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## Income convergence: An analysis for the Brazilian States between 1994 - 2010

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# **Income convergence: an analysis for the Brazilian States between 1994 - 2010**

**Abstract:** The income inequality is a phenomenon that occurs, in greater or lesser proportions, in almost all countries of the world. Its existence is associated with poor distribution of resources, in which the minority concentrated considerable portion of income, at the expense of the rest of the population. In Brazil, the problem is particularly worrisome, as the country is one of the most unequal in the world. Thus, this paper investigates the hypothesis absolute and conditional convergence of GDP per capita between the Brazilian states in the period 1994-2010. For the differentiation of the economies, in the conditional model are included the IDH-M of the states and the dummy variable representing the states of the Northeast. The methodology is based on tests  $\beta$ -convergence, adopted by Barro and Sala-i-Martin (1992a). Moreover, through the Exploratory Spatial Data Analysis, are analyzed the effects of space on the dynamics of GDP per capita. The results indicate the existence of spatial dependence in their values in 1994 and 2010. Regarding convergence, there is evidence of the phenomenon, both in absolute level, the conditional. Once in the conditional analysis there is differentiation of Brazilian regions and are represented, through variable IDH-M, important aspects to the economic growth of the states, the those related to education, its results can be considered more accurate than the absolute approach. Thus, as the localities converges to different steady states, subject to their socioeconomic characteristics, in the long run, can persist in Brazil the high degree of inter-state inequality, in which the rich economies remain rich and the poor remain poor.

Keywords: Income Convergence. Economic Growth. Spatial dependence.

## **1-Introduction**

The year 2010 has been characterized as a period of economic recovery of the strong financial crisis that hit the world in 2008. Data released by the International Monetary Fund, for the year of 2010, showed a growth of global GDP to the tune of 5.1%. Much of this recovery has occurred due the significant growth rates of emerging countries, which together grew by 7.4%. Among them were China's growth (10.4%) and India (10.1 percent). Developed countries, in turn, grew, on average, only 3%.

Brazil was also one of the highlights in this scenario. In 2010, its gross domestic product (GDP) reached US\$ 1,670 trillion (IPEA, 2013), occupying seventh position in the ranking of the world's largest economies. Moreover, this represented an increase of 7.5%

compared to 2009, making the Brazilian performance higher than the world average. The growth rate in 2010 was the largest increase in the Brazilian economy since 1986. The primary sector, covering farming, represented by 5.77% of the total indicator, the industry, classified as secondary sector, accounted for 26.82% and the Commerce and services sector, 67.41% (IPEA, 2013).

The GDP per capita reached in current values US\$ 8,500, an increase of 6.5% over the previous year. The generation of 2.5 million new jobs, an increase of more than 150% in comparison with 2009 also marked 2010 (IPEA, 2013).

Despite these favorable results in the economy, the country still present strong inequality. One of the main indicators used to measure this disparity is the Gini coefficient, which measures the degree of inequality in household income. In 2010 the coefficient achieved 0.531. Although this was the lowest rate since 1960, it still features the Brazil as one of the most unequal countries in the world. The regional income distribution is shown in table 1.

**Table 1:** Distribution of national income among regions in Brazil (1994 - 2010).

Region	Percentage in national territory	Percentage in national income	
		1994	2010
Midwest	18.9%	6.10%	9.30%
Northeast	18.3%	12.87%	13.46%
North	45.2%	5.09%	5.34%
Southeast	10.8%	57.27%	55.39%
South	6.8%	18.67%	16.51%

Source: IPEA, 2013

The southeastern region contributed in the period analyzed with more than half of national income, although it is one of the smallest regions in territorial terms. Only the State of Sao Paulo, had a stake in both years, approximately 34% of the total production. In contrast, the participation of the northern region, whose extensions covering almost half of the Brazilian territory, not exceeded 6% in both periods examined.

It is important to note, however, that although the inequality in income distribution between the regions is present in both periods, in the year of 2010 it was less expressive. This fact can be shown by the analysis of the variation of the participation of each region in national income (table 2).

**Table 2:** Participation change in the national income according to Brazilian regions (1994-2010)

<b>Region</b>	<b>Participation change</b>
Midwest	52.46%
Northeast	4.58%
North	4.91%
Southeast	-3.28%
South	-11.57%

Source: IPEA, 2013

The South East and the South were the only regions whose participation decreased over the period. Together, in 1994, they accounted for 75.94% of national income. In 2010, the participation decreased to 71.91%.

