Static and Dynamic Decompositions of Income Inequality in Brazil *

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STUDY OBJECTIVE.

Income inequality results from a disproportional allocation of resources to specific population shares, but it can also be conceptualized by a disproportionate allocation of population to income shares, or by a combination of both. The objective of this chapter is twofold. It first describes how population and income shares have changed for the Brazilian poor, middle and rich classes in 1980, 1991 and 2000. Second, it investigates how population and income shares have combined to generate total inequality in Brazil during the same period. Total inequality is decomposed into three subpopulations to assess the contribution of the inequality prevailing within and between the poor, middle and rich classes. The exercise entails static and dynamic decompositions that will answer the following questions: 1) in which income class is inequality higher? 2) What is the contribution of the poor, middle and rich classes to total inequality? 3) How has class-specific and total income inequality changed over time? 4) What factor has contributed the most to changes in total income inequality: changes in population distribution, changes in income allocation, or changes in inequality within the groups? In answering these questions the chapter disentangles the importance of population growth from the importance of income distribution between and within subpopulations in the generation of income inequality in the total population.

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BACKGROUND AND SIGNIFICANCE.

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; Henriques, Barros and Instituto de Pesquisa Econômica Aplicada. 2000). Explanations for the perverse maintenance of inequality in Brazil have been draw from the labor market, structural economic shocks, socioeconomic differences, educational expansion and from differences in "effort and opportunities" (Roemer 1998). Only recently has the dynamic of income inequality in Brazil been studied using decomposition methods combining the influence of relevant socioeconomic groups on trends in total inequality (Ferreira et al. 2006).

Decompositions are useful to clarify and attribute importance to different components of a social system. Decomposition techniques are common in demography and are at the core of population dynamics. The most fundamental example of demographic decomposition is the separation of population change into three fundamental components: fertility, mortality and migration. Further decompositions are also possible: age, period and cohort (APC); decomposition of total fertility rates into crude rates; decomposition of mortality by causes of death and many others (Canudas-Romo 2003).

Decomposition techniques are also used beyond the realm of demography. To some extent, all sciences use decomposition as a research tool. This is evident in regression, principal component and factorial analyses. What these methods do is to express variations in the variable of interest as a function of variations in one or more independent variables, vectors or factors. To decompose "means to separate something into its constituent parts or elements or into simpler compounds." (Canudas-Romo 2003) It is in this simplification that lays the virtue of decomposition techniques. Decomposition techniques are suitable for assessing the contribution of a set of factors to inequality and for allowing the researcher to estimate, control and simulate future outcomes of population growth.

Decompositions of inequality and its changes are particularly important in the design of policy measures, their expected effects and in evaluation of the impacts of inequality and redistributive policies on welfare among regions, subgroups and sectors. The tradition of decomposing inequality measures into differences in personal attributes and population subgroups is recent. It started with economists and policy analysts wishing to assess the contribution of inequality within and among different subgroups of the population to overall inequality (Bourguignon 1979; Cowell 1980; Shorrocks 1982, 1983, 1984). Since then various studies have used decomposition methodologies. Personal attributes (age, sex, and race) and labor market status account for only a small part of inequality and inequality changes in the United States. Most inequality in the U.S. happens within, rather than between, groups. (Cowell and Jenkins 1995) Another study investigated the impact of "demographic factors" such as race, age, education, region and family composition on inequality trends in the United States between 1976 and 1989 using multivariate methods (Bishop, Formby and Smith 1997). They did not find significant effects for race, but they report that the impact of age, female heads of household and college educational were quite substantial. The effects of female heads and college education both "increase the Gini to a much greater extent than the progressivity of federal income taxes decreases it." (Bishop et al. 1997) More recently, (Shorrocks and Wan 2005) conducted a spatial decomposition of inequality assuming that the real cost of living is the same across regions. In the theoretical discussion they show that the between-component is expected to rise as the number of groups increases. The empirical results, however, indicate that the increase in the number of subgroups increases the between component of inequality by a small amount. This result is particularly interesting because it indicates that between inequalities might be independent of the number of partitions. It is unclear, however, if the conclusion would hold for partitions defined by variables different from spatial units (i.e. age, income, race, education, etc).

In the Brazilian context, few studies have employed decomposition techniques to disaggregate total inequality in household income per capita into several sociodemographic components: age, gender, race, educational attainment of household head, type of household, region and urban or rural status (Barros, Henriques and Mendonça 2002; Ferreira et al. 2006; Ramos and Vieira 2000). These authors point out that decomposition exercises do not have explanatory power because each attribute is independent of any other attribute. Despite this limitation, they suggest two possibilities to explain the trend in inequality in Brazil between 1981 and 1993, and four to explain the trend between 1993 and 2004. In the first period, the rise in inequality could be explained by 1) educational expansion (e.g. (Ferreira and Barros 1999); and 2) accelerating rate of inflation. In the following interval, between 1993 and 2004, the decline of inequality is attributable to 1) decline in inequality between inequality subgroups; 2) regional converge of income between states and rural-urban areas; 3) decline in racial inequality; 4) increase in the volume and improvements in the targeting of social assistance transfers from the government.

The studies of Ramos and Vieira (2000) and Ferreira et al (2006) are important references because they apply the same methodology to the same country and period of investigation proposed here. It differs, however, in one important aspect: the variables used to decompose income inequality. Ferreira et al (2006) decomposed inequality into sociodemographic subgroups defined according to characteristics accounting for a small part of total inequality between groups. Differences in years of schooling of the head were the most important determinant of overall inequality, accounting for between 34% and 42% depending on the year. The other variables had very low explanatory power[1]. In the present investigation, instead of using age, gender, race, family structure or schooling as the criteria for the decomposition, I use more fundamental variables to define the partitions of the decomposition: income and population shares.

This chapter builds on the idea that the best way to understand the sources of inequality is to identify the groups where inequality is high and then to decompose it into population and income allocation effects. In order to advance the debate on inequality I address how subpopulations with different incomes combine to affect income inequality in the overall population. I identify how socially distinct groups combine and change to generate income inequality. Nevertheless, before defining these social groups it is necessary to understand what lies at the root of income inequalities. I believe the best way to approach this problem is to first understand how inequality is measured.

