ECONOMIC GROWTH, INCOME CONCENTRATION AND THEIR EFFECTS ON POVERTY IN BRAZIL

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Abstract

From data about the Brazilian states from 1995 to 2009, the impact of variations of economic growth and income inequality on poverty in Brazil are here analyzed in an attempt to evaluate the Bourguignon hypothesis (2002) which states that the more unequal a country is, the less efficient its economic growth will be for poverty reduction. In order to verify such effects, it is necessary to estimate poverty elasticities related to income and inequality. Besides, two dynamic econometric models are specified and these models are then estimated by the Generalized Method of Moments for Systems (System GMM) which was developed by Arellano-Bond (1991), Arellano-Bover (1995) and Blundell & Bond (1998). The estimated results of the models lead to the conclusion that income increase´s effectiveness for poverty reduction is lesser when the initial development level is low. The same happens when the initial inequality index is high. Thus, regions of low initial development level and/or high initial inequality are less predisposed to poverty reduction through income growth. Therefore, high inequality and low initial development level in the majority of Brazilian states do hinder poverty reduction by income growth.

Key Words: Economic growth**,** Poverty and Inequality.

Resumo

A partir de dados em painel para os estados brasileiros no período 1995-2009, analisa-se o impacto de variações do crescimento econômico e da desigualdade de renda sobre as alterações da pobreza no Brasil, buscando avaliar a hipótese de Bourguignon (2002) de que quanto mais desigual o país menor será a efetividade do crescimento econômico em reduzir a pobreza. Para verificar esses efeitos estimam-se as elasticidades da pobreza em relação à renda e à desigualdade. Para isso, especificam-se dois modelos econométricos dinâmicos que são estimado pelo Método dos Momentos Generalizado-sistema (MMG-sistema) desenvolvido por Arellano-Bond (1991), Arellano-Bover(1995) e Blundell e Bond (1998). Os resultados estimados dos modelos permitem concluir que o aumento da renda sobre a redução da pobreza é menor quando o nível inicial de desenvolvimento é baixo. O mesmo se dá quando o índice inicial de desigualdade é alto. Assim sendo, regiões com baixo nível inicial de desenvolvimento e/ou alta desigualdade inicial apresentam condições menos propícias à redução da pobreza através do crescimento da renda. Portanto, elevada desigualdade e o baixo nível de desenvolvimento inicial da maioria dos estados brasileiros são empecilhos para a reversão do quadro de pobreza via crescimento da renda.

Palavras chaves: Crescimento econômico, Pobreza e Desigualdade.

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1 INTRODUCTION

The development policies in various countries have as their main goal, the increase of their populations' well-being. Certainly, amongst their many goals, poverty reduction is prioritized, due to the fact that despite these economies' increasing capacity of generating wealth, poverty has been proving to be a persistent phenomenon.

According to Rocha (2006) even in successful cases of economic growth, it is evident that the expansion of production of an economy doesn't necessarily benefits all of its individuals. It is so in rich countries that are unable to eradicate remaining poverty areas or in developing countries where economic expansion causes social inequalities to grow.

The relation between income and inequality changes on poverty reduction is a recurrent topic due to the fact that in many countries, poverty issues have not yet been equated as a result of economic growth.

For instance, Cline (2004) while studying various countries in the 1990's concluded that in many economies, there was poverty reduction due to economic growth. However, some countries that did not have significant economic growth managed to reduce poverty. Thus, economic growth alone is not able to explain poverty alterations. Therefore, income inequality now gets the spotlight as a poverty reduction factor.

Chen and Wang (2001) investigated poverty and inequality in 1990's. They break down poverty variation due to economic growth and changes in inequality. They conclude that economic growth benefited the rich more specifically, and verified that only the median income of the richest 20% did grow more than the median income. They point to the importance of income inequality for poverty reduction.

Barros e Mendonça (2001), for example, verified that in Brazil, the incidence of poverty is higher than in other countries which have a *per capita* income similar to Brazil´s *per capita*. In their study they conclude that income inequality is the cause of the relative inefficiency of economic growth for poverty reduction, that is, the effect of economic growth on poverty reduction is lesser in Brazil than it is in countries which have the same income level as Brazil.

If any variation of poverty is due to either income redistribution or economic growth (or both causes), it becomes important to assess the effect of each factor on poverty variation. Recent studies have tried to explain which factors influence income-poverty elasticity and inequality-poverty.

For instance, Ravallion e Chen (1997) estimated that for a developing countries' sample, poverty income elasticity (measured by the number of people of income below poverty line of a dollar a day) found an elasticity of -3, that is, for each 1% of increase in median income there is a 3% reduction of the proportion of individuals whose income is below the poverty line. However, there are countries that manage to alter their inner poverty without showing significant economic growth rates. Bourguignon (2002) estimated the income-poverty elasticity for a group of countries by approximating income distribution by log-normal distribution. He showed that the bigger the median income is, and lower the concentration is, the wider is elasticity.

Regarding the empiric national evidence, Marinho and Soares (2003) estimated that median income elasticity on the Brazilian states' poverty from 1985 to 1999. They concluded that the bigger median income is, the bigger its corresponding elasticity absolute value is. Moreover, they also concluded that the bigger a concentration is, the smaller its absolute value will be. The biggest income-poverty elasticities happened in the states of São Paulo and Rio de Janeiro.

In another study about Brazil, Hoffmann (2004) applied another methodology and estimated the same elasticities and compared them with the results reached by Marinho and

Soares (2003). Hoffman verified that the two estimates showed very similar variation patterns.

Salvato *et al.,* (2007) investigated the relation between growth, poverty and inequality using data from Brazilian municipalities and such study measures poverty elasticities in relation to economic growth and the income inequality variation rate. Besides, the study group tests the existence of an nonlinear interaction between growth and initial inequality, aiming to evaluate the hypothesis that states that the bigger the inequality, the lower is the efficacy of growth for poverty reduction. They found that among the major regions of Brazil, the biggest growth elasticity of poverty reduction was verified in the Southeast region. Of the states involved, São Paulo gets the spotlight. The study also showed a negative correlation between the Modulus of Elasticity and the initial inequality, that is, the bigger the initial inequality, the smaller the reduction of poverty caused by economic growth. That reinforces the Bourgignon (2002) hypothesis. The results also show that there is a negative correlation between redistribution elasticity and initial inequality.

However, these issues have not yet been completely elucidated. According to Barreto (2005) there is not yet a consensus about the relations between poverty, growth and inequality. Therefore, it is extremely important to determine the effects each of these factors exert on poverty. The measuring of these elasticities is essential in order to aid growth and income redistribution policies, once poverty reduction is influenced both by alterations in economic growth as well as inequality reductions, as Cline (2004) states. Under such terms, the goal of this paper is to analyze the impacts of both economic growth variations and income inequality variations on poverty alterations in Brazil. If assumed that growth alone is not enough to explain alterations of poverty, income inequality becomes a complementary factor for such explanation, by assessing the hypothesis that the more unequal a country is, the less efficiency economic growth will have in reducing poverty (Bourguignon (2002).