Table 2 points, still, positive variation of other regions of the country. For example the Midwest region, which increased their participation about 52%. This evolution is due to the development of agricultural activity and the appearance of agribusiness-related industries in the region.

In addition, to this regional equity analysis, the scenario of income inequality in the country would be observed by different levels of *per capita* income among Brazilian regions (table 3).

**Table 3:** Per-capita income (thousand dollars) of Brazil according to regions (1994 - 2010).

<b>Region</b>	<b>Per capita income</b>	
	<b>1994</b>	<b>2010</b>
<b>Midwest</b>	11.13	6.01
<b>Northeast</b>	2.94	4.27
<b>North</b>	4.61	5.67
<b>Southeast</b>	8.75	11.59
<b>South</b>	8.15	10.14
<b>Brazil</b>	6.52	8.82

Source: IPEA, 2013

In 1994, the *per capita* income in Brazil was about US\$ 3,000. The Midwest presented value more approached the national average. The South and Southeast regions showed higher levels than the national average. In contrast, Northeast and North showed values above the Brazilian average. In the same year, the income *per capita* of the Southeast was approximately three times higher than the Northeast.

In 2010, *per capita* national income reached around US\$ 30,000, representing an increase of 35% compared to 1994. Among the factors that have contributed to this increase we can highlights the economic stability, expansion of global demand for commodities, and

the policies of income transfer. In 2010, in addition to the Southeast and South, the income *per capita* of the Midwest also surpassed the average Brazilian. Northeast and North regions, once again, showed lower levels compared to national.

Although still find high regional inequalities, some points in terms of reduction of inequality were observed. Initially, the significant increase in *per capita* income in the Midwest of 85.4%, , surpassing the South, whose variation was 24.36%. The Northeast also presented a significant growth, at the expense of the North, the region with the lowest variance. The growth of the Southeast was 32.50%. It should be noted, that with the exception of the North, regions with income levels relatively low *per capita* in 1994 were those that had the largest variations in the period.

Table 4 shows the variation in income *per capita* in each region during the period considered.

**Table 4:** Variation in *per capita* income according to Brazilian regions (1994-2010)

Region	Variation in income <i>per capita</i>
Midwest	85.40%
Northeast	45.11%
North	22.92%
Southeast	32.50%
South	24.36%
Brazil	34.60%

Source: IPEA, 2013.

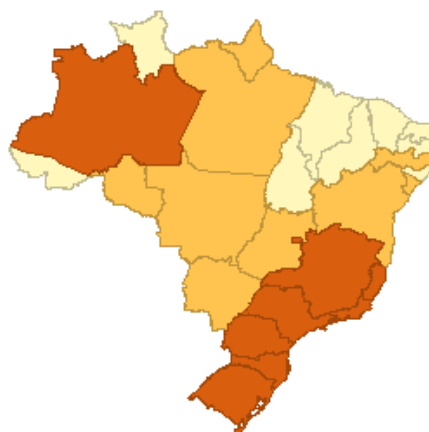
The results described above can be better detailed through the analysis of the income *per capita* of the Brazilian States. Figures 1 and 2 illustrate the State distribution of income *per capita* in the years 1994 and 2010.

Quantile: PIPPC\_94

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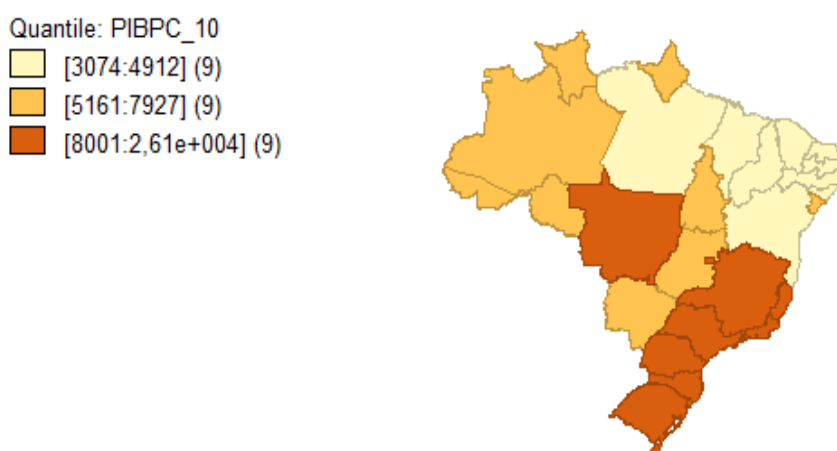
[6104:1,106e+004] (9)