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[1] This is also the case the United States, where Cowell and Jenkins (1995) report that differences in sex, race, age and employment status explain at most 30 percent of total inequality.

MEASURES OF INCOME 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. Among all inequality measures, four are particularly popular: Gini, GE (2), Theil-T, and Theil-L indexes. These four measures are defined as:

$$\text{Gini Index} = \frac{1}{2n^2\mu}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|y_i - y_j\right| \tag{1}$$

$$\textbf{GE (2)} = \frac{1}{2}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\mu}\right)^2 - 1\right] \tag{2}$$

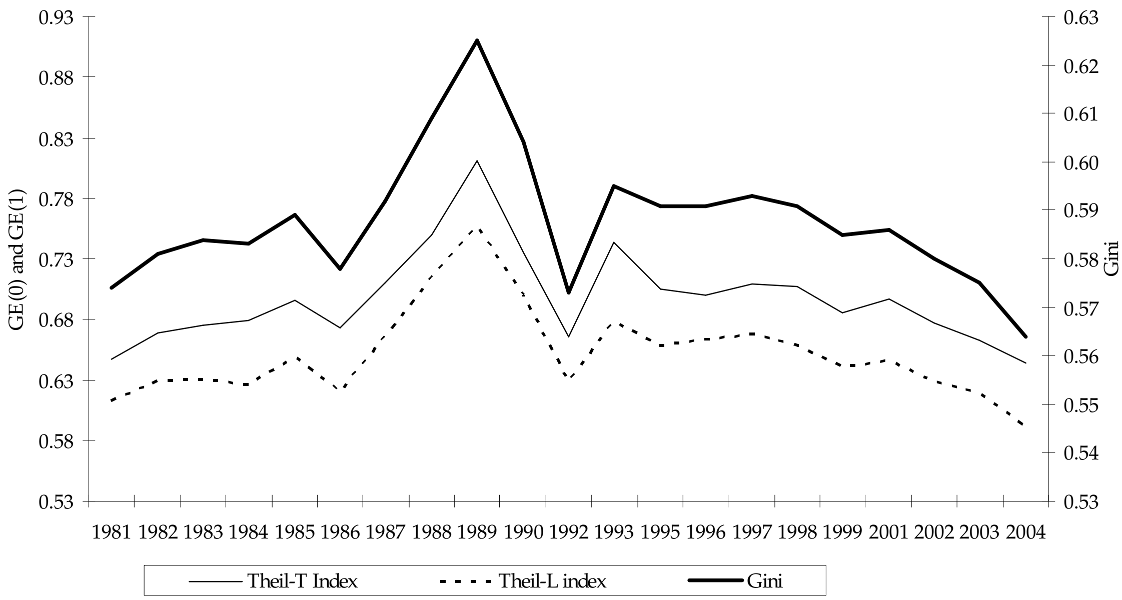
$$\textbf{GE (1) = Theil-T Index} = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\mu}\ln\frac{y_i}{\mu} \tag{3}$$

$$\textbf{GE (0) = Theil-L index = mean log deviation} = \frac{1}{n}\sum_{i=1}^{n}\ln\frac{\mu}{y_i} \tag{4}$$

where n is the number of individuals in the sample, y_i is the income of individual i, $i \in$ (1,2,…,n) and $\mu = 1/n\sum y_i$ is the arithmetic mean income. GE (2) – which is equal to half the squared coefficient of variation – gives more weight to gaps in the upper tail of the distribution, where the dispersion of income is higher. GE (1) gives equal weights to the dispersion of income across the distribution, while GE (0) gives slightly more weight to distances between incomes in the lower tail.

When dealing with summary inequality statistics it is always possible that the pattern of results obtained with one index differ from that obtained with another. The picture of inequality in the U.S., however, is broadly consistent regardless of the index used (Mookherjee and Shorrocks 1982). Ambiguity in the results or interpretation of the evidence rarely happens. An empirical comparison between Theil and Gini indexes does not show very significant differences in the trend of inequality in Brazil either. The graph below shows that the Gini and Theil indexes provide similar results in terms of variation of inequality once the scale of the Gini is adjusted.

Graph Graph 1. Three measures of income inequality in Brazil, 1981-2004



Source: Ferreira et al (2006: 7)

I will focus on the Theil-L index as an inequality measure for two reasons: first, because it satisfies all the desirable axioms of inequality[2]. Second, because its decomposition over consecutive years is simpler and provides results that are consistent with the decomposition of other inequality measures (Mookherjee and Shorrocks 1982:

[2] 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).

891-92). This is not true, for instance, of the Gini index, which fails the decomposability axiom if the sub-vectors of income overlap. The Gini index is decomposable, but the component terms of total inequality are not always intuitively or mathematically appealing.

What calls attention in equations (1) to (4) is that all of them depend on only two variables: income (y) and people (n). Regardless of which measure one picks, they will always be a function of how income is distributed among individuals. For this reason, the composition and change of income inequality will also be a function of how these two variables are composed and changed over time. By understanding and measuring how population and income change, one can also comprehend how income inequality changes.

Since inequality is by definition a consequence of how population and resources are combined and distributed, the first fundamental task to understand inequality is to identify what economic groups retain most of the resources, and how these resources are distributed across specific income groups. In Brazil, the importance of studying the poor in relation to those at the top of the distribution has been highlighted before (Ferreira 2001; Medeiros 2005). Previous studies argue that in order to understand the fundamental causes of poverty and inequality one has to investigate the formation and characteristics of groups responsible for the largest shares of total inequality. Income inequality is Brazil is mostly driven by the upper part of the income distribution, the richest ten percent (Barros and Mendonça 1995). Table 1 presents population shares, relative mean incomes and two inequality measures for the three income classes considered in this dissertation.

