Static and Dynamic Decompositions of Income Inequality in Brazil between 1980 and 2000

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Abstract. This article uses the methodology suggested by Cowell and Jenkins (1995) and Mookerjee and Shorrocks (1982) to decompose two generalized inequality measures: the Theil index, and the mean log deviation of income. The decomposition separates the total inequality observed in Brazil in 1980, 1990 and 2000 into three income classes: poor, average and rich. This decomposition exercise shows how population and income shares of each subgroup have changed over time, calculates individual inequality measures for each subpopulation and indicates which share of total inequality is due to inequality within and between these three groups. The dynamic decomposition shows what share of variation in inequality is attributable to the allocation

Introduction

Income inequality in Brazil has been historically high and a myriad of articles and books have combined efforts to explain its causes, consequences and what could be done to reduce it (De Ferranti et al 2004; Ferreira et al 2006). Explanations for the perverse maintenance of inequality in Brazil have been draw from the labor market, structural economic shocks, demographic differences, educational expansion and from differences in effort and opportunities (Roemer 1996). Only recently has income inequality in Brazil been studied from a dynamic perspective combining the and isolating the separate influence of separate groups on total inequality trends (Ferreira et al. 2006).

This article builds on the idea that the best way to understand the sources of inequality is to identify the groups where inequality is higher and then to decompose it into population compositional effects and income allocation effects. In order to advance the state of the debate on inequality, I address the following question: *How do subpopulations with different incomes combine to affect income inequality in the total population?* Answering this question will help to clarify how inequality within and between economic subgroups are related to total inequality. What economic group – poor, average or rich – accounts for most part of observed inequality levels? As aggregate inequality is a function of subpopulation sizes and their respective income shares, it is possible to measure the relative contribution of these two components on total inequality, and also by how much they would have to change in order to reduce inequality. This exercise entails a static decomposition, in a given year, and a dynamic decomposition, capable of accounting for changes in the level of inequality by partitioning the distribution of income into subgroups (Cowell and Jenkins 1995; Mookerjee and Shorrocks 1982). The dynamic decomposition, in particular, allows one to decompose the change in total inequality into three effects: the first derives from the allocation of people in different subpopulations, the second arises from variations in relative mean incomes between partitions, and the

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third depends on changes in inequality within each one of the subpopulations. This article has two main contributions to the discussion on inequality. The first is to describe, from a static perspective, the relative importance of each income group in the composition of total inequality. The second is to investigate, from a dynamic perspective, what has been most important to explain changes in income inequality: Differential population growth or changes in the allocation of income within these subgroups?

Data and Methods.

The dataset used in this study will include special tabulations of these variables available in the 1980, 1991 and 2000 Brazilian Censuses produced by the *Instituto Brasileiro de Geografia e Estatística* (IBGE). The Brazilian censuses are publicly available at IPUMS International website (Ruggles et al 2004).

Measuring Income and Defining Income Classes.

The measure of income is per capita family income, which takes into account all the sources of income within the family, the number of people and the role of the family as a solidary unit of consumption and earnings (Rocha 1996). Family per capita income is better since it automatically "corrects" for family size as the total income is shared equally among all the family members (Datta and Meerman 1980). A similar measure, per capita household income has also been considered in other studies of inequality (Ferreira and Barros 1999; Fiorio 2006; Firpo, Gonzaga and Narita 2003; Pero and Szerman 2005) and provides similar results. Gross monthly family income per capita will be measured in 2007 Brazilian Reais with a dollar exchange rate of approximately BR$/US$=2.03. The Brazilian INPC official consumer price index is used to convert current incomes into real ones (Ferreira, Leite and Litchfield 2006: 5).

The total population will be divided into subgroups according to three levels of income: poor, average and rich. To define the income threshold separating these three subpopulations I follow the strategy adopted by Medeiros (2005), who defines who is poor and who is rich according to a distributive rule taking into account a given poverty line. The poverty line is defined by the value separating 33 percent of the population with lowest per capita family income[2]. This value is low enough to avoid any controversies about who is poor and is compatible with most people's perception of what represents an "insufficient" income to survive. Using data from the Northeast and Southeast regions of Brazil, Medeiros (2005: 120) shows that about 83 percent of the population considers the estimated poverty line of R$80.97 per capita as insufficient to survive and pay for the maintenance (85%) and purchase of food (49%) for the family. With this poverty line, a "surplus line" can be established to define the rich subpopulation as all those individuals with a *per capita income above which income would have to be transferred in order to eradicate poverty*. In other words, the surplus line represents the point above which income would have to be reduced in order to generate sufficient transfers to eliminate

[2] Poverty lines in Brazil have not been officially established yet, in spite, or because of, numerous studies which have not agreed on the best methodological procedures of measuring poverty (Rocha 1988, 1996, 1998, 2000; Ferreira, Lanjouw and Neri 2000; Neri 2000). Some studies suggest that a poverty line should not even be implemented in Brazil because it would create an inflexible yardstick to implement compensatory policies (e.g. Schwartzman 2002). See Medeiros (2005: 115) for a comparison between poverty lines defined according to different methodologies.