**Figure 1:** *Per capita* Income of Brazilian States, (1994)

Source: Elaboration from IPEA, 2013

The North, and mainly, the Northeast regions were presented, in 1994, the lowest levels of this variable. Traditionally, are the poorest areas of the country, which present serious problems in sectors such as education and health. The States of Maranhão and Piauí were those with the lowest incomes *per capita*, in the order of R \$ 1,598 .54 and \$ 1,754 .13, respectively. Note also, that the States of the South and Southeast, concentrated almost exclusively, rents *per capita* highest in the country. Are exception from this rule the Amazons and the Federal District, where the product *per capita* was the largest in the country in the period.

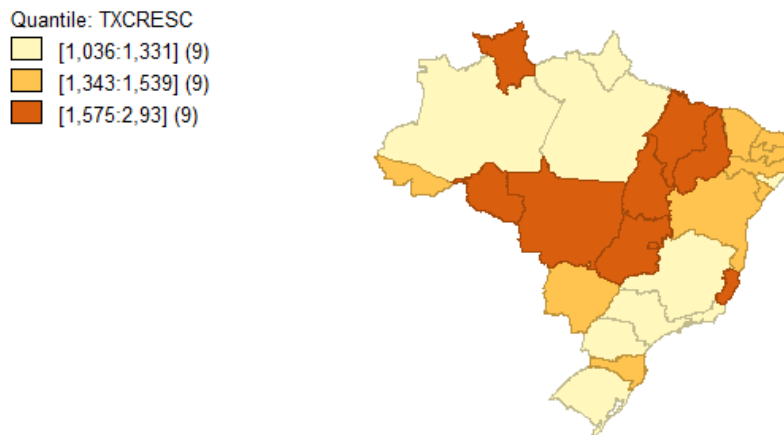


**Figure 2:** *Per capita* Income of Brazilian States (2010)

Source:Elaboration from data from IPEA, 2013

Taking as a reference the Figure 2 it can be observed that although the levels of *per capita* income have increased during the period from 1994 to 2010, are still evident disparities Interstates: the South-East and Southern States continued with the highest levels of *per capita* income in the country, the opposite scenario of North and Northeast. The rise in the Midwest, driven by the development of agribusiness, can be perceived by the entry of the State of Mato Grosso in the Group of the largest incomes *per capita* in the country. The State holds the title of largest national producer of grain. Data by the national supply company (CONAB) indicated that in 2011/2012 crop production was 40.4 million tons, worth more than the sum collected in the States of North, Northeast and Southeast together.

The visualization of growth rates of *per capita* income of Brazilian States shows is important to check if there is any tendency of reduction of disparities in the period, that is, if poorer States grew relatively more than the rich. These are illustrated in Figure 3.



**Figure 3:** Growth rate of *per capita* income of Brazilian States (1999-2010)

Source: Prepared from data from IPEA, 2013

The States of the South and Southeast regions were those with the smallest variations in income *per capita* over the period. Most States with high growth rates belonged to the North and northeast regions. In this group, are the two poorest States in the country in 1994: Maranhão and Piauí. Therefore that the States, which had lowest income levels *per capita* initials, were mostly the same as that presented the highest growth rates in the period. This scenario of States that had lower *per capita* incomes grow relatively more than those who had higher income *per capita* can be an indication of the existence of absolute convergence of *per capita* income in the period.

You can understand, therefore, that between the years of 1994 and 2010 there was in Brazil a thawing trend in income inequality, evidenced by the increased participation of the regions the Midwest, Northeast and North on national income, in addition to the significant increase of *per capita* income in traditionally underserved regions, such as the Northeast. In this context, the present study seeks to establish whether the socioeconomic scenario built post Real plan acted in order to reduce inequalities between the Brazilian States.

## 2-Methods

### 2.1. Exploratory Spatial Data Analysis

Instruments of Exploratory Spatial Data Analysis (ESDA) are used to assess the effects of space on the dynamics of the present variables in this study. The ESDA uses data georeferenced to the identification of patterns as the heterogeneity and spatial

dependence. The first refers to the structural instability, which can occur in the form of various coefficients or not variances in terms of error in space. The second effect, according to Anselin and Griffith (1988b, p. 15) occurs when the values of the dependent variable and/or the terms of errors on a site are correlated with the values of the corresponding observations in neighboring localities ". As part of this work, the effects will be analyzed this last space interaction.