The table gives an approximate estimate of the amount of inequality in the income distribution:

Table 1. Time paths of population share, relative incomes and inequality values by income class, Brazil 1980-2000

	Income class		
	Poor	Middle	Rich
Population shares ($f_j = n_j/n$)			
1980	0.315	0.674	0.011
1991	0.375	0.615	0.010
2000	0.259	0.724	0.018
Mean incomes (in R$)			
1980	47	343	4430
1991	42	334	4280
2000	45	363	4640
Income shares			
1980	0.050	0.779	0.171
1991	0.059	0.775	0.166
2000	0.033	0.738	0.230
Relative mean incomes ($\lambda_j = \mu_j/\mu$)			
1980	0.158	1.157	14.920
1991	0.157	1.260	16.152
2000	0.126	1.019	13.030
Within income class inequality: GE(0)			
1980	0.121	0.346	0.161
1991	0.145	0.347	0.115
2000	0.143	0.360	0.177
Within income class inequality: GE(1)			
1980	0.095	0.378	0.251
1991	0.119	0.378	0.143
2000	0.110	0.387	0.294

Source: 1980, 1991 and 2000 Brazilian Census

Table 1 exemplifies that the distribution of income is usually more unequal among the richest one percent than among the poorest 31.5 percent. The richest class detained more than 17 percent of the income share in 1980, while the poor detained about 5 percent of income. The middle class detained the remaining 78 percent. There is also evidence to support the fact that the population share component of the poor might be more important than the relative income of the poor. This conclusion derives from the fact that total inequality varied in the same direction as the population share and inequality in the poor group. The share of the poor population, and inequalities in the poor and in the total populations increased between 1980 and 1991 and then decreased in 2000.

To stratify the population by income levels is a suitable strategy to decompose total inequality because income not only is the underlying variable of inequality, but also because it is a reflection of other types of inequality including racial, educational, political, and sexual. By stratifying the total population and total inequality into income groups is a promising strategy because it embraces discrepancies in productive characteristics that might be blamed for income inequality but that are not easily observable (e.g. influence of social networks, beauty, diligence, commitment).

By defining particular income groups – poor, middle and rich – it becomes possible to measure their relative contribution to total inequality. Stratifying the population by income helps to understand how inequality is composed and has changed within and among these socioeconomic classes. Moreover, dividing the population into distinct income classes offers an opportunity to study an often neglected side of the income distribution, the rich. Much attention is given to the poor, but the rich, the big retainers of resources, are rarely investigated. Decomposing total inequality into three income groups will advance knowledge of the dynamics of income inequality in Brazil by showing how population and income allocations have shifted and combined among the poor, middle and rich classes to generate total inequality. In the next section I describe the rationale behind the definition of these three classes.

DATA AND METHODS.

This section presents the dataset and two methodological aspects of the project: 1) the concept of income and the criteria used to define social classes according to their economic status; and 2) the methods employed to decompose inequality from static and dynamic perspectives.

Data.

The dataset used in this study includes special tabulations of income from the 1980, 1991 and 2000 Brazilian Censuses produced by the *Instituto Brasileiro de Geografia e Estatística* (IBGE). Brazilian censuses are publicly available at the IPUMS International website (Ruggles et al. 2004). Further details about the Brazilian censuses and its sample characteristics can be obtained at:

https://international.ipums.org/international/sample_designs/sample_designs_br.html

Measuring income and defining income classes.

The measure of income used 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 "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 utilized 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 is measured in January 2002 Brazilian *Reais*. The Brazilian INPC and IGP official consumer price index are used to convert current incomes into real ones (Corseuil and Foguel 2002).

The total population is divided into subgroups according to three levels of income: poor, middle and rich classes. To define the income threshold separating these three subpopulations I follow the strategy adopted by (Medeiros 2005), who defines the poor and the rich according to a distributive rule taking into account a pertinent poverty line. The poverty line is defined by the value separating 33 percent of the population with lowest per capita family income[3]. This value is low enough to avoid any controversies about who is poor and is compatible with the popular perception of what represents an "insufficient" income to survive. Using data from the Northeast and Southeast regions of Brazil, Medeiros (2005: 120) reports that 83 percent of the population considers the estimated poverty line of R$80.42 per capita[4] as "insufficient to cover the living expenses (85%) and the 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

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[3] Official poverty lines do not exist in Brazil. Studies have not agreed on the best methodological procedures of measuring poverty (Ferreira, Lanjouw and Neri 2000; Neri 2000; Rocha 1996, 2000, 2003). 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 the introduction of this dissertation for a comparison of poverty lines defined according to different methodologies.

[4] This value was equal to $44.5 per month on October 2007.

line represents the point above which income would have to be reduced in order to generate sufficient transfers to eliminate 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:

$$z_r = \frac{G_p}{(n-k)\sum_k^n y_i} \tag{5}$$

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:

$$G_r + G_p = 0 \tag{6}$$

Equation (6) can be rewritten to show that the surplus line defining the rich subpopulation should satisfy the following situation:

$$\sum_k^n (z_r - y_i) + \sum_1^l (z_p - y_i) = 0 \tag{7}$$

Having defined poverty (z_p) and surplus (z_r) lines, the middle income class is residually defined by all those individuals in between the two lines.

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 (Medeiros 2005: 123). This approximation is not affected by variations in income top-coding, and it is simpler to calculate and provides very similar results. In sum, because of its methodological simplicity, the three income classes are defined as:

- Poor class: 33 percent of the population at the bottom of the family per capita income distribution;
- Middle class: population between the 33rd and 99th percentiles of the income distribution;
- Rich class: one percent of the population at the top of the family per capita income distribution.

The main function of imaginary lines defining the poor and the rich is to discriminate broad but relatively homogeneous social groups to allow the study of their characteristics rather than to generate a criterion to implement and execute distributive public policies of any kind. In the absence of official and consensual definitions for what "economic classes" mean, it seems reasonable to avoid a series of contestable presuppositions and to understand the definition of class as a simple instrument required to an analytical end. It is preferable to adopt a criterion that is at the same time easy to implement, relevant to the object of study and compatible with previous studies than to struggle with alternative class schemes whose validity is debatable and at best conditioned on the goal of analysis.