In order to verify such effects, we must estimate poverty elasticities in relation to income and inequality. These latter ones are estimated by a dynamic econometric model for data on a panel, developed by Arellano-Bond (1991), Arellano-Bover (1995) and Blundel-Bond (1998). On the panel, the analysis units will be the Brazilian states and the period of time, from 1995 until 2009.

The article comprises six additional sections besides this introduction. The second section brings a general review of national and international literature about the triangular relation between poverty, economic growth and inequality, besides briefly recapitulating the Brazilian inequality history. The third section theoretically defines the income-poverty and the inequality-poverty elasticities. Then, the fourth section analyzes the database. The fifth section shows the econometric model, its estimation methods and result analysis. For last, conclusions are commented in the seventh section.

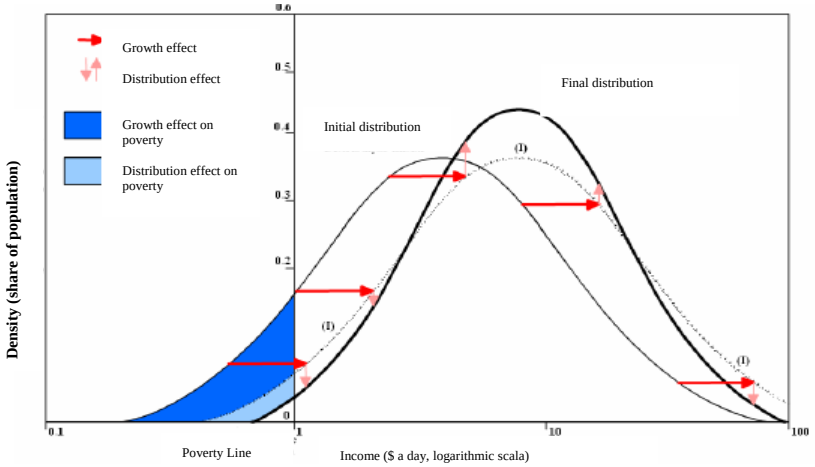
2 THE TRIANGULAR RELATION BETWEEN POVERTY, ECONOMIC GROWTH AND INEQUALITY.

This section brings a review of the literature about the triangular relation between poverty, economic growth and income inequality. The interaction between these three variables creates the necessary conditions for determining at what magnitude, income growth or inequality reduction produce an impact for poverty reduction.

Borguignon (2002) describes what he calls “The poverty-inequality-growth triangle”. He spots a relation between these three variables. His article adopts a log-normal income distribution and explains poverty changes as result of two factors: a) The Growth Effect: it happens via a proportional change in all income decils, but there isn´t necessarily a change in the relative income. b) The Distributive Effect: when a change in relative income distribution occurs.

Thus, one can show that changes in poverty may occur from economic growth (characterized by median income growth) as well as income inequality improvement.

Graph 1 – Decomposition of Poverty Variable Due To Economic Growth and Income Distribution.



Source: Borguignon (2002)

The curves on Graph 1 show the income distribution densities in which the latter is represented on the horizontal axis on a logarithmic scale. The displacement from the initial distribution to the final distribution happens via an intermediate step, which is the horizontal translation of the initial distribution into curve (I). This change represents an equally proportional increase of all incomes in a certain population, which comes from The Growth Effect.

The change happens due to a displacement of income distribution density to the right. Considering *z* as the poverty lines, we can verify that there has been a decline of the number of poor individuals. Such decline of the proportion of poor individuals is caused exclusively by the Growth Effect.

But the movement of curve (I) for the final distribution happens when the median income is kept constant and the relative income distribution is altered (that means Distribution Effect) Thus, without changing the median income of the population, the poverty level fell. That is a result of income inequality fall. That is income concentration reduction caused a diminishment of the number of individuals whose income was below the poverty line.

Such relation was named by Borguignon (2004) as "The Poverty-Inequality-Growth Triangle." Since then, numerous studies were developed in order to identify and measure the existing relation between the impacts of growth and income inequality on poverty reduction.

2.1 Poverty *versus* Economic Growth

Many national and international empiric works analyzed the relations between economic growth and poverty. There seems to be a consensus among researchers on the assumption that in order to study poverty reduction, two factors are fundamental: average growth rate and income inequality initial level.

For instance, Kraay (2004) conducted the decomposition of poverty variance in order to verify the importance of economic growth for poverty reduction. For this, he used a sample of developing countries during the 80´s and the 90´s. His analysis concluded that the variation of poverty levels is due to median income increase, and therefore, policies that promote economic growth would be decisive for the well-being of the poorest individuals.

The relation between growth and poverty reduction can be measured through income-elasticity or growth-elasticity. If this elasticity is high, economic-growth public policies that fight poverty are more efficient. Otherwise, if elasticity is low, poverty-reduction strategies should combine economic growth plus some type of income redistribution.

Ravallion and Chen (1997) estimated income-poverty and inequality-poverty elasticities of 45 countries. The results showed that in countries of low inequality, if income level increases by 1%, poverty reduction increases by 4,3%. In countries where inequality is high, poverty reduction would increase by only 0,6%. The researchers concluded that growth has little effect on poverty. On the other hand, if inequality tends to diminish due to growth, the effect on poverty reduction will be more significant.

In another study, Ravallion (2001) verified that growth elasticity of poverty is much higher in countries that combined growth with some inequality reduction. This shows that the estimation methodology for poverty-growth elasticity must be controlled by the income-redistribution component. For instance, Ravallion (2005) estimated the Pro-Poor Growth Rate for China and India, regarding the 1990's and found out that changes in income distribution were actually detrimental to the poor in these countries. These individuals' income growth rate was lower than the total ordinary income growth rate in that analyzed period. This result reproduced a *growth incidence curve* c with positive slant for the higher income levels. On the other hand, the Pro-Poor Growth rate estimate was positive, indicating a decrease in absolute poverty.

Chen and Wang (2001) studied the relation between poverty, income and inequality in 1990's China. They concluded that despite the fact that poverty got reduced by economic growth, income concentration actually promoted poverty increase. The researchers also verified that the median income increase benefitted more relatively the rich, that is, only the median income of the 20% richest increased more than the total median income. Therefore, it became evident that income concentration reduced the effect of growth on poverty.

Stewart (2000) estimated that a 1% GNP growth promoted 0,21% of poverty reduction in Zambia while the same variation promotes a 3,4% poverty reduction in Malaysia. The difference between these poverty reductions is due to specific income inequality differences these regions have.

In the same vein, Deininger and Squire (1996) analyzing the relation between economic growth's potential effect for reducing inequality in a sample comprised of various countries. They found that different inequality levels have distinct implications on economic growth and these levels are negatively related to poverty.

Using a sample of 84 countries between 1996 and 2000, Son (2004) showed that in 95% of the cases, economic growth contributed to poverty reduction. In the remaining cases, either the growth rate was negative or it was not possible to draw any conclusion due to ambiguity found in the sample.

The literature in Brazil has shown some works on the same topic. Hoffmann (1995) spotted poverty reduction in the 1970's with high income increase rate and relative inequality stagnation. In the 1980's there was poverty and inequality increases with out-of-control inflation.

In a later study, Hoffmann (2005) found that a 1% increase of the *per capita* household income in Brazil led to a 0,84% reduction of poor individuals' proportion and that the absolute value of this elasticity grows along with income and decreases as inequality gets higher.