For the calculation of indicators of Spatial autocorrelation, first, it is necessary to estimate a spatial weights matrix. Second Dassow (2010, p. 55) "the idea of spatial effects of a locality on the other is used for weights, through the array of weights or spatial weighting matrix". In the simplest version,  $W$  is a symmetric matrix in which every element  $w_{ij}$  takes on the value 1 if localities  $i$  and  $j$  are neighbors, and the value 0 otherwise. Generally, the array  $W$  is standardized through the Division of each element  $w_{ij}$  by the sum of the elements of its respective line. The contiguity rule adopted in this work was the Queen (Queen), in which are considered as neighboring units that have borders or common vertices

After estimation of spatial weights matrix, one can perform the calculation of Spatial autocorrelation measures. As the number of locales analyzed in this study is relatively small, only the global indicators of Association are sufficient. These indices provide a single measure for the set of all States, featuring the entire region of the study. The statistic  $I$  of Moran was chosen to detect the presence of this type of spatial dependence. Formally, it is defined by equation 1:

$$I = \frac{n}{\sum \sum w_{ij}} \frac{\sum \sum w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum (y_i - \bar{y})^2} \quad (1)$$

where  $n$  is the number of locales,  $y_i$  is the value of the attribute in analysis,  $w_{ij}$  is the spatial weight for the pairs of localities  $i$  and  $j$ .

The null hypothesis to be tested is that of spatial randomness and the alternative hypothesis, the presence of spatial dependency on the data. If the null hypothesis is rejected at a significance level of 5%, it is necessary to ascertain whether the autocorrelation is positive or negative.  $R$  values larger (smaller) than the value expected  $and(I) = -1 (n - 1)$  imply global autocorrelation positive (negative).

The preview of this spatial Association are check on the diagram of dispersion of Moran, which contains the value of the attribute studied for each location on the



horizontal axis and its spatial lag (average of the neighbouring us attribute) on the vertical axis. The diagram is divided into four quadrants (AA, BB, AB, BA), which are each corresponding to a pattern of spatial location association between the State and its neighbors. Localities of the quadrants (AA) and (BB) have positive Spatial autocorrelation, i.e. form clusters with similar attributes ' values. The regions belonging to the other two quadrants in turn have negative Spatial autocorrelation, i.e. are clusters with distinct values.

## 2.1-Income Convergence

To verify that the panorama of the Brazilian economy in the period 1994-2010 contributed to the reduction of inequalities in the country are tested for the existence of the convergence of *per capita* income of the Brazilian States. More precisely, the presence of the tested  $\beta$ -convergence, which occurs when there is a negative relationship between *per capita* GDP and its growth over the period studied. This kind of relationship implies that the *per capita* incomes of the relatively poorer localities have grown more than the rich regions, reducing existing disparities between them.

Barro and Sala-i-Martin (1992b) adopted the methodology used to test the  $\beta$ -absolute convergence. The explanatory variable is the initial level of GDP *per capita* by State Institute of applied economic research (IPEA). The dependent variable is the average growth rate of GDP *per capita* of the Brazilian States in the period 1994-2010. This relationship is given by equation 2:

$$\frac{1}{T} \ln\left(\frac{Y_{0+T}}{Y_0}\right) = \alpha + \beta_1 \ln(Y_0) + \varepsilon_{0,T} \quad (2)$$

in that  $Y_{0+T}$  is the GDP per capita of the State  $i$  in period  $T + 0$ ;  $Y_0$  is the GDP *per capita* in the initial period;  $T$  is the number of years between the beginning and end of the period studied;  $\alpha$  is a constant;  $\varepsilon_{0,T}$  is the random error term and  $\beta_1$  the parameter that indicates the presence or absence of income convergence. For this phenomenon to occur, the coefficient  $\beta_1$  must present negative sign and be statistically significant at the 5% level of significance.

In addition to the analysis of the absolute convergence, was also estimated a conditional model. In this type of modeling are included variables representing the savings, in order to differentiate them. Thus, unlike the first approach, localities converge to discrete stationary States which are conditional to the initial values of the attribute included in the template.