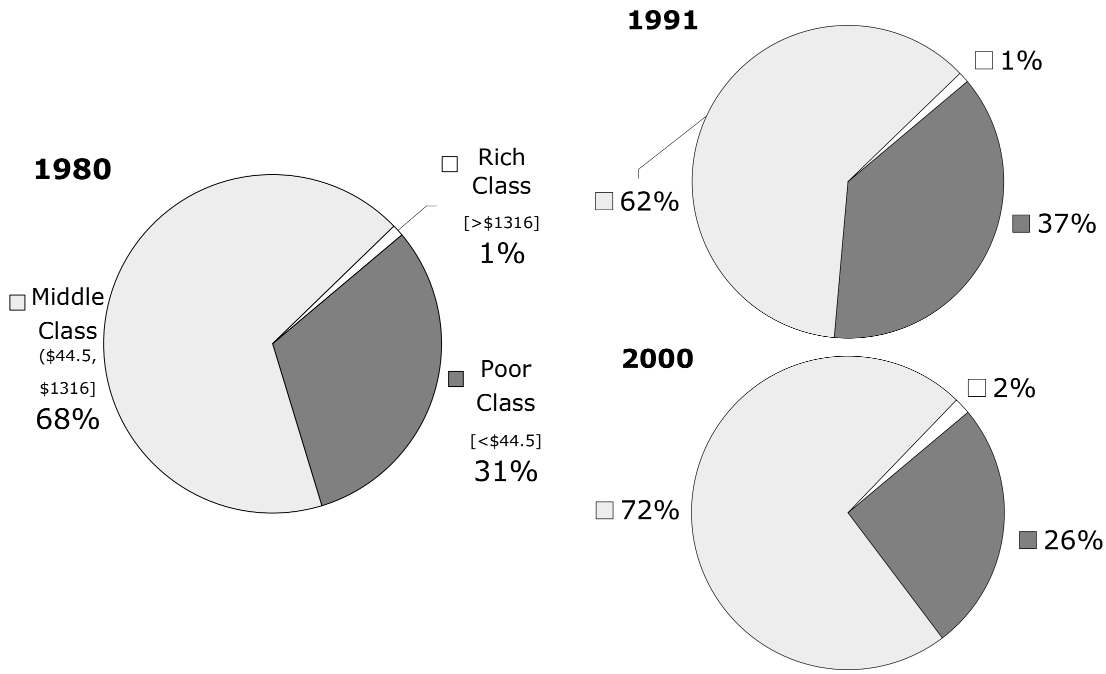
In sum, my definition of "social/economic class" follows a sociological agreement according to which social classes should characterize homogeneous groups, be meaningful for analytical purposes and relatively comparable over time (Grusky and

Sorensen 1998; Hauser and Warren 1997; Sorensen 1991; Wright 1997, 2005). My definition of class fulfills these requirements and does not change over time. It does not change between 1980, 1991 and 2000. Once I define the poor as 33 percent of the population at the bottom of the income distribution in 1980, I use the absolute value separating this same 33 percent in 1980 to define the poor in 1991 and in 2000 as well. Example: In 1980, R$80.97 (about $44.5) defines the poverty line. In 1991 and in 2000, R$80.97 per capita is the same value used to define the poverty threshold. As a result, the size of the population in the poor class changes over time, but the definition of who is poor remains the same. The same logic follows for the rich and middle classes. Thus, the cutting points used to identify social classes do not change over time, but the share of population in each one of the "classes" does. This change is exactly what I want to analyze in order to infer demographic fluctuations in the size of the three classes. Needless to say, all income values are real, not current, and hence comparable over time.

After excluding missing and zero income values[5], the final distribution of people in each social class and year looks as follows:

[5] Missing and zero income values accounted for 3.5% of the total sample in 1980, 3.35% in 1991, and 6.54% in the 2000 Brazilian Census.

Figure 1. Population distribution by income class in Brazil, 1980-2000



Source: 1980, 1991 and 2000 Brazilian Censuses

Figure 1 is compatible with the information presented in the first rows of table 1. It shows that the proportion of people living below poverty was 31 percent in 1980, increased to 37 percent in 1991 and then declined to 26 percent in 2000. The rich population remained relatively stable, while the middle class declined to 62 percent and then increased to 72 percent in 2000.

Decomposition techniques.

Static and dynamic decompositions of income are carried for 1980, 1991 and 2000 using Brazilian censual data. The static decomposition separates total inequality into a component of inequality *between* poor, middle and rich classes, and a component *within* group inequality. Total inequality (I) can then be expressed as a direct sum of between (I_B) and within (I_W) inequalities, $I = I_W + I_B$. For each class of generalized inequality index, within and between inequalities are defined as:

$$GE(0) = I_W^{GE(0)} + I_B^{GE(0)} = \sum_{j=1}^{k} f_j GE(0)_j + \sum_{j=1}^{k} f_j \ln(1/\lambda_j) \qquad \textbf{(8)}$$

$$GE(1) = I_W^{GE(1)} + I_B^{GE(1)} = \sum_{j=1}^{k} f_j \lambda_j GE(1)_j + \sum_{j=1}^{k} f_j \lambda_j \ln(\lambda_j) \qquad \textbf{(9)}$$

where f_j is the population share and $\lambda_j = \mu_j / \mu$ is the mean income of each subgroup j, j= poor, middle, rich, relative to that of the whole population. The first term of equations (8) and (9) represent within inequality and is simply the sum of subgroup inequalities weighted by population and the relative mean income shares. The second term, inequality between subgroups, reflects differences in the subpopulation means. In decompositions by income class this term corresponds to the pure "class effect".

When these two components, I_B and I_W, are divided by total inequality they express the share accounted for by within and between inequalities in the distribution of income. Comparing static decompositions of inequality at different points in time sheds light on the changing structure of the income distribution. The dynamic decomposition, on the other hand, provides insight into the factors associated with changes in inequality.

