REGIONAL *PER CAPITA* INCOME INEQUALITY REDUCTION IN BRAZIL FROM 1995 TO 2005: LABOR PRODUCTIVITY CONVERGENCE OR PUBLIC INCOME TRANSFERENCES?

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Resumo
O trabalho faz uso de macro e micro dados para analisar em que medida a redução da desigualdade regional de renda *per capita* ocorrida entre 1995 e 2005 deriva da convergência da produtividade do trabalho ou dos efeitos espaciais ou regionais de políticas públicas federais não-espaciais como o aumento do salário-mínimo no período e as transferências públicas de renda. Os resultados mostram que apesar de haver convergência regional de produtividade do trabalho, cerca de 17,4% e 21% da diminuição da desigualdade regional brasileira de renda *per capita* pode ser atribuída, respectivamente, às transferências de renda e aos aumentos do salário-mínimo que beneficiaram relativamente mais os estados mais pobres do país entre 1995 e 2005. A conclusão geral é que tanto as políticas públicas federais não-espaciais de amparo aos indivíduos mais pobres do país como, principalmente, a convergência de produtividade de trabalho (argumento neoclássico) favoreceram a redução da desigualdade regional de renda *per capita* no país.

Palavras-chave: convergência, produtividade do trabalho, transferências de renda.

Abstract
The work uses both macro and micro data to analyze the forces explaining Brazilian regional *per capita* income inequality reduction from 1995 to 2005. The results point out that both labor productivity convergence (neoclassical argument) and public federal non-spatial policies, mainly minimum-salary growth and income transference programs, do have a role in explaining regional inequality reduction during the period. More specifically, it is shown that income transference and the minimum-salary growth explain, respectively, 17.4% and 21% of Brazilian regional *per capita* income inequality reduction from 1995 to 2005. The general conclusion, thus, it that both public federal non-spatial public policies and, mainly, labor productivity convergence explain Brazilian regional *per capita* inequality reduction from 1995 to 2005.

Key-words: convergence, labor productivity, income transference.

Código *JEL*: R11, R12.

Área 9 – Economia Regional e Urbana

Regional *per capita* Income Inequality Reduction in Brazil from 1995 to 2005: Labor Productivity Convergence or Public Income Transferences?

1. Introduction

Although its well known high inequality level, as recently shown by some researchers (Barros, et. al. 2006; Ferreira, et. al., 2006; Hoffman, 2006; Soares, 2006), Brazilian income distribution appears to be becoming consistently less concentrated in the last fifteen years. Less perceived, this less concentrated income distribution has an important spatial dimension in the country: *per capita* income of poor states has been growing at a higher rate than that of the richer ones. To be more precise, of 27 federal units, only 9 presented a lower rate of *per capita* income growth than these of São Paulo state, the richest one, from 1995 to 2005. In the same period, seven of the nine Northeast states, the poorest region, presented a higher rate of *per capita* growth than that of São Paulo.

Theoretically, there is a potential immediate explanation for this spatial convergence from 1995 to 2005: the well known convergence propriety of Neoclassical model of growth. According to this propriety, as compared to those of richer states, the higher capital marginal productivity in poorer states implies a higher rate of accumulation and growth. So we would observe convergence in labor productivity among Brazilian states.

But, at least for the spatial dimension of recent Brazilian inequality reduction, things are not so simple. In fact, during the period from 1995 to 2005, there were at least three general important economic phenomenons that potentially favored more poor states than rich ones in Brazil. First, during these years the rate of inflation fell substantially, which, at least potentially, tended to favor proportionally more states with proportionally more poor people than states with proportionally less poor people. Secondly and more objectively, contrasting with the almost stationary dynamic of Brazilian *per capita* income, there was a significant real growth of Brazilian minimum-salary, which, again, tended to favor proportionally more the poorer states, since they have a labor force more dependent on this base line salary. Finally, the period is one characterized by unprecedented federal income transferences to poor people (for example, the Bolsa-Família program). Once more, as poor Brazilian states present proportionally more poor people, they have been receiving in *per capita* terms more resources from federal transferences.

The general objective of this work is to determine what kinds of forces explain the regional *per capita* income inequality reduction in Brazil from 1995 to 2005. To this end, the paper first investigated if there was labor productivity convergence. Then it identifies what are the roles of public income transference and of minimum-salary in the observed regional *per capita* income inequality dynamic in Brazil.

In order to organize the investigation, the next section begins by presenting some evidence about spatial effects of non spatial public policies in Brazil from 1995 to 2005. In section three both macro and micro data are used, first to describe Brazilian regional *per capita* income inequality evolution, second, to investigate if there was labor productivity convergence and, third, to determinate how this dynamic is linked to that of regional *per capita* income inequality. In the section four we estimate both the role of

public income transference and minimum-salary policies in Brazilian regional *per capita* income inequality reduction from 1995 to 2005. The conclusions of the work are presented in section five.

2. Potential regional impact of non-spatial public policies

At least three general important events characterized the Brazilian economic environment during the period from 1995 to 2005 implying important possible spatial or regional differentiated impacts. First and most basically, the period is marked as one of low inflation by Brazilian standards: inflation rate fell from more than 30% per month during 1993 to less than 5% per year in 2005. If, as most believe, high inflation affects more the poor individual than the rich one and if there were proportionally more poor individuals in Brazilian poor states than in rich ones, the low inflation phenomenon has potential for causing regional differentiated effects. Secondly, during the period, as compared to average income, there was a significant real growth of the Brazilian minimum-salary; more specifically, this salary grew almost 42% in real terms and, for example, Brazilian *per capita* household income grew 0.9% from 1995 to 2005. Again there is a potential spatial or regional differentiated impact here, since the population of poor Brazilian states population are much more dependent on changing this baseline salary. The last and probably clearer effect comes from the non-intentional spatial bias of public income transference programs, mainly the Bolsa-Família program from 2003 to 2005. As the Northeast Brazilian region has absolutely and proportionally more poor people than any other region, its states have been favored with this kind of federal resources.

Note that all the three potential regional or spatial differentiated impacts come from general or individual focused policies, a situation very different from traditional sector regional policies presented in Brazil during the 1960's and 1970's. To highlight the potential regional differentiated impacts of these policies, table 1 presents some information about regional labor markets and social conditions in Brazil.

Table 1 – Regional differences in social and labor market conditions in Brazil – Values in percentage (%) of labor force (informal) or of population (others) - 2005.