Marinho and Soares (2003), using data from 26 Brazilian states, from 1985 to 1999, applied a methodological procedure that allowed for decomposing the variation in poverty due to the change in median income and also caused by changes in income concentration. The results show that in all Northern region states, the effect of income concentration surpassed

the income effect. This way, income growth had a strategic importance in fighting poverty. According to the authors, the higher the median income, the higher absolute elasticity value and the higher the concentration, the smaller the absolute elasticity value.

Manso, Barreto and Tebaldi (2005), using data from PNAD (Brazil´s National Household Sampling Research) they tried to elucidate the relations between income growth, poverty reduction and the distributive profile of richness. In that study, the authors deepened the understanding of Brazil´s regional inequality problem through an evaluation of the impact of economic growth on poverty. Their analyses made it possible to isolate the effects of economic growth and of income inequality on poverty reduction in each region of Brazil. The results show that the growth components of average income growth and of income distribution are sufficient to explain a big part of the variations of poverty levels between Brazilian states.

The results so far shown, somehow reinforce the evidences that poverty-fighting policies through growth are more efficient when accompanied by income redistribution.

2.2 Poverty *versus* Inequality

This subsection investigates in the literature on the subject, the existing relation between poverty and inequality. On general terms, many authors state that the proportion of poor individuals in a given region lowers when an economic growth policy is combined with income redistribution.

Income inequality is an important aspect in poverty debates. Poverty is a world issue that afflicts modern society and has been analyzed in various studies. It endures despite the growing material wealth amassment in the world. Poverty's extension and seriousness are shown by the number of poor individuals in all countries. For certain, inequality and poverty walk hand in hand.

Ravallion (2005) observed that for a group of developing countries, a nonlinear relation between growth-poverty elasticity and the inequality level in the initial period. The author states that economic growth will have little effect on the poor, in case it is not able to reduce inequality. He estimates a 1% growth will reduce poverty by 4,3% in countries with low income inequality. However, in countries with high income inequality, the very same 1% growth rate will bring only a meager reduction by 0,6% of the poor proportion.

Therefore, one of the factors that influence the poverty reduction rate, given the same level of growth rate, is the change in income distribution. This is also verified by Datt and Ravallion (1992) who measured how poverty variation is explained by the growth income distribution effects. So, models that aim to estimate poverty reduction´s growth elasticity must incorporate the income inequality variation as an explanatory variable, so that growth elasticity will not incorporate income distribution changes.

According to Bourguignon (2004), income inequality reduction is instrumental for poverty reduction and economic growth might not be so necessary. Similar results were found for Brazil by Barros, Henriques and Mendonça (2001). These authors state that income distribution inequality is the reason why economic growth is relatively less efficient than it could be for poverty reduction, that is, the effect of growth on poverty reduction is weaker in Brazil than in other countries that reached the same income level as Brazil´s.

In Brazil there have been some works that aim for plausible explanations linking poverty, growth and inequality. According to Rocha (2006), despite the endurance of poverty through decades, it was only after solving the inflation problem that social problems became priorities such as inequality diminishment. This fact, in a certain way, says why studies on the poverty-growth-inequality triangle had been scantily produced in the past.

For Barreto (2005), poverty reduction can be attained in a fast way when a country in growth has a less uneven income distribution. Therefore, the implementation of public

policies for inequality reduction, besides solving the problem itself, might also indirectly help with other economic policies' goals such as increasing growth and reducing poverty.

Generally, literature shows that significant indexes of poverty reduction are the result of economic growth plus policies that fight income inequality. These two effects contribute to elevate the median income of the poorest individuals and therefore, they do reduce poverty.

Table 1 – Brazil´s Poverty Index – from 1995 to 2009

Years	P_0	Years	P_0
1995	38,7	2003	39,1
1996	38,1	2004	37,0
1997	38,5	2005	34,1
1998	37,2	2006	29,6
1999	39,0	2007	28,0
2001	38,3	2008	25,4
2002	38,2	2009	23,5
Difference:	-15,20		

Source: produced by the authors using PNAD (National Household Sampling Research) data.

For instance, Rocha (2006) states that the proportion of poor individuals in Brazil had a two-percentage-point reduction from 2001 to 2004. According to this author, this reduction which took place in the early years of that decade was due to many factors whose impact differs in each region of the country. Among these factors are welfare benefit expansion and distributive changes in work income.

According to the author, the persistence of poverty in Brazil is mostly due to the existing inequality. She states that poverty can be reduced either by income growth or by better income distribution. However, there is a consensus that income inequality reduction must be emphasized once income growth without inequality reduction might mean the postponement of poverty eradication for a future era.

The significant fall of poverty levels in Brazil from 1995 to 2009 is shown by the data of Table 1. The proportion of poor individuals (P_0) was 38,70% in 1995 and dropped to 23,50% in 2009, which meant a 15,20 percentage point reduction.

Therefore, analyzing this indicator one can see a significant poverty reduction in Brazil from 1995 to 2009.

2.3 Growth *versus* inequality

The relation named economic growth versus inequality has been analyzed in literature that considers the existing causalities between these variables. Many issues associated to these variables are like the one regarding how inequality is generated and how inequality reproduces itself as time goes by or the issue regarding how inequality and economic development process are interrelated. For Diniz (2005), there is a double causality relation between these variables.

The hypothesis by Kuznets (1955) states that the "Inverted U" is the starting point of this postulate. Firstly, inequality would increase in the onset of economic growth, when economy shifts from rurality towards industrialization (a transfer from a less productive sector into a more productive one). Later on, inequality would diminish when most of the workforce get active in the industrial sector.

Therefore, the development policy can be explained by economic growth and inequality reduction would ensue. With higher and better-distributed income, the poverty issue would be solved.

According to Barreto (2005), many studies analyze the impact of inequality on economic growth. Some models show that inequality can either harm growth or stimulate growth.

For example, Alesina and Rodrik (1994) state that the causality between growth and inequality is based on three facts: (a) government expenditure and redistributive tax policy would be negatively related due to their harming effects on capital accumulation; (b) tax rates would tend to be proportional to income and the advantages of public expenditures would be equally offered to all citizens, which implies that expenditure and tax levels would be inversely related to income; (c) the overall tax load given by the government could be the one chosen by the median voter, which implies less capital accumulation which leads to lesser growth.

Still under the assumption that inequality harms growth, we have the Stewart postulate (2000), which says: (a) high inequality causes political instability, uncertainty and smaller investments and smaller growth; (b) high inequality is likely to lead to populist tax redistribution policies which are actually effects of disincentivization and small growth; (c) higher inequality has an effect of the wealthier layers of society, who will then request special tax treatment, which leads to an excess of investments on certain areas and growth reduction.

Besides, there are those who believe that inequality stimulates economic growth, and Bourguinon (1981) states that the propensity to save money is different between the rich and the poor. That is, the rich tend to save more than the poor, which causes a tendency for higher investment levels in economies where inequality is higher which in theory brings faster growth.

Opposing that, there are authors like Barro (2000) and Lopez (2004), who do not believe in the existence of any relation between inequality and economic growth and who found out that investment levels do not significantly depend on inequality.