Mookherjee and Shorrocks (1982: 897) suggest a methodology to decompose the changes in the GE (0) index of inequality into four additive components:

$$GE(0)_{t+1} - GE(0)_t = \Delta GE(0) \cong \begin{bmatrix} \sum_{j=1}^{k} \overline{f_j} \Delta GE(0)_j \\ + \sum_{j=1}^{k} \overline{GE(0)_j} \Delta f_j \\ + \sum_{j=1}^{k} \left(\overline{\lambda_j} - \overline{\ln \lambda_j} \right) \Delta f_j \\ + \sum_{j=1}^{k} \left(\overline{v_j} - \overline{f_j} \right) \Delta \frac{\ln \mu_j}{\ln \mu_j(t)} \end{bmatrix} \qquad \textbf{(10)}$$

where Δ is the difference operator, v_j is the income share of each partition, λ_j is the mean income of group j relative to the overall mean, e.g. μ_j/μ, and the overbar represents the average value between initial and final periods. The first term in equation (10) captures the pure inequality effect. It represents the impact of changes in within group inequality. The second and third terms capture the allocation effect. The second term represents the impact of changes in the population shares on the within group component. The third term captures the impact of population changes in the between group component. The fourth and last term accounts for the income effect. It represents the contribution to ΔGE(0) attributable to relative (not absolute) changes in the subgroup means.

The dynamic decomposition of income shows the contribution of shifting population shares within and between groups to total inequality. In the next section I decompose total inequality into the allocation of population and income among social classes. It measures the influence of population changes on inequality dynamics and it shows that demography matters. As usual in most quantitative analyses, the approach adopted here is more diagnostic, not giving a causal account of the transmission process, but indicating where to look to find the causes.

RESULTS.

The results are grouped in two subsections. The first subsection presents the results of the static decomposition of income inequality for two classes of indicators: GE (0) and GE (1). The second subsection presents the results of the dynamic decomposition of inequality. The dynamic decomposition is conducted only for GE (0) because this measure is more easily decomposable and because the trend of inequality reported by GE (0) is compatible with trends previously reported in the literature (Ferreira et al 2006).

Static decomposition of inequality.

Generalized entropy indices of inequality were calculated for the poor, middle and rich classes in 1980, 1991 and 2000. The results of the static decomposition of inequality are summarized in the tables below:

Table 2. Decomposition of aggregate income inequality by year

Year	GE(0) Aggregate inequality $1/n\Sigma\ln(\mu/y_i)$	GE(0) Within income class component $\Sigma f_j GE(0)_j$	GE(0) Between income class component $\Sigma f_j \ln(1/\lambda_j)$	GE(1) Aggregate inequality $1/n\Sigma(y_i/\mu)\ln(y_i/\mu)$	GE(1) Within income class component $\Sigma f_j \lambda_j GE(1)_j$	GE(1) Between income class component $\Sigma f_j \lambda_j \ln(\lambda_j)$
1980	0.7256	0.2732	0.4524	0.8262	0.3422	0.4840
1991	0.7909	0.2687	0.5222	0.8560	0.3240	0.5318
2000	0.7786	0.3009	0.4777	0.8933	0.3563	0.5371

Share accounted for by within and between inequalities in the distribution of income by year

Year	GE(0) Aggregate inequality $1/n\Sigma\ln(\mu/y_i)$	GE(0) Within income class component $\Sigma f_j GE(0)_j$	GE(0) Between income class component $\Sigma f_j \ln(1/\lambda_j)$	GE(1) Aggregate inequality $1/n\Sigma(y_i/\mu)\ln(y_i/\mu)$	GE(1) Within income class component $\Sigma f_j \lambda_j GE(1)_j$	GE(1) Between income class component $\Sigma f_j \lambda_j \ln(\lambda_j)$
1980	100%	38%	62%	100%	41%	59%
1991	100%	34%	66%	100%	38%	62%
2000	100%	39%	61%	100%	40%	60%

Table 2 reports two relevant results. The first is the raw trend of inequality measured by GE(0) and GE(1). The level of inequality using Census data is higher than reported by previous studies using PNAD data (Ferreira et al 2006: 7). This difference in the level of inequality results discrepancies in the sample selection and composition of the two datasets. The table above shows that GE(0) inequality rose in the 1980s and fell between 1991 and 2000, but GE(1) inequality has risen since 1980. The trend of inequality reported by GE(0) is consistent with previous results (see Graph Graph 1), but the trend of GE(1) is not. This discrepancy between GE(0) and GE(1) is puzzling. It is unclear why GE(1) inequality in 2000 is higher than in 1991, but it probably results from the fact that GE(1) gives equal weights across the distribution, while GE(0) gives more weight to distances in the lower tail. On one hand, the discrepancy between GE(0) and GE(1) is intriguing because according to Graph Graph 1Graph Graph 1, the trend in inequality should be the same, independent of which measure is used. On the other hand, because of their specific compositions, it is not surprising that different measures provide different results. This discrepancy could also be affected by the listwise deletion of cases whose income was missing or equal to zero.

The second relevant result in Table 2 refers to the decomposition of inequality. Regardless of which measure is used, GE(0) or GE(1), it is clear that Brazilian inequality is mostly driven by the between component, which accounts for more than 60 percent of total inequality in all years. This indicates that inequality in Brazil is mostly associated with differences in the mean incomes of the poor, middle and rich classes rather than to the inequality prevailing within each socioeconomic class. In 1991, for instance, 66 percent of inequality was due to differences in the subgroup means, while the remaining 34 percent was due to the within component.

It is possible to disaggregate between and within components by class to allow a description of class specific contributions to total inequality (Table 3). Since the importance of between and within components is similar when inequality is measured by either GE(0) or GE(1), the weight of each social class in the static and dynamic decompositions are shown only to GE(0). This analytical strategy simplifies and avoids ambiguity in the interpretation of the results.