poverty (e.g. number of people below the poverty line). In a population with n individuals whose incomes are ascendant and represented by y_i there are two groups: i) the rich, with incomes between k and n and above the surplus line z_r ($y_i > z_r$) and ii) the poor, with incomes between 1 and l and below the poverty line z_p ($y_i < z_p$). So in mathematical terms, the surplus line z_r is:

$$z_r = \frac{G_p}{(n-k)\sum_k^n y_i} \quad (1)$$

Where G_p is the poverty hiatus defined as the sum of the difference between the poverty line and the income of those below it or $G_p = \sum_1^l (z_p - y_i)$. The poverty line, therefore, should satisfy the condition where:

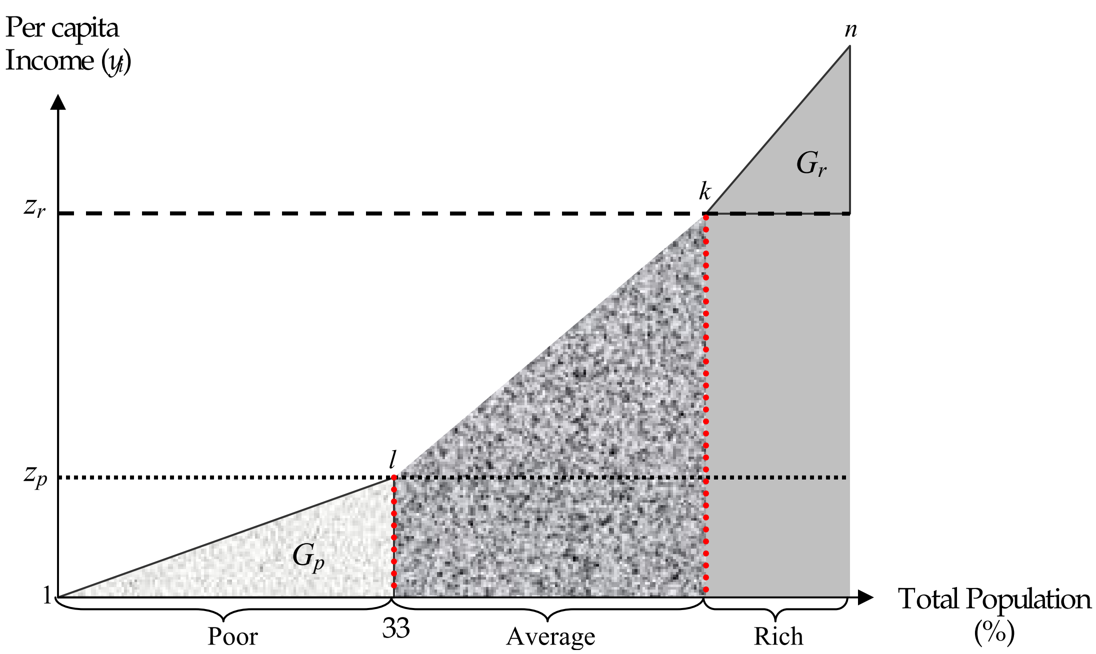
$$G_r + G_p = 0 \quad (2)$$

Equation (2) can be rewritten to show that the surplus line defining the rich subpopulation should satisfy the following situation:

$$\sum_k^n (z_r - y_i) + \sum_1^l (z_p - y_i) = 0 \quad (3)$$

Having defined poverty (z_p) and surplus (z_r) lines, the average income class is residually defined by all those individuals in between the two lines. The graph below shows the distributive logic behind the definition of the three (rich, average, poor) income classes:

Graph 1. Level and Distribution of Family Per Capita Income for a Hypothetical Population



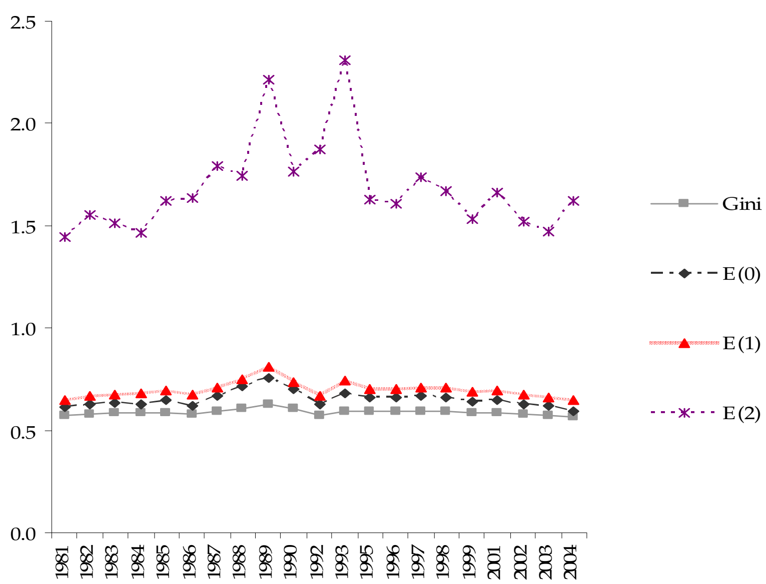
Alternatively, the empirical evidence coming from other household surveys in Brazil (e.g. PNAD) has shown that the richness line defined above can also be approximated by taking the one percent richest population in the top of the income distribution. This approximation has proved to be simpler and provide very similar results.