Table2 – Main Features of the *per capita* Income Distribution in Brazil from 1995 to 2009.

Years	Gini	40-10+	20-20+	10-10+	Income	Perc/z
1995	0,601	23,7	27,4	67,0	520,6	19,7
1996	0,602	24,2	29,3	74,9	529,7	19,5
1997	0,602	24,2	28,7	72,3	529,0	19,8
1998	0,601	23,6	27,5	67,2	534,5	19,1
1999	0,595	22,7	26,2	63,2	504,4	19,9
2001	0,597	22,9	26,9	68,4	511,9	19,7
2002	0,590	21,9	24,7	59,2	511,9	19,5
2003	0,585	21,1	24,3	59,4	481,9	20,1
2004	0,575	19,5	22,0	51,7	497,9	18,9
2005	0,572	19,2	21,3	49,7	528,4	17,5
2006	0,560	18,3	20,4	47,5	577,5	15,2
2007	0,550	17,7	20,2	49,0	592,5	14,4
2008	0,540	16,8	18,9	44,0	622,6	12,9
2009	0,540	16,3	18,6	43,8	637,4	12,2

Source: Society & Labor Study Institute – IETS. Footnote: The poverty line of R$ 196 was used for 2009, and the INPC (Brazil´s National Consumer Price Index) was applied for deflation.

Some information about income inequality in Brazil ranging from 1995 to 2000 are shown in Table 2. These data are from The Gini index, the ratio between income owned by the richest 10% and the poorest 40% (40-10+), the ration between income owned by the richest 20% and the poorest20% (20-20+), the ratio income owned by the richest 10% and the poorest 10% (10-10+), the actual *per capita* household income and the percentage of poor individuals/poverty line (Perc/z).

It is verifiable in this table that income owned by the richest 10% in Brazil, in 1995 was 23,7 times the income owned by the poorest 40%. In 2009, the rich earned 16,3 times what all poor individuals earned. Also worth noticing, are the indicators (10-10+) and (20-20+) that show a marked reduction during that period. (especially the first indicator that went from 67 to 43,8). The *per capita* household income grew approximately 22,5%. The last column shows that the poor individuals/poverty line reached a stability level around 19%.

These data show that income inequality in Brazil has declined in recent years, which corroborates the results found by Neri (2006), Barros *et al* (2007) and Hoffmann (2007). In the same direction, Manso, Barreto and Tebaldi (2005) showed that income inequality significantly dropped after The Real Plan. From 1995 to 2004, there was a 2,71% reduction of the Gini index.

3 INCOME AND POVERTY INEQUALITY ELASTICITY

The determination of poverty-income elasticity and poverty-inequality elasticity aim to analyze the impact of growth variations and income inequality variations on poverty alterations. Such methodology was initially proposed by Bourguignon (2002).

He follows the classical definition proposed by Foster, Greer and Thorbecke (1984) that measures poverty by the proportion of poor individuals. That is, the proportion of people whose *per capita* income is lower than the poverty line expressed as *z* given by: $H_t = \Pr(y_t < z) \equiv F_t(z)$ where, $F_t(z)$, is the income distribution function.

Therefore, the proportion of population in time t whose income is lower than the absolute poverty z, is equal to the probability that income y_t will be lower than the poverty line. This way, the proportion of poor individuals between two periods of time *t* and t' will be: $\Delta H = H_{t'} - H_t = F_{t'}(z) - F_t(z)$. Assuming that the income distribution curve is log-normal, Bourguignon (2002) defines the displacement of the original curve as shown on Graph 1 for the final distribution curve in terms of poverty variation as follows:

$$\Delta H = H_{t'} - H_t \approx [F_t(\frac{z}{\bar{y}_{t'}}) - F_t(\frac{z}{\bar{y}_t})] + [F_{t'}(\frac{z}{\bar{y}_{t'}}) - F_t(\frac{z}{\bar{y}_{t'}})]$$

The first expression between brackets represents the growth effect, with constant relative income distribution F_t. The second expression between brackets represents the inequality effect, as an alteration in relative income occurs if income is kept constant.

Under these terms, poverty variation is affected by two effects. Firstly, due to income growth and secondly, due to income distribution inequality.

According to Epaulard (2003) the relative variation of poverty coming from income growth and from the redistribution effect can be decomposed as:

$$\frac{dH}{dt} = \frac{\partial H_t}{\partial \bar{y}_t}\frac{d\bar{y}_t}{dt} + \frac{\partial H_t}{\partial G_t}\frac{dG_t}{dt}.$$

In terms of elasticity: $\frac{dH}{dt} = \varepsilon_y^H \frac{d\bar{y}_t}{dt}\frac{H_t}{\bar{y}_t} + \varepsilon_G^H \frac{H_t}{G_t}\frac{dG_t}{dt}$

where the Gini coefficient is defined as, $G = 2\Phi\left(\sigma_t / \sqrt{2}\right) - 1$. Term $\Phi(.)$ corresponds to accumulated distribution of the standard normal, and σ_t is the standard deviation of the

income logarithm. So, Epaulard (2003) showed that poverty-income elasticities, ε_y^H, and the inequality-poverty elasticity, ε_G^H, are defined as:

$$\varepsilon_y^H = \frac{\partial H_t}{\partial \overline{y_t}} \frac{\overline{y_t}}{H_t} \equiv -\frac{1}{\sigma_t} \frac{\phi(\log(z/\bar{y}_t)/\sigma_t + \sigma_t/2)}{\Phi(\log(z/\bar{y}_t)/\sigma_t + \sigma_t/2)} \leq 0 \quad \text{and} \quad \varepsilon_G^H = \frac{\partial H_t}{\partial \sigma_t} \frac{\sigma_t}{H_t} \equiv \frac{1}{\sigma_t} \frac{\phi(\log(z/\bar{y}_t)/\sigma_t + \sigma_t/2)}{\Phi(\log(z/\bar{y}_t)/\sigma_t + \sigma_t/2)} (-\log(z/\bar{y}_t)/\sigma_t + \sigma_t/2) > 0$$

Besides, the author points out that the poverty-income elasticity (ε_y^H) and the inequality-poverty elasticity (ε_G^H) decrease in absolute terms with the ratio of poverty line and median income ($z/\bar{y}_t$) and with the standard deviation of the income logarithm (σ_t). Poverty-income elasticity is always either positive or null. On the other hand, poverty-inequality elasticity can be more or less than zero[3].

Therefore, the effect of income distribution change on poverty reduction is a function of income growth level and inequality degree. That is, alterations of poverty can derive either from economic growth (characterized by median income growth) or from income inequality drop. However, when the combination of these two factors occurs, poverty reduction should be even more prominent.

4 DATABASE

The data used for the estimates of econometric models described in the next section were taken from the PNADs (Brazil´s National Household Sampling Research and published by IBGE (The Brazilian Institute Of Geography And Statistics). The sample is of Brazilian states in the period from 1995 to 2009[4].

The *per capita* household income variable is calculated by dividing the total income of a household by its number of members. Then, an arithmetic average of the variable is calculated, and that is how the median income of each state of the sample is obtained. A negative relation between such variable and poverty is expected.