Table 3. Static decomposition of inequality, GE(0), by income class, Brazil 1980-2000

		WITHIN	BETWEEN	SUM
GE(0)_80	Poor	0.0380	0.5815	0.6195
	Middle	0.2334	-0.0981	0.1353
	Rich	0.0018	-0.0310	-0.0291
	TOTAL	**0.2732**	**0.4524**	**0.7256**
Percent contribution		**38%**	**62%**	
GE(0)_91	Poor	0.0543	0.6931	0.7474
	Middle	0.2132	-0.1423	0.0709
	Rich	0.0012	-0.0286	-0.0274
	TOTAL	**0.2687**	**0.5222**	**0.7909**
Percent contribution		**34%**	**66%**	
GE(0)_00	Poor	0.0371	0.5368	0.5739
	Middle	0.2607	-0.0138	0.2469
	Rich	0.0031	-0.0453	-0.0422
	TOTAL	**0.3009**	**0.4777**	**0.7786**
Percent contribution		**39%**	**61%**	

The last column of Table 3 shows that the poor group contributes to most of total inequality in 1980, 1991 and 2000. Because of their low relative income and significant population size, the poor class was responsible for about 85 percent of total inequality in 1980, 95 percent in 1991 and about 74 percent in 2000. The table also shows that after the between component of the poor class, most inequality is associated to the within component of the middle class.

Perhaps a better way to compare the relative contribution of each social class to inequality is to track the relative composition of total inequality. The figure below provides a visual description of how poor, middle and rich classes have contributed to the between component of inequality:

Figure 2. Static decomposition of inequality GE(0), Brazil, 1980-2000

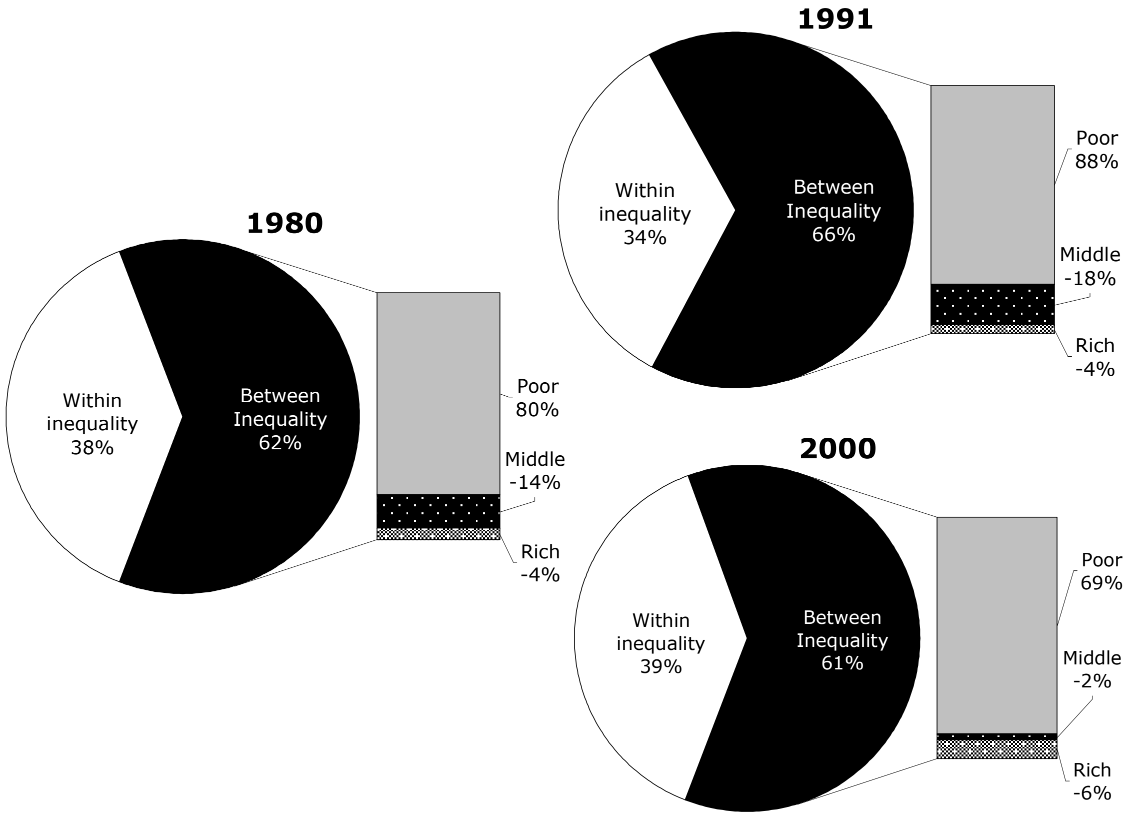


Figure 2 clarifies that the poor are responsible for the vast majority of the between component of income inequality. In fact, the weight of the poor in the between component would be even higher if the middle and rich classes were not contributing in the opposite direction, decreasing the between component. The two variables contributing to the between component of inequality are population shares and relative incomes. Both variables contribute to the absolute magnitude of the between component of inequality, but only the relative mean contributes to the direction of the effect. When the mean income in subpopulations is lower than in the total population, the effect is positive. When it is equal the effect is null. And when the mean income is higher in subpopulations than in the total population the between component will always be negative. So in the Brazilian example, it is possible to conclude that one of the reasons why inequality is so high is because the poor class has mean incomes much lower than in the general population. *Ceteris paribus*, if in 1980 the mean income of the poorest 31 percent was about 6 times higher, and the mean income of the rich class was about 15 times lower, income inequality would virtually disappear.

Dynamic decomposition of inequality.