The variable used to characterize the localities was the Municipal Human Development Index (HDI-M) of the Brazilian States of 1991, made available by the United Nations development program (UNDP). For the composition of this indicator are taken into consideration the following aspects: average per capita household income of municipalities, gross school attendance rate, literacy rate of the population of 15 years old or more, life expectancy at birth. The closer to 1 the value of this index, the higher the level of development of the town. Although there are no data of this variable for the year 1994, since its availability is tied to years of Census of the Brazilian Institute of geography and statistics, its use proved to be extremely pertinent. Firstly, she characterizes the different units of the Federation in dimensions essential to the process of economic growth. In addition, as to their composition are collected specific information from the municipalities and the State as a whole not minimize the effects of generalization of data. In this way, although certain temporal lag, the inclusion in the conditional model of HDI-M of the units of the Federation in the year of 1991 proved a very useful alternative to illustrate the socioeconomic status of the Brazilian States at the beginning of the period analyzed in this work.

It was also included on a conditional dummy modeling to intercept the Northeastern States, the region with the lowest level of per capita income in 1994. The inclusion of this variable was the same procedure adopted by Azzoni (2001) to distinguish the different regions of Brazil and illustrate the presence of distinct stationary States in the country. Equation 3 show the  $\beta$ -conditional convergence test:

$$\frac{1}{T} \ln\left(\frac{Y_{0+T}}{Y_0}\right) = \alpha + \beta_1 \ln(Y_0) + \beta_2 X_{1,i} + \beta_3 D_{1,i} + \varepsilon_{0,T} \quad (3)$$

It is estimated a multiple linear regression, in which  $\beta_2$  is the parameter of the variable X 1, which corresponds to the IDH-M State in 1991 and  $\beta_3$  the dummy parameter of the States of the Northeast region. As in the previous approach, conditional convergence will occur if the parameter  $\beta_1$  introduce negative sign and is statistically significant at 5% of significance.

In order to calculate the length of time required to occur the absolute and conditional convergence in the Brazilian States, equation 4 was used:

$$v = \frac{\ln(1 + \beta_1 T)}{-T} \quad (4)$$

where v represented the speed of convergence.

Considering the estimated speed, the number of years for which *per capita* income «becomes half the level of its steady-state is given by the equation 5:

$$t = \frac{\ln(2)}{v} \quad (5)$$

where t is the time of half life.

### 3-Results and discussion

#### 3.1-Spatial Dependence

Initially, it was tested the hypothesis of spatial randomness of GDP *per capita* of the Brazilian States, i.e. it was found statistically if, in the years of 1994 and 2010, the GDP *per capita* of each State of Brazil were dependent of GDP per capita of its neighbors. The results of the bookmark I of Moran are presented in the Global Table 5:

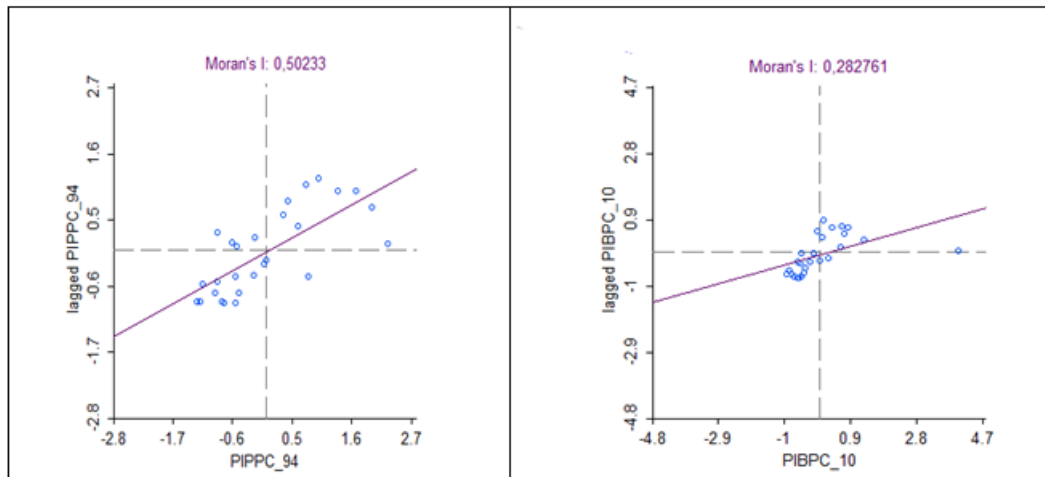
**Table 5:** I of Moran GDP Global *per capita* of Brazilian States (1994-2010).

Year	Variable	I of Moran	Expected Value	Probability
1994	GDP <i>per capita</i>	0.5023	-0.0385	0.001
2010	GDP <i>per capita</i>	0.2828	-0.0385	0.008

Source: prepared by using the GEODA software.