In this article, households whose *per capita* income is insufficient to satisfy their basic needs are categorized as poor. So, the absolute poverty indicator is here the proportion of poor individuals (P_0). In order to define such indicator, the chosen *poverty line* was that of half minimum wage. The poverty indicator P_0 is defined as, $P_0 = q/n$, where n is the total number of individuals and q is the number of individuals whose *per capita* household income y_i lies below poverty line z.

The inequality measure used here is the Gini coefficient that was calculated based on the *per capita* household income given by the PNAD surveys. This indicator is often used to express the degree of income inequality that can be associated to the Lorenz curve. The curve is defined by the group of points from incomes ordered in an increasing sequence, this way showing the accumulated proportion of individuals and the accumulated proportion of income. The curve is used to calculate the Gini coefficients for each state in the period from 1995 to 2009. Regarding what was discussed in the previous section, the relation between the Gini coefficient and poverty may be positive, that is, the bigger the inequality, the bigger will be the poverty.

It is worth reminding, that all monetary variables were used for real values of 2009, using Brazil´s INPC (National Index of Consumer Prices) of 2009.

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[3] According to Epaulard (2003) the poverty-inequality elasticity will have a positive mark unless a country happens to have a very low median income. This elasticity will be positive when $\overline{y}_t < z \exp\left(-\frac{1}{2}\sigma_t^2\right)$.

[4] There was no PNAD in 2000. To fill the gap, the arithmetic averages of variables of 1999 and 2001were used instead. The older data about the Northern region were not used in the sample due to unavailability of data about rural areas before 2004.

5 ECONOMETRIC MODEL

The econometric specification of the model is based on economic growth´s contribution and income distribution variations for poverty alterations. Besides, it is accepted as a hypothesis, the supposition that states that current poverty variation tends to perpetuate itself and/or tends to influence the performance of this variation in the future[5]. Taking this into account, the relation between poverty variation and its determinants is then investigated through a dynamic panel regression model, defined by the following formula[6]:

$$\Delta \ln[P_{0,it}] = \beta_0 + \beta_1 \Delta \ln[P_{0,it-1}] + \beta_2 \Delta \ln[\overline{Y}_{it}] + \beta_3 \Delta \ln[Gini_{it}] + \eta_t + \mu_{it} \quad (1)$$

The variables of model (1) are defined this way: $\Delta \ln P_{0,it} = \ln P_{0;it} - \ln P_{0;it-1}$ represents the poor individuals' proportion variation between two periods of time; $\Delta \ln \overline{Y}_{it} = \ln \overline{Y}_{it} - \ln \overline{Y}_{it-1}$ is the *per capita* median household income variation, $\Delta \ln Gini_{it} = \ln Gini_{it} - \ln Gini_{it-1}$, represents the income concentration variation as measured by the Gini Coefficient; η_i are individuals' unobservable aleatory effects and μ_{it} represents aleatory disturbances. The variables of model (1) are defined in a natural logarithm in which *i* represents the state and *t* the period of time. Due to that, parameters β_2 and β_3 are, respectively, the income-poverty elasticities, $\varepsilon_y^{P_0}$, and the inequality-poverty elasticity $\varepsilon_G^{P_0}$. Please notice that these elasticities do not vary along time.

An expansion of model (1), shown in Kalwij and Verschoor (2004), makes it possible for income and poverty inequality elasticities to vary in time and depend on inverse initial development level (poverty line divided by initial *per capita* household income*)* and on the initial inequality level[7]. When these variables are included in model (1) it is the opportunity to evaluate the hypothesis that says the bigger the initial inequality, the lesser the effectiveness of growth for poverty reduction (the Bourguignon hypothesis). Such model is dynamically described like this:

$$\Delta \ln[P_{0,it}] = \beta_0 + \beta_1 \Delta \ln[P_{0,it-1}] + \beta_2 \Delta \ln[\overline{y}_{it}] + \beta_3 \Delta \ln[\overline{y}] \ln[G_{i0}] + \beta_4 \Delta \ln[\overline{y}_{it}] \ln[\frac{z_{it}}{\overline{y}_{i0}}]$$

$$+ \beta_5 \Delta \ln[Gini_{it}] + \beta_6 \Delta \ln[Gini_{it}] \ln[Gini_{i0}] + \beta_7 \Delta \ln[Gini_{it}] \ln[\frac{z_{it}}{\overline{y}_{i0}}] + \beta_8 \ln[G_{i0}]$$

$$+ \beta_9 \ln[\frac{z_{it}}{\overline{y}_{i0}}] + \eta_i + \mu_{it} \quad (2)$$

where, besides variables $\Delta \ln[P_{it}]$, $\Delta \ln[\overline{y}_{it}]$, $\Delta \ln[Gini_{it}]$ that follow the same previously described formulations, we see $\Delta \ln[\overline{y}_{it}] \ln[G_{i0}]$ and $\Delta \ln[\overline{y}_{it}] \ln[\frac{z_{it}}{\overline{y}_{i0}}]$ representing, respectively, the interactions between *per capita* median household income variations and the initial Gini index of state *i* (G_{i0}) an the inverse of the initial development level $\frac{z_{it}}{\overline{y}_{i0}}$ (poverty line divided by initial *per capita* household income). Likewise, variables $\Delta \ln[Gini_{it}] \ln[G_{i0}]$ and

[5] Ribas *et al* (2006) found evidence of poverty persistence in Brazil.
[6] This model can be seen in Bourguignon (2002) and Kalwij and Verschoor (2004). However, these authors do not consider that poverty might have a dynamic behavior.
[7] Kalwij and Verschoor (2004) also did not consider the dynamic behavior that poverty has in time.

$\Delta \ln[Gini_{it}]\ln[\frac{z_{it}}{\bar{y}_{i0}}]$ represent, respectively, the interactions between the Gini inequality index and the initial inequality index of state *i* and the inverse of the initial development level .

The hypotheses adopted in these models are $E[\eta_i] = E[\mu_{it}] = E[\eta_i \mu_{it}] = 0$ and $E[\mu_{it}\mu_{is}] = 0$ for *i=1,2,.....,N* e $\forall t \neq s$. Additionally, there is a standard hypothesis which is relative to the initial conditions $\Delta \ln P_{it}$: $E[\Delta \ln P_{it-1}\mu_{it}] = 0$ to *i=1,2,....,N* e *t=1,2,.....,T* (AHN e SCHMIDT, 1995).

Thus, the specification of model (2) takes into account that the inequality elasticity and the *per capita* median household income elasticity depend on the initial inequality and on the ratio between poverty line and initial *per capita* median household income.

Naturally, β_2 and β_5 coefficients are no longer respectively interpreted as income-elasticity and inequality-elasticity. In order to calculate such elasticities, it is necessary to consider the interaction terms. So, the income-poverty elasticity and the inequality-poverty elasticity are now respectively defined as:

$$\varepsilon_{\bar{y}_{it}}^{P_0} = \beta_2 + \beta_3 \ln[G_{io}] + \beta_4 \ln[\frac{z_{it}}{\bar{y}_{i0}}] \qquad (3)$$

$$\varepsilon_{G_{it}}^{P_0} = \beta_5 + \beta_6 \ln[G_{io}] + \beta_7 \ln[\frac{z_{it}}{\bar{y}_{i0}}] \qquad (4)$$

Now it becomes noticeable that income-poverty elasticity and inequality-poverty elasticity do vary in time.