	Degree of Informality	**Labor income <= Minimum wages**	***Per capita* household income < R$150**
North	59.3	47.0	53.0
Northeast	61.4	63.4	69.0
Southeast	44.8	26.9	33.2
South	43.4	31.8	32.2
Centre-West	49.5	32.6	35.9
Brazil	50.5	39.5	44.8

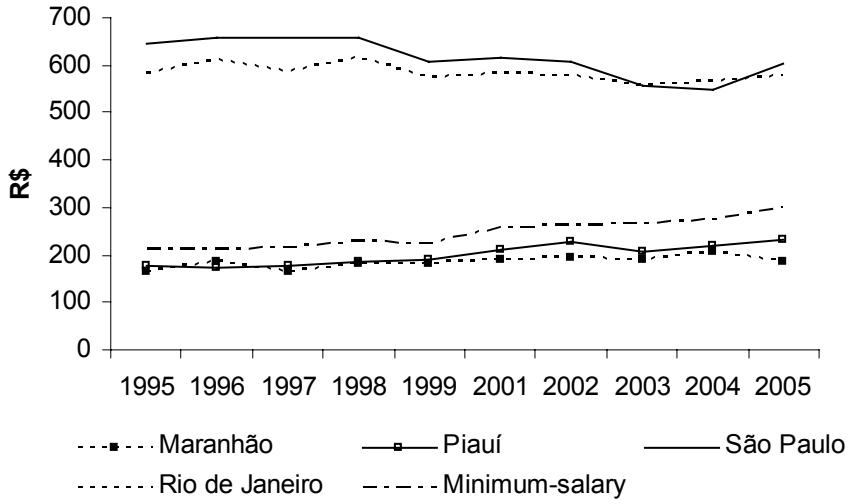
Source: author calculation from PNAD micro data. The degree of informality includes employed without formal contract, self worker, and worker in activities for self consumption or in building for self use. The value of R$ 150,00 corresponded to a half of minimum-salary in 2005.

From the first data column, note that the poorest region, Northeast, presented more than 60% of its labor force in the informal sector. On the other hand, the richest regions of Southeast and South presented the majority of their labor force in the formal sector. The numbers in table 1's second column also suggest that workers from poorer

regions are much more minimum-salary dependent. Additionally, it is possible to observe from table 1 data third column that, among Brazilian regions, Northeast region also present the highest parcel of poor in its population. Thus, this region presented more individuals as candidate to receive benefits from federal public income transfer programs.

To give more objectiveness to the potential differentiated regional impacts of these non-spatial policies, by choosing the cases of the two richest states (São Paulo e Rio de Janeiro) from the richest region (Southeast) and of the two poorest states (Maranhão e Piauí) from the poorest region (Northeast), the following graph 1 shows how regional differentiated is the relationship between the dynamic of sates' *per capita* income and that of the minimum-salary.

Graph 1 - Evolution of minimum-salary and of *per capita* income - two poorest and two rirchest states

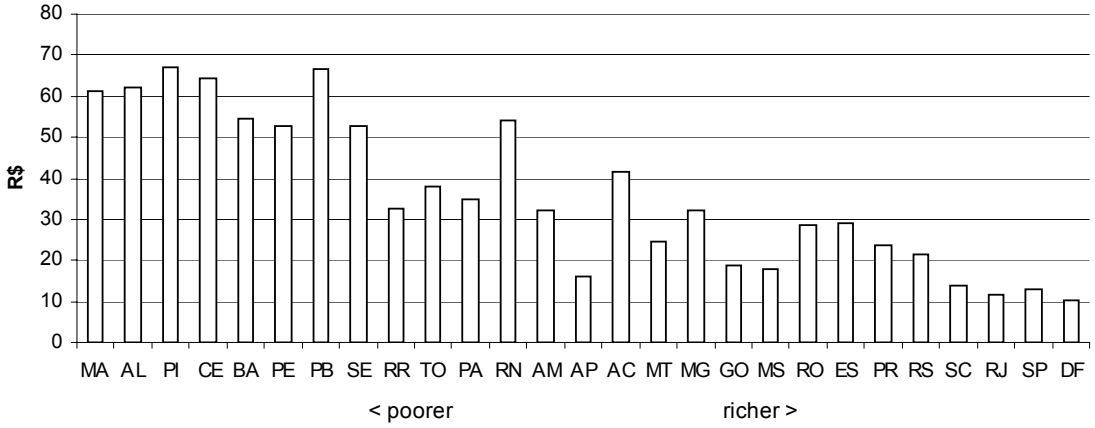


Source: author calculation from PNAD micro data and IPEA data base.

This shows that the *per capita* income trajectories for the states of Maranhão and Piauí are very close to that of minimum-salary from 1995 to 2005. On the other hand, such a link does not appear to exist when considering *per capita* income trajectories of the rich states of São Paulo e Rio de Janeiro in the same period. More specifically, simultaneously to a real minimum-salary growth of 41% during the period from 1995 to 2005, the *per capita* income rates of growth for the poorest states of Maranhão e Piauí were, respectively, 11,7% and 32,8%, while they were negative for both São Paulo e Rio de Janeiro sates (respectively, -6,5% and -0,5%).

Besides from this potential regional differentiated effect of minimum-salary, the following evidence from graph 2 do not permit any doubt about the regional or spatial bias in the federal public income transference program of Bolsa-Família. In general, not only more resources have been directed to poor states, but the 15 states receiving more federal public transferences (in *per capita* terms) are located in only two geographic regions, Northeast and North of Brazil. To put the spatial contrast in a more dichotomist way, although representing 28% and 15%, respectively, of Brazilian population and GDP, the Northeast region received almost 52% of Bolsa-Família resources in 2005. By contrast, in the same year, the Southeast region, that was responsible for 42% and 55% of Brazilian population and GDP, received 24% of Bolsa-Família resources.

Graph 2 - *Per capita* public income tranference of Bolsa-Família program - 2005



Source: author calculations using PNAD micro data and data from Ministry of Social Development.

In this article we analyze both the influences of these non-spatial forces and that of the labor productivity convergence on regional *per capita* income inequality reduction in Brazil from 1995 to 2005.

3. Income regional inequality evolution in Brazil from 1995 to 2005

In this section we initiate the investigation into the specific potential role of labor productivity convergence and that of non-spatial federal public policies on the dynamic of regional *per capita* income reduction from 1995 to 2005. To begin with, sub-section one presents evidence about the evolution of regional *per capita* income inequality in Brazil obtained from traditional convergence tests, known as β-convergence and σ-convergence tests (Barro and Sala-I-Martin, 1995). In the second sub-section, the investigation is complemented by considering other traditional inequality measures.