Measuring Inequality.
Coulter (1989) reports about 50 different inequality measures, but Litchfield (1999) points that only a few have the "desirable properties" required to be a good inequality indicator[3]. I use the Theil index to measure inequality because it satisfies all the desirable axioms and because it gives equal weights to the dispersion of income across the distribution. The Theil index is one member of the Generalized Entropy (GE) class of inequality measures and can be mathematically defined as:

$$GE\ (1) = Theil\text{-}T\ Index = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\bar{y}}\ln\frac{y_i}{\bar{y}} \qquad (4)$$

An empirical comparison between the Theil index and other inequality measures, however, does not show very significant differences in the trend of inequality in Brazil (Graph 2). Only GE (2) – which is equal to half the squared coefficient of variation – presents significant differences in the level and pattern of inequality in Brazil. This difference results from the fact that GE (2) gives more weight to gaps in the upper tail of the distribution, where the dispersion of income is higher. For analytical purposes, and for the sake of simplicity, only the Theil index will be considered in the paper.

Graph 2. Inequality Measures in Brazil, 1981-2004



Source: Ferreira, Leite and Litchfield 2006

Preliminary results.

[3] Inequality measures should meet five key axioms: 1) Pigou-Dalton Transfer Principle: requires an inequality index to increase (or at least not fall) when income is transferred from poor to rich; 2) Income Scale Independence: inequality measures must be invariant to uniform proportional changes (e.g. when changing currency unit); 3) Principle of Population: merging to identical populations should not affect inequality; 4) Anonymity: inequality must be independent of individual characteristics other than their income; and 5) Decomposability: overall inequality must be consistently related to constituent parts of the distribution, such as subpopulations defined according to specific characteristics (e.g. race, sex, age) (Cowell 1995).

Generalized entropy indices of inequality have been generated for the three classes of income in 1980 and 1991, but the complete decomposition exercise is still pending. A later version of this paper will present the results for the three years and a full structured decomposition of inequality for Brazil during the period of analysis.
However, just to demonstrate the feasibility of this study, partial results are presented below:

In 1980

Generalized Entropy indices GE(a), where a = income difference sensitivity parameter, and Gini coefficient

All obs	GE(-1)	GE(0)	GE(1)	GE(2)	Gini
	1.46081	0.72562	0.82615	3.59056	0.61794

Subgroup summary statistics, for each subgroup k = 1,...,K:

Family per capita income class	Pop. share	Mean	Rel.mean	Income share	log(mean)
Poor	0.31482	46.80909	0.15769	0.04964	3.84608
Average	0.67372	343.40231	1.15682	0.77937	5.83890
Rich	0.01146	4.43e+03	14.92012	0.17099	8.39594

Subgroup indices: GE_k(a) and Gini_k

Family per capita income class	GE(-1)	GE(0)	GE(1)	GE(2)	Gini
Poor	0.21828	0.12061	0.09542	0.08629	0.23897
Average	0.40361	0.34643	0.37780	0.53991	0.46122
Rich	0.13597	0.16100	0.25148	0.73410	0.30036

Within-group inequality, GE_W(a)

All obs	GE(-1)	GE(0)	GE(1)	GE(2)
	0.67097	0.27321	0.34218	2.36027

Between-group inequality, GE_B(a):

All obs	GE(-1)	GE(0)	GE(1)	GE(2)
	0.78983	0.45241	0.48397	1.23029

In 1991

Generalized Entropy indices GE(a), where a = income difference sensitivity parameter, and Gini coefficient

All obs	GE(-1)	GE(0)	GE(1)	GE(2)	Gini
	1.66279	0.79092	0.85596	2.44214	0.63624

Subgroup summary statistics, for each subgroup k = 1,...,K:

Income class (1980 cutoff)	Pop. share	Mean	Rel.mean	Income share	log(mean)
Poor	0.37475	41.73484	0.15733	0.05896	3.73134
Average	0.61497	334.33063	1.26038	0.77510	5.81213
Rich	0.01027	4.28e+03	16.15169	0.16594	8.36274

Subgroup indices: GE_k(a) and Gini_k

Income class (1980 cutoff)	GE(-1)	GE(0)	GE(1)	GE(2)	Gini
Poor	0.22265	0.14502	0.11924	0.11124	0.27175
Average	0.40407	0.34671	0.37830	0.54241	0.46135
Rich	0.10525	0.11535	0.14304	0.21566	0.26466

Within-group inequality, GE_W(a)

All obs	GE(-1)	GE(0)	GE(1)	GE(2)
	0.72756	0.26875	0.32399	1.10894

Between-group inequality, GE_B(a):

All obs	GE(-1)	GE(0)	GE(1)	GE(2)
	0.93523	0.52217	0.53197	1.33320

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