The probability associated with the I of Moran allows Global to reject the null hypothesis of spatial randomness of GDP *per capita* in the year of 1994, as in the year 2010. Since the computed value of I is greater than its expected value is positive Spatial autocorrelation present in the two years analyzed. This indicates that States with high (low) levels of GDP *per capita* tend to be near States that also have high (low) values of this variable. Spatial dependence on the values of GDP *per capita* has significant implications in terms of economic development of the regions of Brazil. Once this dependence exists, the adoption of public policies capable of improving the socioeconomic status of certain State ends up benefiting their neighbouring regions. This overflow effect of government policies can be considered an important factor towards reducing regional inequalities and to the very process of income convergence in the country.

Estimates regarding this Spatial autocorrelation of the GDP per capita of the Brazilian States can be illustrated through the Scatter diagram of Moran, as shown in Figure 4:



**Figure 4:** Scatter Diagram of Moran for the GDP *per capita* of the Brazilian States (1994-2010)

Source: prepared by using the GEODA software.

Through the above diagrams, it is possible to observe a slight concentration of the Brazilian States in the third quadrant (BB). There is predominance in the two years analyzed in agglomerations with States with low levels of GDP *per capita* that are neighborhood with locales that also have low values of this variable. In the year of 1994, fell in this pattern of global association Northeast region States, besides the Amapá, Pará and Tocantins. In 2010, became part of this cluster States of Acre, Rondônia and Roraima.

In relation to units belonging to the first quadrant (AA), characteristic of States with high values of GDP *per capita*, surrounded by neighbors with the same characteristics of this attribute, there hasn't been any change in the period, that is, those States that had this pattern of membership in 2010 are the same as they had in 1994. Are part of this group all the States of the South and Southeast regions, in addition to the Distrito Federal and Mato Grosso do Sul.

### 3.2 Convergence of *per capita* income of Brazilian States

Table 6 presents the estimates obtained through ordinary least squares estimation for equation 2, referring to the model of absolute convergence.

**Table 6:** Regression estimates of absolute convergence of GDP *per capita* for the Brazilian States (1994-2010)

Variable	Standard		T-statistic	P-Value
	Coefficient	Deviation		
Constant	0.1183467	0.04038116	2.930741	0.0071268
ln (GDP initial)	-0.0112301	0.004808969	-2.335244	0.0278556

Source: prepared by using the GEODA software.

The parameter  $\beta$ -convergence presents negative sign and is statistically significant at the 5% level, i.e. According to the model, the States with lower initial levels of *per capita* income growth rates were higher than those of the richest States in the period. To verify the effectiveness of these estimates, it is necessary to make the diagnosis of the estimated model. This information is presented in table 7:

**Table 7:** Regression Diagnostics of absolute convergence of GDP *per capita* for the Brazilian States (1994-2010)

R <sup>2</sup>	0.179073	Adjusted r <sup>2</sup>	0.146236
Akaike criterion	-154.355	Schwarz criterion	-151.763
F-Statistic	5.453	Prob (F-Statistic)	0.0278556
Test Jarque Bera	31.299733	Prob (Jarque-Bera)	0.0478811
Test Breuch-Pagan	0.0478811	Prob (Breuch-Pagan)	0.5175814
Number of observations	27	N° of multicollinearity condition	31.299733

Source: prepared by using the GEODA software.

According to the test Breuch-Pagan, the model features constant variance in terms of the error, that is, the waste is homoscedasticity. Once your condition number is less than 100, the multicollinearity is considered weak, do not constitute serious problem for analysis (CARVALHO et al., 1999). The criteria of Akaike and Schwarz, as well as the coefficient of determination and the F-statistic also does not indicate any kind of problem in regression. On the other hand, the test Jarque Bera indicates that the errors are not normally distributed. The normality assumption is essential for waste that results from linear regression are trusted. In this way, some kind of adjustment in the model of absolute convergence should be performed.

The presence of outliers in the data is considered one of the main causes of absence of non-normality. Outliers are disparate observations, atypical, that are not well adjusted by the model. To verify that this would be the reason for the problem was analyzed through a Box Plot, the distribution of the data on growth rates of GDP *per capita* between the years of 1994 and 2010. Their results showed three locations with disparate growth rates during the period. They are the Federal District and the States of Roraima and Tocantins. The significant variation in GDP *per capita* in these latter two States, possibly is tied to the fact that they submit extremely low values of this variable in 1994, so that any increase is quite significant in terms of growth rates. The presence of these outliers, probably justifies the lack of normality in the waste in the model of absolute convergence.