3.1 Traditional convergence tests

Although it is not possible to entirely isolate the different effects of labor productivity and those of minimum-salary and of income transference on the dynamic of regional inequality by using traditional convergence tests, two reasons justify their consideration here. First, contrary to the majority of traditional inequality measures, they are theoretically well established, i.e., they can be derived, for example, from the Neoclassical growth model. Additionally, by considering both labor productivity and *per capita* income measures they provide a kind of necessary condition for establishing the importance of labor productivity convergence in Brazilian regional *per capita* income reduction.

Initially, table 2 shows the estimative of β-convergence, i.e., obtained by regressing states *per capita* income growth or labor productivity growth on initial levels of respective variable, formally:

$$\frac{\ln(y_{T_i}) - \ln(y_{0i})}{T} = \alpha + \beta \ln(y_{0_i}) + \varepsilon_i \quad (1)$$

Where y_{Ti} and y_{0i} are state *i* labor productivity or *per capita* income, respectively, at the final and initial periods, *T* is the time interval, α and β are parameters and ε_i is an error term.

In order to investigate the potential role of productivity versus non-spatial public policies on Brazilian regional inequality reduction, four dependent variables are considered. On one hand, by using states valued added or product, both states labor productivity and *per capita* product are considered; on the other hand, by using states individual micro data, sates *per capita* income and labor *per capita* income are also considered.

Although potentially also reflect indirect influence of non-spatial public policies[1], the dynamics of the first two measures are fundamentally and theoretically linked to the Neoclassical convergence growth model propriety and, in this way, they could reflect a less government dependent inequality reduction or a more economically consistent movement. Different from this, the two based income measures can potentially reflect both labor productivity convergence and the influence from public non-spatial policies on regional inequality reduction (mainly, minimum-salary and public income transference). Note that, in particular, by considering separately *per capita* labor income it is also possible to control the effects of public income transference programs on regional *per capita* income dynamic (but not for those from minimum-salary).

The set of estimative are presented in table 2. The qualitative most important point to highlight is that, as can be noted by the negative and statistically significant values of β coefficients, all results favor regional inequality reduction, i.e., poor states tend to grow more than rich states. Thus, qualitatively, the convergence regression tests result do not depend on the measures of product or income that have been used, which confirms the results first pointed out by Silveira-Neto and Azzoni (2005).

Apart from the situation in which non-spatial public policies have very strong indirect impacts on productivity, this conclusion is the first indicator that it is not possible to attribute entirely to non-spatial public policies the observed regional per capita income inequality reduction in Brazil from 1995 to 2005. In the other words, the evidence suggests that labor productivity convergence does have a role to play in explaining Brazilian regional inequality dynamic. Note, consistent with this perspective, the highest determination coefficient (R^2) is found in labor productivity regression (regression (I)).

But there are also important quantitative differences in using the measures. Firstly, the convergence coefficients are bigger when using incomes (regressions (III) to (VI)) than when using product (regressions (I) and (II)). This implies that from 1995 to 2004 the convergence process was faster for incomes than for products. Specifically, and taking the Neoclassical model as reference for getting an objective measure, the highest speed of convergence is found when using *per capita* income: 3,7% of the gap between

[1] For exemple, through induced spending.

current *per capita* income and its steady-state value vanishes in one year[2]. This measure is much lower when considering labor productivity (1,6%) and *per capita* GDP (1%). This evidence favors an important role for non-spatial public policies (income transference and minimum-salary policies) in regional *per capita* income reduction in Brazil. Note that even when we control public income transferences influence on convergence by considering only labor income (regressions (V) and (VI)), a high value to the speed of convergence (3%)[3] is obtained, which is consistent with the important potential role for minimum-salary on regional convergence.

Table 2 – Convergence regressions – Dependent variable is state product or income growth from 1995 to 2004 – OLS and ML estimative.

	Labor productivity	***Per capita* GDP**	***Per capita* income**		***Per capita* labor income**	
	(I)	(II)	(III)	(IV)	(V)	(VI)
constant	0.159*	0.103*	0.142*	0.314*	0.103*	0.236*
	(0.046)	(0.034)	(0.054)	(0.112)	(0.051)	(0.112)
Ln y_0	-0.016*	-0.010*	-0.024*	-0.038*	-0.020*	-0.030*
	(0.005)	(0.004)	(0.009)	(0.013)	(0.009)	(0.014)
Spatial error coefficient	-	-	-	0.576*	-	0.436
				(0.207)		(0.256)
R^2	0.2394	0.1516	0.1934	-	0.1509	-
N. observations	27	27	27	27	27	27
Spatial diagnostic tests						
Moran's I	1.038	1.020	2.359*	-	1.743	-
***Error* robust Lagrange multiplier**	1.297	0.004	4.917*	-	4.571*	-
***Lag spatial* robust Lagrange multiplier**	1.036	0.006	3.492	-	3.774	-

Sources: author estimative using data from PNAD and from Regional Accounts, both from IBGE. White robust heterocestadicity standard-error in parenthesis; the symbols * indicate statistic significance at 5%. Columns (I), (II), (III) and (IV) estimative are obtained by OLS and columns (IV) and (VI) estimative were generated by using Maximum-likelihood estimator. It is used a contiguity matrix for spatial correlation tests and regressions.

A second more technical point to highlight is the implications derived from the results of spatial diagnostic tests and spatial error regressions. Observe that only for *per capita* income regressions were spatial correlations detected, which, again, is consistent with spatial differentiated impacts of non-spatial public policies. Moran's I statistic for OLS residues, a general spatial correlation statistic, is significant in fact only to the *per capita* income growth case. The results of the two other specific tests, *error* robust Lagrange multiplier and *lag spatial* robust Lagrange multiplier, show, respectively, that for both *per capita* income and labor *per capita* income cases we reject the null

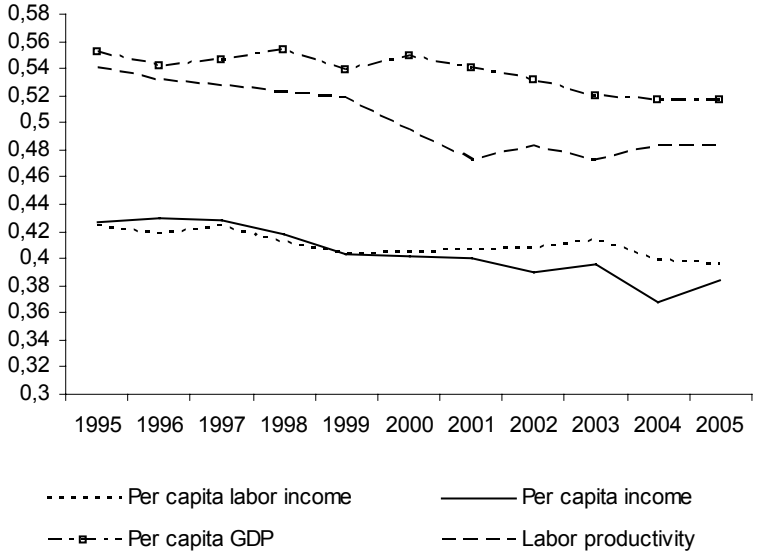
[2] This follows from the Neoclassical model of growth, where it is possible to derive an specific version of equation (1) with $\beta = \left[\left(1 - e^{-\lambda T}\right)/T\right]$, where λ is the speed of convergence.