Traditional estimation techniques are inadequate for models (1) and (2) due to two major econometric problems. Firstly, there is the presence of non-observable effects on individuals, η_i, paired with the lagged dependent variable $\Delta \ln P_{k,it-1}$, on the right side of those equations. In this case, omitting the individual fixed effects in the dynamic model will turn the ordinary least square estimators (OLS) biased and inconsistent.

For instance, due to the probable positive correlation between the lagged dependent variable and the fixed effects, the estimate of coefficient β_1 is biased upwards. On the other hand, according to estimator W*ITHIN GROUPS* which corrects for the presence of fixed effects, an β_1 estimate is generated with a downward bias, in panels of small temporal dimension. (JUDSON and OWEN, 1999).

In order to fix these problems, Arellano-Bond (1991) recommends the Modified General Method of Moments' estimator (Modified-GMM). Such method eliminates fixed effects through the first difference of the equations. So, for models (1) and (2), respectively:

$$\Delta[\Delta \ln[P_{0,it}]] = \beta_1 \Delta[\Delta \ln[P_{0,it-1}]] + \beta_2 \Delta[\Delta \ln[\bar{Y}_{it}]] + \beta_3 \Delta\Delta[\ln[Gini_{it}]] + \Delta\mu_{it} \qquad (5)$$

$$\Delta[\Delta \ln[P_{0,it}]] = \beta_0 + \beta_1 \Delta[\Delta \ln[P_{0,it-1}]] + \beta_2 \Delta[\Delta \ln[\bar{y}_{it}]] + \beta_3 \Delta[\Delta \ln[\bar{y}] \ln[G_{i0}]] + \beta_4 \Delta[\Delta \ln[\bar{y}_{it}] \ln[\frac{z_{it}}{\bar{y}_{i0}}]]$$
$$+ \beta_5 \Delta[\Delta \ln[Gini_{it}]] + \beta_6 \Delta[\Delta \ln[Gini_{it}] \ln[G_{i0}]] + \beta_7 \Delta[\Delta \ln[Gini_{it}] \ln[\frac{z_{it}}{\bar{y}_{i0}}]] + \beta_8 \Delta[\ln[G_{i0}]] + \qquad (6)$$
$$\beta_9 \Delta[\ln[\frac{z_{it}}{\bar{y}_{i0}}]] + \Delta\mu_{it}$$

where, for any w_{it} variable, $\Delta \ln[w_{it}] = \ln[w_{it}] - \ln[w_{it-1}]$. By the making of equations (5) and (6), $\Delta[\Delta \ln[P_{0,it-1}]]$ and $\Delta\mu_{it}$ are correlated and therefore, Ordinary Least Squares

estimators for their coefficients will be biased and inconsistent. In this case, it is necessary to use instrumental variables for $\Delta[\Delta \ln[P_{0,it-1}]]$. The set of hypotheses adopted in equations (1) and (2) imply that conditions of moments $E[\Delta[\Delta \ln P_{0,it-s}]\Delta\mu_{it}] = 0$, for *t=3,4,....T* e *s≥2*, are valid. Based on these moments, Arellano and Bond (1991) suggest the use of $\Delta \ln[P_{0,it-s}]$, for *t=3,4,....T* and $s \geq 2$, as instruments for equations (5) and (6).

Regarding the other explanatory variables, we have three possible situations. An explanatory variable x_{it} can be categorized as (i) strictly exogenous, if it is not correlated to past, present or future terms of error, (ii) weakly exogenous, if it is correlated only to past values of the term of error, and (iii) endogenous, if it is correlated to past, present and future terms of error . In the second case, the values of x_{it} lagged in one or more periods are valid instruments for the estimation of equations (5) and (6). In the last case, though, the values of x_{it} lagged in two or more periods are valid instruments for the estimations for these same equations.

On the other hand, Arellano and Bover (1995) and Blundell and Bond (1998) state that these instruments are weak when dependent variables and explanatory variables show strong persistence and/or relative variance of fixed effects happens to increase. That will produce an inconsistent and biased modified GMM estimator for panels with small T.

This way, the abovementioned authors suggest as a means to ease this bias and imprecision problem, the estimation of a system which respectively combines the set of level equations (equations (1) and (2)) and the differentiation equations (equations (5) and(6)). Then System GMM or the System Generalized Method of Moments is applied. For equations of difference, the set of instruments is the same as abovementioned. For level regression, the right instruments are the lagged differences of the respective variables. For example, if it is assumed that the differences of the explanatory variables are not correlated with the individual fixed effects or (for *t=3,4,....T*) and $E[\Delta[\Delta \ln P_{0,i2}]\eta_i] = 0$, for *i = 1,2,3,...,N*, then the explanatory variables in differences and $\Delta[\Delta \ln P_{k,it-1}]$, if they are exogenous or weakly exogenous, they are valid instruments for level equations. The same happens if they are endogenous, but the instruments become then explanatory variables in the lagged differences of a period and $\Delta[\Delta \ln P_{k,it-1}]$.

Finally, as a way to test the robustness and consistency of the model, Arellano and Bond (1991) suggest two types of test. *Hansen* and *Sargan* that respectively test, if the instruments that were used and the instruments that were additionally required by the System GMM valid. For last, the Arellano e Bond (1991) elasticity tests will verify if the μ_{it} error shows first-order serial correlation and if $\Delta\mu_{it}$ shows second-order correlation. Regarding the consistency of the estimators, it is expected that μ_{it} shows first-order correlation while the $\Delta\mu_{it}$ series will not be in second-order autocorrelation.

It is worth emphasizing that the System GMM estimates about to be shown in the next section are results of the estimation which estimator was corrected by the Windmeijer Method (2005) that is so to avoid underestimation of the true variances in a finite sample by the respective estimator. The estimator used was the one proposed by Arellano and Bond (1991) in two steps. On the first stage, it is supposed that the terms of error are independent and homoscedastic in the states and along the time. On the second stage, residues obtained on the first stage are used in the creation of a consistent estimate of the variance-covariance matrix, and by consequence leaving aside the independence hypothesis and the homoscedaticity. The second stage estimator is asymptotically more efficient when compared to the first stage estimator.

6 RESULTS OF THE ECONOMETRIC MODEL

In this section, the estimation results of model parameters (1) and (2) are shown. They will be used for the calculation of income-poverty elasticity and inequality-poverty elasticity.

The estimated results of model (1) by OLS, *WITHIN GROUPS* and System GMM methods are here in Table 3.

In this table, the estimated coefficient value of the $\Delta \ln[P_{it-1}]$ variable in column [c] by the System GMM method is respectively between the values of the estimated coefficient values of this same variable (columns [a] and [b]) by the OLS and *WITHIN GROUPS* methods. So, system GMM eases the estimation bias problem because on the right side of the equation (1) there is the lagged dependent variable of a period beyond the presence of unobservable fixed effects. Please notice on column [c] the statistical significance of the estimated coefficient of $\Delta \ln[P_{0,it-1}]$ which confirms the initial hypothesis that states that poverty variation has a persistence feature.