In order to solve this problem, a new regression was estimated, in which included a dummy representative of outliers identified. Table 8 presents the estimates found and table 9, model Diagnostics:

**Table 8:** Regression estimates of absolute convergence of GDP *per capita* for the Brazilian States corrected by including a dummy representative of outliers of economic growth (1994-2010)

Variable	Standard		T-statistic	P-Value
	Coefficient	Deviation		
Constant	0.1004041	0.02478936	4.05029	0.0004640
ln (GDP initial)	-0.0095265	0.00294561	-3.23415	0.0035355
Dummy	0.03300325	0.005023961	6.569168	0.0000009

Source: prepared by using the GEODA software.

**Table 9:** Diagnostics of absolute convergence of GDP *per capita* for the Brazilian States corrected by a dummy representative of outliers of economic growth (1994-2010)

R <sup>2</sup>	0.706611	Adjusted r <sup>2</sup>	0.682162
Akaike criterion	-180.136	Schwarz criterion	-176.249
F-Statistic	28.9013	Prob (F-Statistic)	0.000000
Test Jarque Bera	0.4797505	Prob (Jarque-Bera)	0.7867260
Test Breuch-Pagan	0.3965665	Prob (Breuch-Pagan)	0.8201375
Number of observations	27	N° of multicollinearity condition	32.875984

Source: prepared by using the GEODA software.

Table 9 indicate that the inclusion of dummy not only fixed the problem of absence of normality in errors, such as improved significantly the coefficient of determination of the model. Not being verified any more trouble in the diagnosis presented, infers that regression estimates of absolute convergence presented in table 8 are unreliable.

Thus, as the parameter associated with the initial GDP *per capita* has negative sign and is statistically significant at the 5% level, it is possible to observe the existence of a process of convergence of *per capita* income between the Brazilian States in the period from 1994 to 2010. The poorest states have grown more than the richest, in such a way that the hypothesis of  $\beta$ -absolute convergence of *per capita* income is accepted as true.

Through the coefficients obtained in table 8, it is possible to infer that the speed of convergence is 1.04% per annum and the half-life of 67 years, i.e., it is estimated that it would take approximately 67 years for income inequality between the Brazilian States if

reduced to half. In relation to the time of half-life, it is observed that the value found for the period 1994-2010 is much smaller than in other work on the process of convergence of *per capita* income of the Brazilian States. The half-life calculated for the period 1939-1995 by Azzoni (2001c) is 102 years, value similar to 103 years found by Carvalho and Santos (2007b) for the period 1980-2002. In this sense, it is possible to see that the Real Plan post scenario, characterized by stabilization of prices, by raising the minimum wage and income transfer policies, was favorable to the thawing process interstate disparities.

The literature has identified some variables partially correlated with the process of economic growth and that would effect, therefore, the phenomenon of income convergence. In this sense, to verify the influence of the IDH-M of States in this process, are presented in table 10 estimates for the equation of the conditional convergence and in table 11, the diagnosis of the model.

**Table 10:** Regression estimates of conditional convergence of GDP *per capita* for the Brazilian States after inclusion of dummy representative of the Northeast region (1994-2010)

Variable	Standard		T-statistic	P-Value
	Coefficient	Deviation		
Constant	0.3072679	0.05216794	5.889976	0.0000053
ln (GDP initial)	-0.0462557	0.00875485	-5.283441	0.0000232
HDI-M	0.239082	0.06444051	3.71012	0.0011522
Dummy Northeast	-0.0118037	0.00543230	-2.17288	0.0403412

Source: prepared by using the GEODA software.

**Table 11:** Regression Diagnostics of conditional convergence of GDP *per capita* for the Brazilian States between 1994 and 2010, after inclusion of the dummy representing the Northeast region (1994-2010)

R <sup>2</sup>	0.563598	Adjusted r <sup>2</sup>	0.506676
Akaike criterion	-167.415	Schwarz criterion	-162.232
F-Statistic	9.90122	Prob (F-Statistic)	0.000220625
Test Jarque Bera	2.515181	Prob (Jarque-Bera)	0.2843383
Test Days-Pagan	6.324514	Prob (Days-Pagan)	0.0968462
Number of observations	27	N° of multicollinearity condition	86.085612

Source: prepared by using the GEODA software.