[3] To compare with, Barro and Sala-I-Martin (1995) founded a speed of convergence near of 2% for US states case from 1890 to 1990.

hypotheses of no spatial correlation against the alternative hypotheses of a spatial error regression model. In the same way, we do not reject the same null hypotheses against the alternative hypotheses of a lag spatial model regression[4]. Note that both estimative of the spatial error model, obtained by maximum-likelihood, generate a higher convergence coefficient.

As it is now well known, by dealing only with the mean relationship between initial level of development and growth for a set of geographic units, the β-convergence test does not say much about other moments of *per capita* income distribution. In particular, it could be possible that the variance of *per capita* income distribution had grown even if there was β-convergence. Thus, the following graph 3 presents the called σ-convergence test, i.e., the evolution from 1995 to 2005 of the standardized-deviation for the distributions of the four measure we have considered above.

Graph 3 - Evolution of Brazilian regional inequality of *per capita income* and of *per capita* GDP - Standard-deviation of logaritm



Source: author calculations using PNAD-IBGE micro data and Contas Nacionais data, both from IBGE (Brazilian Institute of Geography and Statistics).

Initially, as can be noted by the value of correspondent standardized-deviations, we observe that regional inequality levels are higher for product measures than for

[4] The spatial error model assumes the following specification $g_y = \alpha + \beta \ln y_0 + \psi W\varepsilon + \mu$, where g_y is the growth of *per capita* income, ψ is a spatial parameter to be estimated, W is the assumed spatial matrix of distance relation and μ is well behaved error component (i.i.d). On the other hand, the lag spatial regression model assume spatial correlation in the dependent variable, i.e.: $g_y = \alpha + \beta \ln y_0 + \rho W g_y + \nu$, where ρ is the spatial parameter to be estimated and ν is well behaved error component (i.i.d). The first spatial specification, which is associated to omitted spatial correlated variables, implies that the OLS estimator is not efficient; the second specification has a more serious consequence to OLS estimator: it becomes biased and inconsistent. See Anselim (1988) for a discussion.

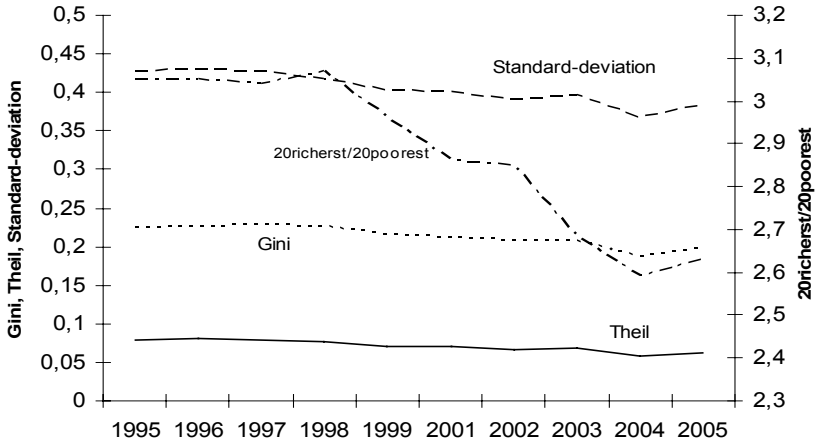
income measures. This can potentially be explained both by federal inter-states income transferences (ex. Bolsa-Família program) and by the difficulties in measuring capital incomes from household research[5].

The second and most important point to highlight is that, for all four measures, it is possible to note that there was σ-convergence from 1995 to 2005. In others words, confirming regression results, from the evolutions of the standardized-deviations we observe a reduction in their values from 1995 to 2005. More specifically, it is possible to note that the strongest reduction occurred for labor productivity standardized-deviation, which, once more, indicates that regional labor productivity convergence had a role to play in regional *per capita* income inequality reduction in Brazil from 1995 to 2005. But we also observe that regional *per capita* income inequality reduction is stronger than regional *per capita* labor income, which is also consistent with an important role to the public income transferences in regional convergence.

3.2 Evidence from traditional inequality measures

The robustness of the above results is tested by also considering traditional inequality measure used in micro data analysis. Apart from this objective, some of these measures also permit the decomposition of inequality changes by different sources of income we consider in the next section, so it is important to know how well regional inequality dynamic in Brazil from 1995 to 2005 as measured by traditional inequality indices can be a good approximation to regional inequality evolution as measured by traditional convergence tests indicators. Working with only the states *per capita* income at this stage, the following graph 4 presents the evolution of three additional inequality measures from 1995 to 2005: Gini indices, Theil coefficient and the ratio average income of 20 per cent richest to average income of 20 per cent poorest states[6].

Graph 4 - Evolution of Brazilian regional inequality of *per capita* income



Source: author calculation from PNAD micro data.

[5] The hypothesis is that richer states present a higher level of capital incomes than poorer states.

[6] Individuals from the 20 percent richest group belong to the state of São Paulo and Distrito Federal, on the other hand, those from the 20 percent poorest group belong to the states of Maranhão, Piauí, Alagoas, Ceará e Bahia (all from Northeast Brazil).

Again, for all traditional measures, it is possible to note the regional *per capita* income inequality reduction in Brazil from 1995 to 2005, which is particularly strong for 20richest/20poorest ratio. Thus, the work definitively assumes from now on that there was regional *per capita* income inequality reduction in Brazil from 1995 to 2005.

Furthermore, it is interesting to observe that regional inequality dynamic shown through Gini indices is very similar to that shown by standard-deviation of *per capita* income; more quantitatively and specifically, while Gini indices fell 11,7% from 1995 to 2005, standard-deviation presented a reduction of 10%. So, measuring Brazilian regional inequality evolution from 1995 to 2005 using the traditional Gini indices measures is a very good approximation to σ-convergence test.

