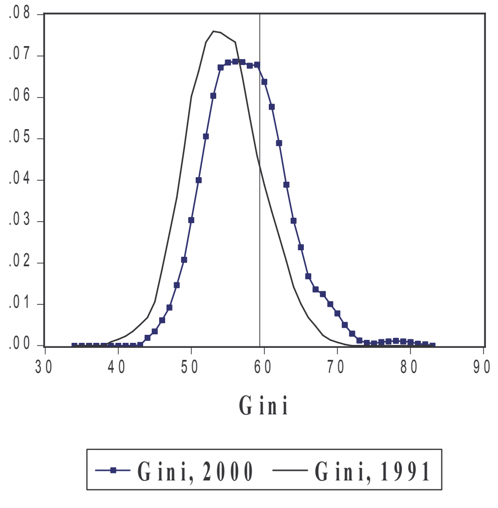

Figure 3 - Kernel Density: Northeast

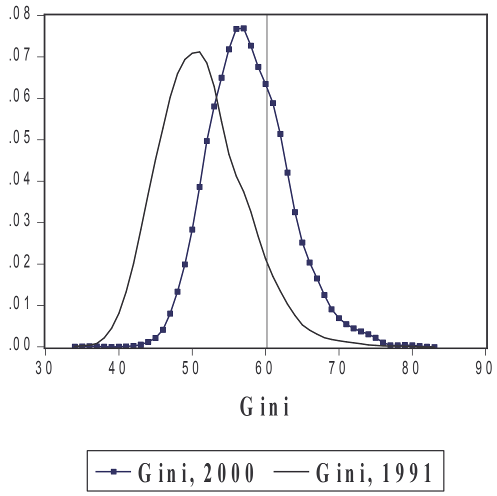

Figure 4 - Kernel Density: North

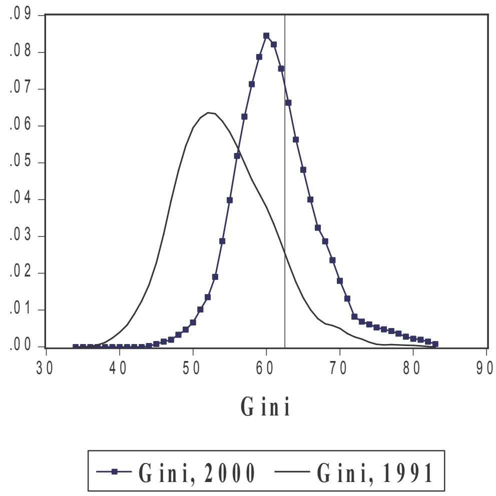

Figure 5 - Kernel Density: Southeast

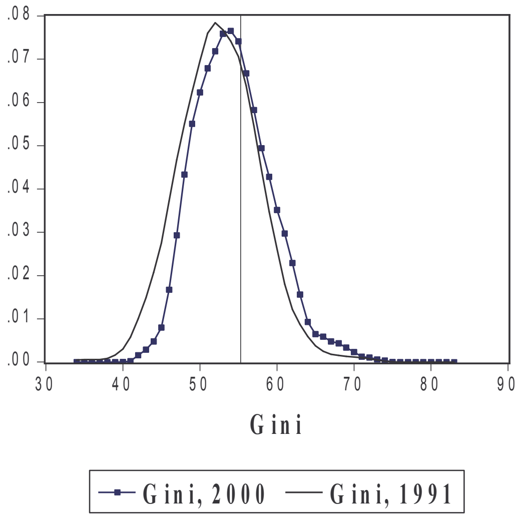

Figure 6 - Kernel Density: South