Table 3 – Results of Regression Models for $\Delta \ln[P_{it-1}]$ - Model 1

	OLS [a]		*WITHIN GROUPS* [b]		System GMM [c]	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
$\Delta \ln[P_{0,it-1}]$	0,1840	0,00	0,1529	0,02	0,1139	0,00
	(0,0672)		(0,0686)		(0,0239)	
$\Delta \ln[\bar{y}_{it}]$	-0,7654	0,00	-0,7886	0,00	-0,6899	0,00
	(0,0651)		(0,0658)		(0,0507)	
$\Delta \ln[Gini_{it}]$	0,8785	0,00	0,9046	0,00	0,7799	0,02
	(0,1451)		(0,1464)		(0,1385)	
Const.	-0,0079	0,11	-0,0080	0,10	-0,0114	0,00
	(0,0049)		(0,0050)		(0,0007)	
	F(3,269)=53,11 Prob>F=0,0000 R_2= 0,37		F(3, 249)= 53,21 Prob>F=0,0000		F(2, 20)= 124,30 Prob>F=0,0000	
	Number of obs: 273		Number of obs: 273 Number of groups: 21		Number of obs: 273 Number of groups: 21 Number of instrum.: 17	
H_0: Absence of Autocorrelation in first-order residues			Value-p		0,001	
H_0: Absence of Autocorrelation in second-order residues			Value-p		0,101	
Hansen Test			Prob > chi2		0,288	
Sargan Test			Prob > chi2		0,262	

Obs.: (i) The values in parentheses are the standard deviations as corrected by the Windmeijer (2005) method; (ii) The values for the Hansen test are the p-values for the null hypothesis that the instruments are valid and (iii) The values for the Sargan Test are the p- values for the validity of the additional instruments which are required by the System GMM method (iii) The explanatory variables in lagged differences as well as $\Delta[\Delta \ln[P_{0,it-1}]]$ and 1-period lagged $\Delta[\Delta \ln[\bar{y}_{it}]]$ were used as instruments in the System GMM.

Source: results obtained by the authors.

The estimated results of the poverty income-elasticity and inequality-elasticity parameters were, respectively, equal to 0,68 and 0,78, according to values on column [c]. Hence, a 1% increase in the *per capita* income, causes a 0,68% decrease in the poor individuals´ proportion. On the other hand, the 1% increase in the income inequality index causes an increase by 0,78% in poverty. It is worth emphasizing, that these elasticities'

estimated signs coincide with the theoretical elasticity signs which were shown in Section 3. Besides, they corroborate the results shown on international articles such as Kalwij and Verchoor (2004), Bourguignon (2004) and that by Marinho and Soares (2003), Hoffmann (2004) and Santos (2008) for Brazil. Therefore, policies that aim towards inequality reduction are more effective in the fight against poverty than policies exclusively designed to improve median income growth.

The estimated results of the equation (2) parameters can be seen in Table 4 as follows. Once again, the estimated parameter of the $\Delta \ln[P_{it-1}]$ variable is, respectively, between the estimated values of this same variable (columns [a] and [b]) that were obtained by the *WITHIN GROUPS* and the OLS methods. However, this parameter if estimated by the system GMM, does not show statistical significance.

Among the isolated factors that substantially contribute to poverty increase, some can be named in an increasing order. The interaction between income variation and the inverse level of development; the initial income inequality; the interaction between income variation and initial income inequality; the income inequality of the present period. See on column [c] the positive and significant values of this variable in Table 4.

The interaction term between income variation and inverse development level shows a positive estimated coefficient and statistically significant, and so is the interaction between income variation and the initial inequality level, according to values seen on column [c].

Once the isolated effect of median income on poverty is negative, the effect of an income increase on poverty reduction is lesser when the initial development level is low. The same happens when the initial inequality level is high.

Thus, one can state that in regions of low initial development level and/or high initial inequality, the conditions for poverty reduction through income increase are less favorable. One can also conclude that the high inequality and the low initial development level of most Brazilian states are impediments to the reversal of poverty through income growth.

But the estimated coefficient on column [c], of the interaction between inequality variation and the inverse of the initial development level is negative and statistically significant. The same happens to the interaction between inequality variation and its initial level. Soon enough, the effect of inequality variation on poverty reduction will be lesser when the initial development level is low or when the initial inequality level is high. In other words, poverty reduction as a consequence of income inequality reduction can be less effective if a region has low initial development level and/or high initial inequality level.

Therefore, low initial development level and high initial income inequality in Brazil are impediments to poverty reduction, regardless the means used to achieve such reduction. Be it through economic growth, be it through income inequality reduction.

The estimation of the coefficient of the initial inverse development level shows a positive relation and it is also statistically significant with the poor individuals' proportion (values on column [c]). Under these terms, the bigger the inverse of the initial development level, the bigger the incidence of poverty. That is, the lower the initial *per capita* household income, the bigger the incidence of poverty.

The last lines in Table 4 show the Arellano and Bond test results (1991) for the first-order and second-order autocorrelation of the residues and those by *Hansen* and *Sargan* for the validity of the instruments. According to the p-Values on column [c], the Arellano and Bond tests show that the null hypothesis of absence of first-order correlation can be rejected and then the existence of second-order autocorrelation of the residues can be accepted. The p-Values of the *Hansen* Test and of the *Sargan* Test allow for the acceptance of the hypotheses that the instruments used for the estimation of models are valid.

Table 4 – Results of Regression Models for $\Delta \ln[P_{0,it}]$ - Model 2

	O.L.S. [a]		*WITHIN GROUPS* [b]		System GMM [c]	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
$\Delta \ln P_{0,it-1}$	0,1463 (0,0676)	0,03	0,0425 (0,0720)	0,55	0,1301 (0,0711)	0,08
$\Delta \ln[\overline{Y}_{it}]$	-0,3675 (0,1485)	0,01	-0,4137 (0,1516)	0,00	-1,0806 (0,2936)	0,00
$\Delta \ln[\overline{Y}_{it}] \ln[G_{i0}]$	0,4371 (0,2629)	0,09	0,5238 (0,2687)	0,05	1,6851 (0,5050)	0,00
$\Delta \ln[\overline{Y}_{it}] \ln[\frac{z_{it}}{\overline{y}_{i0}}]$	1,064 (0,4832)	0,02	1,0820 (0,4801)	0,05	1,1565 (0,3860)	0,00
$\Delta \ln[Gini_{it}]$	0,4209 (0,3479)	0,22	0,4865 (0,3507)	0,16	3,4064 (0,8328)	0,00
$\Delta \ln[Gini_{it}] \ln[G_{i0}]$	-0,3783 (2,6100)	0,53	-0,5010 (0,6166)	0,41	-5,6068 (1,4515)	0,00
$\Delta \ln[Gini_{it}] \ln[\frac{z_{it}}{\overline{y}_{i0}}]$	-2,998 (0,8709)	0,00	-3,0703 (0,8771)	0,00	-1,2865 (0,6120)	0,05
$\ln[G_{i0}]$	0,1283 (0,1121)	0,25			1,1980 (0,5580)	0,04
$\ln[\frac{z_{it}}{\overline{y}_{i0}}]$	-0,0931 (0,0377)	0,01	-0,2159 (0,0479)	0,00	0,2876 (0,6176)	0,00
Const.	0,0851 (0,0650)	0,19	0,0491 (0,1344)	0,00	0,7001 (0,3002)	0,03
	F(9,63)=21,93 Prob>F=0,0000 R2= 0,43		F(8, 244)= 26,63 Prob>F=0,0000		F(8, 20)= 16,24 Prob>F=0,0000	
	Number of obs: 273		Number of obs: 273 Number of groups: 21		Number of obs: 273 Number of groups: 21 Number of instrum.: 17	
H_0: Absence of Autocorrelation in the first-order residues			p-Value		0,002	
H_0: Absence of Autocorrelation in th second-order residues			p-Value		0,829	
Hansen Test			Prob > chi2		0,360	
Sargan Test			Prob > chi2		0,269	