In the next sections, the different roles of public income transference, of labor market, and these of minimum-salary dynamic on regional *per capita* income reduction in Brazil that it was just shown are more deeply investigated.

4. Decomposition of Brazilian regional income inequality and its changes from 1995 to 2005

If individuals have different sources of income, the level of regional income disparity among regions of a country depends both on how the different sources of income are distributed among these regions and on the relative importance of each source of income in total income. For example, if the total income results of labor income and social security income only, a high level of regional income inequality can be explained by the high level of regional concentration on labor income and, as is normally observed, by the high participation of labor income in total income. Thus, the evolution of regional disparities are influenced both by the changes in the levels of regional concentration of each source of income and by the changes in the participations of each source of income in total income.

As for the case of Brazilian regional disparities, at least three probable occurrences can be stated for the period from 1995 to 2005. First, as part of social security income is attached to minimum-salary and in view of the strong growth of this base line salary, there is a good chance of growth in the participation of this source of income in total income. The effect of this probable change on regional disparities depends, of course, on how this specific source of income is distributed among regions. Second, as noted above, during the period from 1995 to 2005 public income transferences favored the poorest state; so, if this source of income did not reduce its participation in total income, the movement potentially contributed to a reduction of Brazilian regional income disparity. Finally, the strong growth of minimum-salary could also be responsible for a better regional labor income distribution if its impact on poorer states is bigger than on richer states. In this way, a better regional distribution of total income in 2005 could be the result of a regional progressive movement of labor income, i.e., favoring the poorest states.

In the next sub-section, focusing specifically on the Gini coefficient, a way of decomposing these different effects is presented. The method highlights, for each source of income, two potential dynamic effects, a concentration-effect and a participation-

effect. The second sub-section presents the results of this decomposition for the evolution of Brazilian regional per income inequality change during the period from 1995 to 2005.

4.1 A decomposition of inequality measures

As recently pointed out by Hoffman (2006), based on the Shorrocks (1982) decomposition, if individuals present different sources of income, some inequality measures can be expressed as a sum of the inequality indicators from each source of income multiplied by the correspondent participation in the total income. As for the case of the traditional Gin coefficient, for example, the value of this indicator (G) can be put as:

$$G = \sum_{i=1}^{n} \alpha_i C_i \quad , \tag{2}$$

where, n is the number of different income sources, α_i represents the participation of source i on total income, and C_i is a measure of how pro-poor (pro-rich) this specific income is distributed .

This last measure, the concentration coefficient, can be obtained from a concentration curve, which shows, for a source of income, how the accumulated proportion of income parcel i is related to the population accumulated proportion, when individuals are ranked according to total income. More specifically, with β_i defined as the area between the concentration curve of income source i and abscissa axis, the concentration coefficient can be calculated as:

$$C_i = 1 - 2.\beta_i \quad . \tag{3}$$

Note that if the source income i is integrally direct to the poorest individuals (regions), poverty condition measured in terms of total income, the value of coefficient of concentration is -1 (because the β_i would be equal to 1). In the opposite case, source income i is integrally direct to the richest individuals (regions), the value of coefficient would be 1 (because the β_i would be equal to zero). Thus, this coefficient is limited to the interval [-1;1], which differs from Gini coefficient interval ([0;1]) because the concentration curve is not decreasing, different from Lorenz curve, an increasing curve.

For two dates, t e t-1, it is possible to observe how much of Gin temporal variation can be attributed to the sources of income participations' variations (participation-effect) and how much of this variation can be attributed to the source income distributions' variations. As showed by Hoffman (2006), with different dates Gini defined as:

$$G_{t-1} = \sum_{i=1}^{n} \alpha_{it-1} C_{it-1} \quad \text{e} \quad G_t = \sum_{i=1}^{n} \alpha_{it} C_{it} \ , \tag{4}$$

and so,

$$\Delta G = \sum_{i=1}^{n} \left(\overline{C}_i \Delta\alpha_i + \overline{\alpha}_i \Delta C_i \right), \qquad \text{where } \overline{C}_i = \frac{1}{2}\left(C_{it} + C_{it-1}\right) \text{ and } \overline{\alpha}_i = \frac{1}{2}\left(\alpha_{it} + \alpha_{it-1}\right). \tag{5}$$

After some manipulation, this last expression can be put in a way that shows the different influences of temporal sources income variations: a part that reflects variations on the level of concentration of these sources (concentration-effect) and a part that can be attributed to variations in participations in total income (participation-effect). Formally:

$$\Delta G = \sum_{i=1}^{n} \left(\overline{C}_i - \overline{G}\right)\Delta\alpha_i + \sum_{i=1}^{n} \overline{\alpha}_i \Delta C_i \,, \qquad \text{where } \overline{G} = \frac{1}{2}\left(G_t + G_{t-1}\right). \tag{6}$$

The first right side term of equation (6) represents the participation effect. It is possible to note that a specific source *i* participation increasing in total income would help in lowering Gini coefficient only if the distribution of this parcel of income was more pro-poor than total income distribution. The second right side term of equation (5) represent an effect of concentration: a pro-poor change in a specific source of income, in other words, a reduction in its concentration coefficient, favors a reduction in total income regional inequality, and the more important this parcel of income, the stronger the effect.

Observe that, in using this decomposition for studying the evolution of regional inequality with micro data, it is possible to assume regions as units of observation, or to assume individuals with the regional *per capita* income as units of observation. The positive point about the second expedient is that, different from the first, it takes into account the importance of population localities. So, the following analysis considers this approach, but results do not substantially change if we take regions as unit of observation[7].

4.2 The contribution of different income sources to the Brazilian regional income inequality levels from 1995 to 2005

Taking into consideration the nature of the sources of income and the partition possibilities of Brazilian annual household micro data research of PNAD (Pesquisa por Amotra de Domicílio), the analysis assume the following partition for the Brazilian states *per capita* income: i) labor income, ii) social security and pensions incomes, iii) interest, dividends and other incomes (denoted by "interest, dividends and transferences") and iv) rents and donations[8].

In the following analysis, some observations have to be kept in mind about this partition. Firstly, the labor income parcel effects on regional inequality include that of minimum-salary dynamic, which, as was seen, appears to benefit more poor states than rich ones. In the same way, because some benefits are attached to minimum-salary, the potential effects of the dynamic of this base line salary also act through social security and pension income parcel. Finally, interest, dividends and transferences parcel includes the Bolsa-Família resources, the most important public income transference program[9].

Initially, the following table 3 presents the source of income participation evolution during the period from 1995 to 2005. From the evidence, three important

[7] If required, the authors can make the results available.