The previous section described the importance of each income class in the composition of income inequality and called attention to the fact that about 60 percent of inequality is due to differences in the mean incomes of social classes. The remaining 40 percent of inequality is due to the dispersion of income within these classes. This analysis helped to understand the structure of inequality, but it did not address to the influence of mean incomes and population shares on the variation of inequality. In this section I show how much inequality has changed between 1980, 1991 and 2000 and report the weight that population shares and mean incomes have had in this change. The results of the dynamic decomposition of inequality are summarized in Table 4:

Table 4. Decomposition of the trend in aggregate inequality: Index GE(0) x 100

	Change in aggregate inequality $\Delta GE(0)$	Contribution to $\Delta GE(0)$ due to changes in: Within income class inequality $\Sigma f_j \Delta GE(0)_j$	Population shares $\Sigma GE(0)_j \Delta f_j$	Population shares $\Sigma(\lambda_j - \ln\lambda_j)\Delta f_j$	Mean income class incomes $\Sigma(v_j - f_j)\Delta \ln\mu_j$
1980-1991	6.5	0.8	-1.3	4.5	2.5
1991-2000	-1.2	0.9	2.3	-4.6	0.3
1980-2000	5.3	1.6	1.1	0.3	2.3

RELATIVE *Decomposition of the trend in aggregate inequality: Index GE(0) x 100*

	Change in aggregate inequality $\Delta GE(0)$	Contribution to $\Delta GE(0)$ due to changes in: Within income class inequality $\Sigma f_j \Delta GE(0)_j$	Population shares $\Sigma GE(0)_j \Delta f_j$	Population shares $\Sigma(\lambda_j - \ln\lambda_j)\Delta f_j$	Mean income class incomes $\Sigma(v_j - f_j)\Delta \ln\mu_j$
1980-1991	9%	1%	-2%	6%	3%
1991-2000	-2%	1%	3%	-6%	0%
1980-2000	7%	2%	2%	0%	3%
		Within component		**Between component**	

Table 4 shows the four components of inequality change described in equation (10). It shows that the largest change in inequality happened in the 1980s, when aggregate inequality increased by nine percent. Since inequality decreased by two percent between 1991 and 2000, the net increase in income inequality between 1980 and 2000 was equal to seven percent. The second column represents the *ceteris paribus* impact of changes in inequality within social classes. It shows a sequence of positive contributions between successive decades. Total income inequality increases by one percent in both decades due to variations in the specific income inequality of social classes. The third and fourth columns indicate the impact on the within and between group components, respectively, of changes in the population share. Most of the variation in inequality during these two decades was due to variations in population shares, especially in the between component. Variations in population shares generate a significant inequality-augmenting effect in each decade of the twenty year period. The last column gives the contribution of relative changes in the mean incomes of social classes and shows a positive contribution over the period.

Table 5. Decomposition of changes in inequality by income class, 1980 and 1991

	1980- 1991				
	a	b	c	d	Σ row
Poor	0.008	0.008	**0.120**	0.033	**0.170**
Middle	0.000	-0.020	-0.060	-0.004	**-0.084**
Rich	0.000	0.000	-0.015	-0.005	**-0.021**
Σ col	**0.008**	**-0.013**	**0.045**	**0.025**	**0.065**

Note: The columns describe the contribution of within and between components to changes in inequality. The position of each column is analogous to the position in Table 4, namely: a = within income class inequality; b= population share in the within component; c= population share in the between component; d= mean income class income in the between component.

Table 6. Decomposition of changes in inequality by income class, 1991 and 2000

	1991- 2000				
	a	b	c	d	Σ row
Poor	-0.001	-0.017	**-0.244**	-0.019	**-0.280**
Middle	0.009	0.038	0.110	0.007	**0.165**
Rich	0.001	0.001	0.088	0.015	**0.104**
Σ col	**0.009**	**0.023**	**-0.046**	**0.003**	**-0.011**

Note: Same as in Table 5.

Table 5 and Table 6 show a detailed decomposition of inequality change by income class. In the 1980s and 1990s the dynamics of income inequality is mostly led by the dynamics of income and population taking place in the poor class. The increase in income inequality during the 1980s was predominantly driven by variations in the population share of the poor class. This result is evident if we examine the values of column “c”, which accounts for the impact of population shares in the between component of inequality. As noticed before, this component is responsible for most of the variation in total inequality, and most of it is influenced by changes in the population shares of the poor class. Changes in the population share of the poor class dictate the dynamics of inequality in the 1980s and 1990s. This result is compelling because it reinforces the role of population and population changes in the dynamics of inequality. It shows that the variations in the allocation of individuals are more important than variations in the mean income of social classes. In particular, variations in the size of the poor class are the most important factor associated with inequality change since 1980. Demographic movements over time – especially in the poor subpopulation – are strongly associated with the overall variation of total inequality.

SUMMARY AND CONCLUSION.

This chapter has described how to decompose inequality measures using cross-sectional data and how to disaggregate inequality trends into contributory influences related to shifts in mean incomes and population shares of three socioeconomic groups: poor, middle and rich classes.

The preceding analysis suggested that most inequality in 1980, 1991 and 2000 is due to differences in the mean incomes of the poor, middle and rich classes. Between 61 and 66 percent of total income inequality in Brazil is explained by these differences in mean income. That is, more than 60 percent of total inequality is due to a "class effect." The remaining 39 or 34 percent is explained by differences in inequality within income classes. The general conclusion of this analysis is that reducing differences in mean incomes between socioeconomic classes might be a better strategy than reducing the variation of income within these classes. This strategy is particularly important for the poor class because this class accounts for most of total inequality in Brazil, especially because the poor has mean incomes about six times lower than in the total population. In recent years, the Brazilian government has targeted the poor through conditional income transfer programs such as *Bolsa Escola* and *Bolsa Familia*. These programs have succeeded in reducing relative poverty and income inequality in Brazil by increasing the mean income of the poor and at the same type creating the financial incentives to enhance the stock of human capital of the poor population (Medeiros, Britto and Soares 2008; Soares et al. 2007). The static decomposition of inequality presented in this chapter shows that targeting the poor is a good strategy because that is the group that contributes the most to inequality. Therefore, helping the poor to move out of poverty is perhaps the best and most efficient strategy to reduce income inequality.

The analysis of the trend in aggregate inequality showed that shifts in the population share of the poor are the primary factor leading the increase and subsequent decrease of income inequality in the 1980s and 1990s. Over these two decades, changes in the relative size of the poor class were more important to explain variations in total inequality than changes in the mean incomes or in within inequality of the poor, middle and rich class.