Obs.: (i) The values in parentheses are standard deviations corrected by the Windmeijer method (2005); (ii) The values for the Hansen Test are the p-Values for the Null Hypothesis that instruments are valid and (iii) The values for the Sargan Test are the p-Values for the validity of the additional instruments required by the System GMM method. (iii) The explanatory variables in lagged differences were used as instruments in the System GMM and also $\Delta[\Delta \ln[P_{0,it-1}]]$ and $\Delta \ln[G_{i0}]$ lagged of a period.

Source: results obtained by the authors.

6.1 Poverty-income and Poverty-inequality elasticities in Brazilian states.

The poverty-income and poverty-inequality elasticities for the Brazilian states were calculated according to expressions (3) and (4). The estimated parameters of these two expressions were gotten via the estimation of model (2), once this model happens to be the

most suitable for determining those elasticities, for this model considers the features of income distribution, inequality level and initial development. Table 5 shows those elasticities as a median for Brazilian states and Brazilian regions for the period from 1995 to 2009.

As one could expect, according to the theoretical elasticity signs of income-poverty and inequality-poverty as shown in Section 3, the first is negative and the latter is positive in all Brazilian states and regions. That means the increase in median income and the reduction of income inequality led to a diminution of the proportion of poor individuals.

Table 5 – Median Elasticities of poverty-income and inequality-income in the Brazilian states and regions.

STATES	MA	PI	CE	RN	PB	PE	AL	SE	BA	NORTHEAST
Poverty-income Elasticity	-1.61	1.52	-1.5	-1.54	-1.53	1.56	-1.6	1.56	1.57	-1.54
Poverty-inequality Elasticity	2.33	2.3	2.34	2.3	2.4	2.52	2.5	2.47	2.4	2.39
STATES	MG	ES	RJ	SP						SOUTHEAST
Poverty-income Elasticity	-1.58	1.61	1.63	-1.61						1.6
Poverty-inequality Elasticity	2.48	2.51	2.49	2.42						2.42
STATES	PR	SC	RS							SOUTH
Poverty-income Elasticity	-1.59	1.65	1.64							-1.62
Poverty-inequality Elasticity	2.49	2.38	2.47							2.44
STATES	MS	MT	GO	DF						MIDWEST
Poverty-income Elasticity	-1.58	1.61	1.59	-1.62						-1.6
Poverty-inequality Elasticity	2.49	2.49	2.51	2.5						2.49

Source: results obtained by the authors.

However, analyzing the values of these elasticities in Table 5, it becomes evident that the impact of income inequality on poverty is bigger than the median income growth. The very same evidences were also found by Kakwani (1990) and by Marinho and Soares (2003).

In regional terms, the absolute value of the poverty-income elasticity in the northeast region is lesser than in all other regions. That is, such result corroborates the theoretical hypothesis that poverty-income elasticity is lesser in economies of lower median income. In richer regions, the effect of median income growth is considerably stronger on poverty reduction. These results corroborate those by Marinho and Soares (2003) and Hoffmann (2004). Therefore, less developed regions like the Brazilian northeast do have greater difficulty in reducing poverty through income growth.

In the same vein, poverty-inequality elasticity in the northeast region is also lesser than those of other regions, but with an impact of inequality on poverty bigger than the median income growth.

Generally, these results show the improved effectiveness of inequality reduction in the fight against poverty in Brazil.

7 FINAL CONSIDERATIONS

This article aims to estimate the elasticities of poverty in relation to income and in relation to inequality in Brazil in order to analyze the determiners for poverty reduction. More specifically, it attempts to analyze whether any poverty variation is a consequence of income redistribution or economic growth (or a consequence of a combination of both factors).The article tries to establish and better understand the importance of each of these two effects on poverty variation.

The results of the estimation of the first model show that poverty-income and poverty-inequality elasticities were, respectively -0,68 and 0,77. That is, increase by 1% of

the *per capita* income begets a 0,68% decrease in the proportion of poor individuals. On the other hand, a 1% increase in the income inequality index leads to a 0,77% increase in poverty. It is worth mentioning that these results corroborate other international articles such as Kalwij and Verchoor (2004), Bourguignon (2004) and the one by Marinho and Soares (2003), Hoffmann (2004) and Santos (2008) for Brazil. They converge on the fact that inequality reduction policies are more effective than median income growth policies when it comes to fighting poverty

The estimated results of the second model which allows for elasticities to vary along time, showed that the factors that contribute to poverty expansion are in an increasing order: the interaction between income variation and inverse initial development level, the initial income inequality and the present-period income inequality.

The impact of income growth on poverty reduction is lesser when the initial development level is low. The same happens when the initial inequality index is high. Hence, the conclusion that region of low initial development level and/or high initial inequality level have less favorable conditions for poverty reduction through income growth. Furthermore, there is the conclusion that high initial inequality and low initial development level of most Brazilian states are obstacles for a reversion of poverty through income growth.

The effect of inequality variation on poverty reduction is lesser when the initial development level is low or when the initial inequality level is high. Therefore, the fight against poverty through the reduction of income inequality in Brazilian regions and states of low initial development level and/or high initial inequality level, may not achieve the expected effects.

Thus, the low initial development level and the high initial income inequality level in Brazil antagonize poverty reduction, regardless of the means applied to accomplish such reduction. Be it through economic growth, be it through the lessening of income inequality.

In terms of poverty-income as well as poverty-inequality elasticities, it has been observed that the impact of income inequality on poverty is bigger than the median income growth. These same evidences were found by Kakwani (1990) and by Marinho and Soares (2003).

In regional terms, the absolute value of poverty-income in the northeast is lesser than in all the other Brazilian regions. That is, this result confirms the theoretical hypothesis that poverty-income elasticity is lesser in economies of smaller median income. In richer regions, the effect of median income growth is more effective on poverty reduction. The results obtained in this article corroborate the results found by Marinho and Soares (2003) and by Hoffmann (2004). In sum, less-developed regions like the Brazilian northeast show greater difficulty in reducing poverty through income growth.

Likewise, poverty-inequality elasticity in the northeast region is also lesser than those of other regions, but with an impact of inequality on poverty bigger than that brought about by median income growth.

In a nutshell, these results show the improved effectiveness of inequality reduction in the fight against poverty in Brazil.

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