[8] An identical partition was recently used by Kakwani, Neri and Son (2006). Hoffman (2006) and Soares (2006) have also used similar partitions.

[9] Unfortunately, it is not possible to disaggregate this source of income by each inside components (dividends, interest and transferences).

changes should be highlighted. First, it is clear that labor income component loosed importance in total income. Specifically, it represented up to 80% in 1995 and 76% of total income in 2005. On the other hand, social security and pensions parcel and, mainly, interest, dividends and transferences parcel became consistently more important (from 0,9% to 1,8% of total income). Second, different from social security and pensions parcel, the interest, dividends and transferences parcel participation in 2005 is entirely explained by the movement of the period from 2001 to 2005, which is consistent with the higher growth of public income transferences of the sub-period. Note that, in particular, the biggest participation jump of this component occurs between 2003 and 2004 which coincides with the biggest increase of Bolsa-Família resources, the most important Brazilian public transference income program.

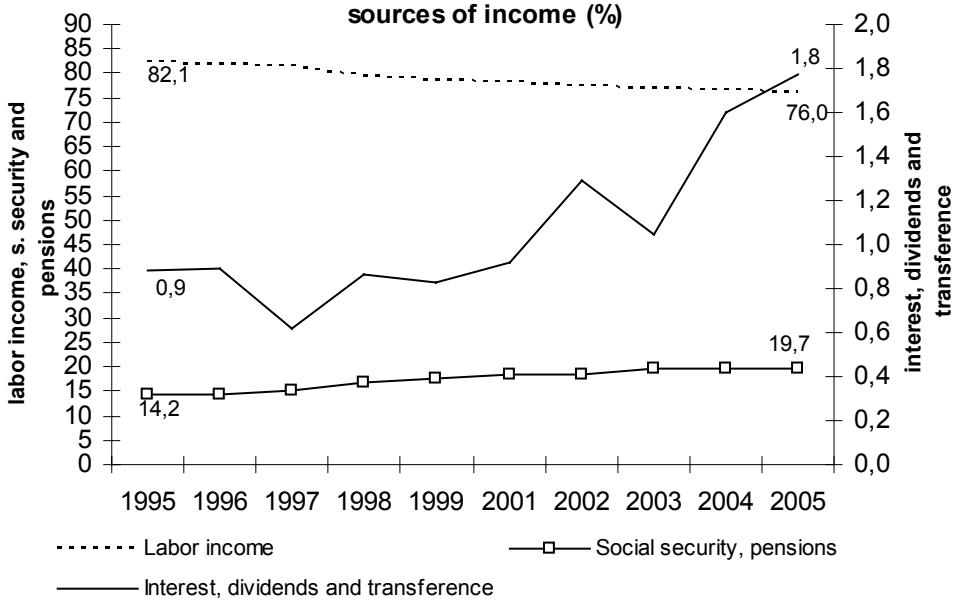
Table 3 – Participation (α_i) of different sources of income (%)

	1995	1996	1997	1998	1999	2001	2002	2003	2004	2005
Labor income	82.1	81.7	81.5	79.4	78.5	78.0	77.4	76.7	76.5	76.0
Social security and pensions	14.2	14.5	15.2	16.6	17.8	18.5	18.6	19.8	19.4	19.7
Interest, dividends and transferences	0.9	0.9	0.6	0.9	0.8	0.9	1.3	1.0	1.6	1.8
Rents and donations	2.8	2.9	2.7	3.1	2.9	2.6	2.7	2.5	2.5	2.5
Total	100	100	100	100	100	100	100	100	100	100

Source: author calculations using PNAD micro data

These three movements are more easily noted by looking at the graph 5, from where it can be immediately observed that the elevation of the participation of interest, dividends and transference income on total income is the most important relative movement.

Graph 5 - Evolution of participation in total income by sources of income (%)



Source: author calculation using PNAD micro data

In table 4 the evolution of each source of income concentration coefficient and that of the Gini coefficient from 1995 to 2005 is presented. By comparing with the value of Gini coefficient, it is possible to appreciate the level of pro-poor state income distribution for each source of income. Initially, it is possible to observe that, in the beginning of the period, labor income, rents and donations and, mainly, interest, dividends and transferences sources of income were less pro-poor states distributed than total income (the values of concentration coefficients are higher than Gini coefficient); on the other hand, social security and pension incomes are more pro-poor states distributed than total income. There are also important particularities in evolution of the concentration coefficients by source of income.

Table 4 – Regional concentration coefficients by sources of income and Gini indices.

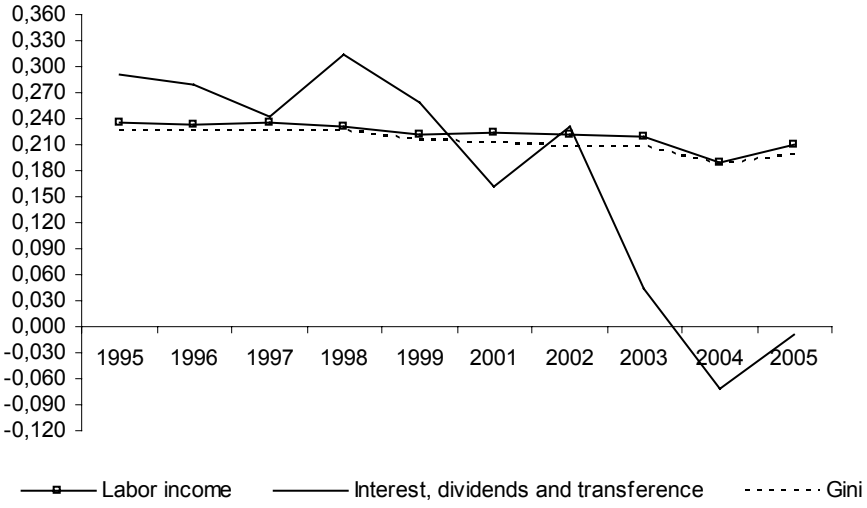
	1995	1996	1997	1998	1999	2001	2002	2003	2004	2005
Labor income	0.2349	0.2340	0.2364	0.2307	0.2221	0.2239	0.2206	0.2203	0.1892	0.2103
Social security and pensions	0.1560	0.1705	0.1814	0.1906	0.1800	0.1667	0.1538	0.1653	0.1943	0.1701
Interest, dividends and transferences	0.2914	0.2791	0.2413	0.3143	0.2587	0.1605	0.2316	0.0433	-0.0713	-0.0100
Rents and donations	0.2648	0.2743	0.2036	0.2572	0.2323	0.2201	0.2145	0.2060	0.1930	0.2124
Total (Gini)	0.2250	0.2264	0.2272	0.2256	0.2153	0.2126	0.2081	0.2072	0.1861	0.1985

Source: author calculations using PNAD micro data. Concentration Coefficients are obtained using equation (2).