Before analyzing the estimated coefficients and their implications, it is necessary to ascertain whether the diagnosis model, presented in table 11, ensures that the parameters found are efficient and reliable. Through the testing Days and Bera-Jarque-

Pagan, it is observed that the waste is normally distributed and homoscedasticity. The condition number indicates the presence of multicollinearity weak, which does not represent a serious problem for tests. Moreover, the coefficient of determination and the F-statistic suggest a good adjustment of the IDH-M and the dummy at the convergence model. As was not detected any problem in regression Diagnostics, it is possible to make inferences from their coefficients, set out in Table 10.

The explanatory variable HDI-M presents positive sign and is statistically significant at 5%. These results indicate the positive influence of the development of municipalities in the growth rates of GDP *per capita* of their States. As for the composition of this index are taken into consideration aspects related to education and longevity, the results of the model show the importance of factors such as the quality of education and the welfare and health of the population in the States economic growth. In this sense, public investment in such sectors in the poorest parts of the country can be an efficient means of promoting the growth of same, thus contributing to the reduction of disparities Interstates.

As well as in absolute approach, the parameter  $\beta$ -convergence in the conditional model also is statistically significant and negative. However, this result does not imply reduction of income inequality in the country. He suggests only that peer States in HDI-M, that is, with similar characteristics, are converging in the long term, for the same steady state. The fact of the dummy to be statistically significant proves this result, as it indicates that the Northeastern States converge on levels of *per capita* income different from other regions of the country. In this way, in the long run, can persist in Brazil a high degree of inequality Interstate, in rich economies will remain rich, and the poor, will remain poor.

The speed of convergence in this conditional model is 9% per year, which represents a half-life of approximately 8 years, i.e. 8 years are needed for that income disparities between the States of same level of HDI-M reduce to half.

## **5-Conclusions**

Through the use of data on the socioeconomic situation of the Brazilian States in the Decade of 1990, this study had as its main objective to analyze if the scenario post Real plan contributed to the reduction of inequalities in the country Interstates. For this, it has been tested for the presence of absolute and conditional income convergence in the period. Additionally, with the use of techniques of spatial Econometrics, we evaluated the effects of spatial dynamics of GDP *per capita* in the years 1994 and 2010.



The positive values of I of Moran Global per capita GDP in the two years analyzed indicated the existence of positive autocorrelation between the Brazilian States in the period. The occurrence of spatial dependence implies that the level of *per capita* income of each State in the country is not independent of the observed values of this variable to your neighbors. As discussed, the presence of these spillover effects can be seen as a relevant factor to easing regional inequalities and to the very process of income convergence.

In the case of absolute convergence, the first model estimated, based on the methodology used by Barro and Sala-i-Martin (1992c), presented the absence of normality in the distribution of waste. Since this problem implies inefficient estimators and few reliable, it was necessary to include in a dummy representative of regression outliers of economic growth, that is, States which had excessively high growth rates during the period. As this procedure not only solved the issue of normality in errors, such as improved coefficient of determination of the regression, this new model proved to be quite appropriate. Its estimates confirm the hypothesis of the absolute convergence of per capita income in Brazil after 1994. Furthermore, indicate that it would take 67 years for the disparities between the Brazilian States to reduce to half.

In relation to the conditional model regression was used to estimate the behavior of output growth rate *per capita* in the period States depending on the *per capita* State product in 1994, the IDH-M States in 1991 and a dummy representing the Northeastern States. The parameter associated with the IDH-M and is statistically significant, showed positive sign, proving the importance of the aspects represented by this indicator in the process of growth of State income. The model also pointed out the presence of conditional convergence, so that States with different characteristics are not necessarily converging on the same steady state in the long run. This scenario of different final levels of *per capita* income in the country was also proven by the fact that the dummy added to the model to be statistically significant, illustrating that the Northeastern States converge towards a steady state distinct from other Brazilian regions.

Once aspects represented by the HDI-M are extremely important to the economic growth process of the Brazilian States, the results of the conditional analysis can be considered more accurate than the absolute approach. In this way, it should be noted that, although the Real Plan post scenario presents some significant advances in terms of Equalization of income level in the country, as the increased participation of the regions the Midwest, Northeast and North on national income, in addition to the significant

increase of *per capita* income in traditionally underserved areas, like the Northeast, conditional convergence estimates indicate a trend of permanence Interstates inequalities, associated with distinct structural features of the Brazilian States. Soon, so that this equalization process occurs in Brazil, is critical to reducing socio-economic disparities between their States. In this sense, government policies in traditionally underserved locales, with focus on key sectors such as education are essential for the construction of a more equitable country.

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