As can be noted by the reduction in the respective coefficients, for the labor income, rents and donations, and Interest, dividends and transferences parcels of total income, there are clear pro-poor states movements. In the other words, the dynamic of distribution of these sources of income favor poor states, as can be noted by lower values of concentration coefficient in 2005. Note that the strongest movement is that of interest, dividends and transferences parcel, for which the value of coefficient became negative in the years of 2004 and 2005, which implied a pro-poor state biased distribution, and near zero for 2003 year, which indicates an almost uniform distribution of this parcel among states. Certainly, it is not coincidence that these years correspond to the period of implementation of Bolsa-Família program. Nevertheless, a very different dynamic is the presented by social security and pensions parcel that, during the period, became less pro-poor state distributed, i.e., its concentration coefficient presented a higher value in 2005 than in 1995.

To highlight the strong power of the change in the concentration coefficient for interest, dividends and transferences parcel, graph 6 illustrates it's dynamic in conjunction with those for labor income concentration coefficient and for Gini indices.

Graph 6 - Evolution of Gini coefficient and contentration coefficient



Source: author calculations using PNAD-IBGE micro data

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From graph 6 it is much clearer that, in spite of presenting a trajectory of reduction since 1998, the biggest change for interest, dividends and transference source of income occurs between 2002 and 2005, the period that coincides with the beginning and consolidation of Bolsa-Família public income transference program.

To get a measure of these important movements in regional *per capita* income inequality in Brazil from 1995 to 2005, the values of the decomposition viewed in last section are presented in the following table 5 (absolute variations) and in table 6 (perceptual variations). Because of the importance of public income transference at the beginning of 2000, besides the period from 1995 to 2005, results are also presented for the two sub-periods from 1995 to 2001 and from 2001 to 2005.

From the following first table, there are two immediate pieces of evidence. First, it is possible to observe that all the sources of income have contributed to the Gini indices variation of -0.0265 from 1995 to 2005, as can be seen by the fact that all specific total influence are negatives. Second, note that the general concentration-effect is bigger than the participation-effect. Nevertheless, a more specific focus permits to note that, different from the other sources, the concentration-effect of social security and pensions parcel acted to augment regional income inequality, i.e., this parcel of income became relatively less pro-poor state distributed from 1995 to 2005, a dynamic also found for the two sub-periods.

As for these sub-periods, notice that from 2001 to 2005 there was a stronger regional inequality reduction than that from 1995 to 2001. By comparing the contributions of the sources of income between these two periods, it is possible to note that stronger reduction from 2001 to 2005 is mainly influenced by the concentration-effect of interest, dividends and transference parcel, in other words, the movement is strongly affected by the public income transference program. Differently from the entire and 1995-2001 periods, is also important to highlight that the total effect of social

security and pensions parcel did not favor regional inequality reduction from 2001 to 2005.

Table 5 – Breakdown of Gini coefficient change (ΔG) - Distribution of *per capita* income of Brazilian states.

	Total income	Labor income	Social security and pensions	Interest, dividends and transferences	Rents, donations e other incomes
			1995-2005		
Concentration-effect	-0.0225	-0.0195	0.0024	-0.0040	-0.0001
Participation-effect	-0.0040	-0.0007	-0.0027	-0.0006	-0.0014
Total contribution	-0.0265	-0.0201	-0.0003	-0.0046	-0.0015
			1995-2001		
Concentration-effect	-0.0095	-0.0088	0.0018	-0.0012	0.0000
Participation-effect	-0.0029	-0.0004	-0.0025	0.0000	-0.0012
Total contribution	-0.0124	-0.0093	-0.0007	-0.0012	-0.0012
			2001-2005		
Concentration-effect	-0.0123	-0.0105	0.0006	-0.0023	0.0000
Participation-effect	-0.0018	-0.0002	-0.0005	-0.0011	-0.0002
Total contribution	-0.0141	-0.0107	0.0002	-0.0034	-0.0002

Source: author calculations using PNAD micro data. For each source of income, the composition-effect and the concentration-effect were obtained using, respectively, $\left(\overline{C}_i - \overline{G}\right)\Delta\alpha_i$ and $\overline{\alpha}_i \Delta C_i$.

Table 6 – Breakdown of Gini coefficient change (ΔG) - Distribution of *per capita* income of Brazilian states – values in percentage (% of Δ Gini).

	Total income	Labor income	Social security and pensions	Interest, dividends and transferences	Rents, donations and other incomes
			1995-2005		
Concentration-effect	84.7	73.4	-9.0	15.1	5.3
Participation-effect	15.3	2.5	10.1	2.4	0.0
Total contribution	100.0	75.9	1.1	17.4	5.3
			1995-2001		
Concentration-effect	76.3	71.1	-14.1	9.5	9.8
Participation-effect	23.7	3.5	19.8	0.0	0.0
Total contribution	100.0	74.6	5.7	9.5	9.8
			2001-2005		
Concentration-effect	87.3	74.2	-4.6	16.2	1.4
Participation-effect	12.7	1.6	3.2	7.8	0.0
Total contribution	100.0	75.8	-1.3	24.0	1.4

Source: author calculations using PNAD micro data. For each source of income, the composition-effect and the concentration-effect were obtained using, respectively, $\left(\overline{C}_i - \overline{G}\right)\Delta\alpha_i / \Delta G$ and $\overline{\alpha}_i \Delta C_i / \Delta G$.

From the above table 5 it is possible to get the relative importance of the different parcels in the three periods. For the whole period, two general observations can be made. First, concentration-effects are always responsible for more than 84% of Gini indices reduction. Second, the two more important sources of income in explaining the Gini indices movement are the labor income parcel, the most important source of income, explaining more than 75% of Gini indices' movement, and the interest, dividends and transference parcel, responsible for more than 17% of Gini indices' movement. For these

two components, both concentration-effect and participation-effect favor regional inequality reduction, but the most important one, in both cases, is the concentration-effect[10].

Comparing the two sub-periods, note that, although labor income contribution is approximately the same, the role of interest, dividends and transference parcel in the reduction of regional inequality is much more important in the second sub-period (2001-2005), when it is responsible for almost a quarter of Gini indices reduction. In fact, from 2001 to 2005, labor income and interest, dividends and transference parcels are responsible for almost the entire regional inequality reduction in Brazil (more than 99% of Gini indices reduction).

To resume, the evidence that has been presented favor both labor productivity convergence and pro-poor individual and state public income transferences in explaining regional *per capita* income inequality in Brazil from 1995 to 2005, with the most important role belonging to the first factor. However, this last statement has to be reconsidered in view of the fact that, surely, the labor income parcel dynamic includes the effects of the public policy for minimum-salary which, as was seen, favored much more the poorest states.

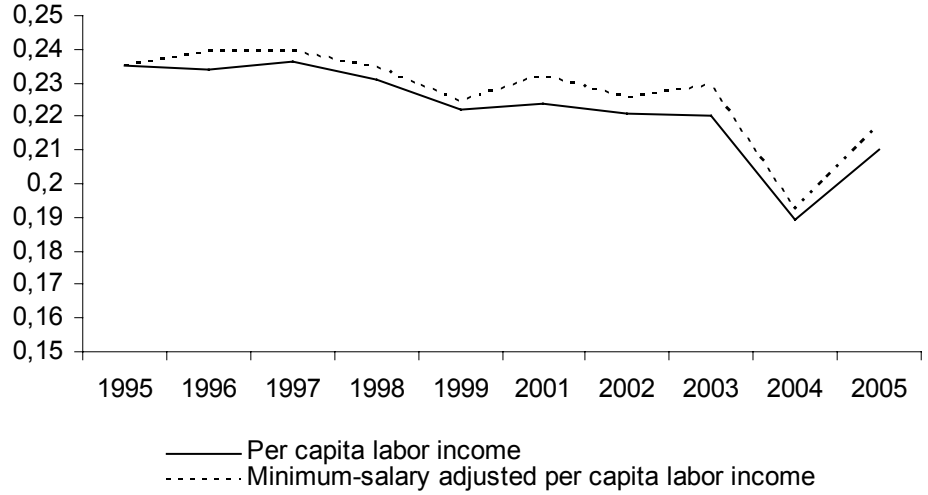
4.3 The minimum-salary effect on Brazilian regional *per capita* income inequality reduction

It is not possible to determine the precise role of minimum salary real growth on Brazilian regional *per capita* income inequality reduction from 1995 to 2005 because the micro data does not permit the desegregation of labor income. Nevertheless, we can get an estimate of this role by discounting minimum salary real growth during the period on labor income of workers that received less or equal this base line salary from 1996 until 2005 and, then, calculating the evolution of the concentration coefficient for this adjusted labor income. The result shows the dynamic of concentration of labor income distribution among states controlling for the influence of minimum salary real growth. The following graph 7 presents the new trajectory of labor income concentration coefficient (minimum-salary adjusted *per capita* labor income) together with real or effective one (*per capita* labor income).

The trajectories are similar but, consistent with previous expectations, it is possible to observe that the minimum-salary adjusted *per capita* labor income coefficient shows higher level of concentration of labor income (higher concentration coefficient values) and a lower reduction from 1995 to 2005. More specifically, the actual labor income concentration coefficient fell by 10,5% and the adjusted minimum-salary labor income concentration coefficient fell by 7,4% . Thus we confirm that minimum-salary dynamic contributed to Brazilian regional *per capita* income reduction.

[10] Note that, different from the interest, dividends and transferences parcel case, that presented a higher participation in total income, the positive contribution of participation-effect of labor income parcel for regional inequality reduction is explained by its reduction in the participation on total income, once this parcel presented a value of concentration coefficient higher than the value of Gini indices.

Graph 7 - Evolution of concentration coefficient - labor *per capita* income without and with minimum-salary real growth control



Source: author calculations using PNAD-IBGE micro data

The apparently small difference between the trajectories showed in graph 7 above could lead someone to think that the minimum-salary adjustment in labor income is not quantitatively important to Brazilian regional *per capita* inequality dynamic, but, as the number in table 7 permits to observe, it is far from being the case.

Table 7 – Minimum-salary participation in labor income concentration-effect and influence on Gini indices variation (%)

	Labor income concentration-effect	Total Gini variation
Other labor market influences	70.6	54.4
Minimum-salary influence	29.4	21.5
Total Labor income Concentration-effect	100	75.9

Source: author calculations using PNAD micro data.

By comparing the two *per capita* labor income concentration coefficients it is possible to take a quantitative idea of minimum-salary influence on Gini indices reduction. Table 7 third column shows that 21,5% of Gini indices reduction can be attributed to the dynamic of minimum-salary from 1995 to 2005. This is because the minimum-salary is responsible for almost 30% of the concentration effect (second column), which itself is responsible for 75,9% of Gini indices reduction, and labor income participation was always above 75% from 1995 to 2005.

Finally, note that, taking into account together minimum-salary and federal income transference effects on Gini indices reduction, total non-spatial public influence on Brazilian regional *per capita* income inequality reduction was almost 40% (17,4% from federal income transference plus 21,5% from minimum-salary influence).

5. Conclusion

This work presented evidence that permits a better understanding of the forces behind Brazilian regional *per capita* inequality reduction from 1995 to 2005. In particular, it highlighted the roles of regional labor productivity convergence and those of non-spatial public policies, mainly minimum-salary growth and federal public income transference.

The results pointed out, first, that there was regional labor productivity convergence from 1995 to 2005, so Brazilian regional *per capita* income inequality reduction can not only be attributed to federal non-spatial policies such as minimum-salary real growth or federal public income transference to the poor individuals.

Second, by measuring regional *per capita* income inequality by Gini indices and decomposing its changes according to different sources of income, it was shown that, as noted initially by the speediest velocity of convergence for *per capita* income, the public income transference had an important role in the Brazilian regional *per capita* income inequality reduction from 1995 to 2005. By measuring the regional *per capita* inequality reduction by the Gini indices reduction, federal public transference was responsible for 17,4% of Brazilian regional *per capita* income inequality reduction. This percentage grew to almost 25% from 2001 to 2005, a period that includes Bolsa-Família income transference program.

Third, from the same decomposition, we noted that the *per capita* labor income regional inequality reduction, which includes both the effects of labor productivity convergence and minimum-salary real growth influence, was responsible for almost 76% of regional inequality reduction. Form this contribution, it was estimated that 21.5 % of Gini indices reduction can be attributed to the growth of minimum-salary that had a stronger impact on poor states than on rich ones.

To conclude, the non-spatial Brazilian public policies can explain less than 50% of regional *per capita* income reduction from 1995 to 2005, measured by Gini indices reduction. So, although helped by these non-spatial public policies, it appears that a regional *per capita* income convergence process consistent with the Neoclassical model of growth has been in place in Brazil since economic stabilization of the 90,s.

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