The decomposition exercise has helped to understand the structure of inequality and how mean incomes and shifts in the demographic composition of socioeconomic classes affect the trend in total inequality. It has demonstrated that differences in mean incomes of poor, middle and rich classes are more important than the differences in the internal inequality of these three groups. It has also demonstrated that variations in the relative composition of socioeconomic classes are more important than changes in subpopulation mean incomes or inequality. The indication that population shifts play an important role in the dynamics of inequality reassures and motivates the chapters that follow. Since changes in population shares are the most important component explaining changes in income inequality, it is reasonable to inquire how population shares evolve and grow over time. What is the role of class specific mortality and fertility rates in the poor, middle and rich classes and how it has changed over time? By measuring how these three classes reproduce over time will shed light on population dynamics and create the required inputs to answer how inequality would be different had class specific fertility and mortality rates been different. The next chapter addresses the demographic dynamics of specific classes more closely. In particular, it shows how fertility and mortality rates of the poor, middle and rich classes have changed between 1980 and 2000 and what impact these changes might have in the long term.

REFERENCES

Barros, R.P.d., R. Henriques, and R. Mendonça. 2002. "Pelo fim das décadas perdidas: educação e desenvolvimento sustentado no Brasil." in *Discussion text n.857*. Rio de Janeiro: IPEA.

Barros, R.P.d.and R.S.P.d. Mendonça. 1995. "Os Determinantes da Desigualdade no Brasil." in *Texto para Discussao n. 377*. Rio de Janeiro: IPEA.

Bishop, J.A., J.P. Formby, and W.J. Smith. 1997. "Demographic change and income inequality in the United States, 1976-1989." *Southern Economic Journal* 64(1):34-44.

Bourguignon, F. 1979. "Decomposable Income Inequality Measures." *Econometrica* 47(4):901-920.

Canudas-Romo, V. 2003. *Decomposition methods in demography*. Amsterdam, Netherlands: Rozenberg Publishers.

Corseuil, C.H.and M.N. Foguel. 2002. "Uma sugestão de deflatores para rendas obtidas a partir de algumas pesquisas domiciliares do IBGE." *Texto de discussão do IPEA* 897:1-13.

Coulter, P.B. 1989. *Measuring inequality: a methodological handbook*. Boulder: Westview Press.

Cowell, F.A. 1980. "On the structure of additive inequality measures." *The Review of Economic Studies* 47(3):521-531.
Cowell, F.A.and S.P. Jenkins. 1995. "How Much Inequality Can We Explain - a Methodology and an Application to the United-States." *Economic Journal* 105(429):421-430.
Datta, G.and J. Meerman. 1980. "Household Income or Household Income per Capita in Welfare Comparisons." *Review of Income and Wealth* 26(4):401-418.
De Ferranti, D.M., G.E. Perry, F.H.G. Ferreira, and M. Walton. 2004. *Inequality in Latin America: breaking with history?* Washington, D.C.: World Bank.
Ferreira, F.H.G.and R.P.d. Barros. 1999. *The slippery slope: explaining the increase in poverty in urban Brazil, 1976-1996*. Washington, DC: World Bank Poverty Reduction and Economic Management Network Poverty Division.
Ferreira, F.H.G., P. Lanjouw, and M.C. Neri. 2000. "A new poverty profile for Brazil using PPV, PNAD and census data." *Pontificia Universidade Catolica Do Rio De Janeiro. Departamento De Economia. Texto Para Discussao* No. 418:1-66.
Ferreira, F.H.G., P.G. Leite, J.A. Litchfield, and World Bank. Development Research Group. Poverty Team. 2006. *The rise and fall of Brazilian inequality, 1981-2004*. Washington, D.C.: World Bank Development Research Group Poverty Team.
Ferreira, M.C. 2001. "Permeável, Ma Non Troppo: a Mobilidade Social em Setores de Elites, Brasil - 1996." *Revista Brasileira de Ciências Sociais* 16(47):141-160.
Fiorio, C.V. 2006. "Understanding Inequality Trends: Microsimulation Decomposition for Italy." in *STICERD DARP 78*. London: London School of Economics.
Firpo, S.P., G. Gonzaga, and R. Narita. 2003. "Decomposição da Evolução da Desigualdade de Renda no Brasil em Efeitos Idade, Período e Coorte." *Pesquisa e Planejamento Econômico* 33(2):211-252.
Grusky, D.and J. Sorensen. 1998. "Can class analysis be salvaged?" *American Journal of Sociology* 103(5):1187-1234.
Hauser, R.and J. Warren. 1997. "Socioeconomic indexes for occupations: A review, update, and critique." *Sociological Methodology* 27:177-298.
Henriques, R., A.R. Barros, and Instituto de Pesquisa Econômica Aplicada. 2000. *Desigualdade e pobreza no Brasil*. Rio de Janeiro: IPEA.
Medeiros, M. 2005. *O que faz os ricos ricos: o outro lado da desigualdade brasileira*. São Paulo: Hucitec.
Medeiros, M., T. Britto, and F.V. Soares. 2008. "Targeted Cash Transfer Programmes in Brazil: BPC and the Bolsa Familia." in *Working paper number 46*: International Poverty Centre.
Mookherjee, D.and A. Shorrocks. 1982. "A Decomposition Analysis of the Trend in UK Income Inequality." *Economic Journal* 92(368):886-902.
Neri, M.C. 2000. "Assets, markets and poverty in Brazil." *Escola de Pós-Graduação em Economia da Fundação Getúlio Vargas. Ensaios Econômicos* No. 374:1-41.
Pero, V.and D. Szerman. 2005. "Mobilidade Intergeracional de Renda no Brasil." in *Anais do XXXIII Encontro Nacional de Economia [Proceedings of the 33th Brazilian Economics Meeting] 146*: ANPEC - Associação Nacional dos Centros de Pósgraduação em Economia [Brazilian Association of Graduate Programs in Economics].

Ramos, L.and M.L. Vieira. 2000. "Determinantes da desigualdade de rendimentos no Brasil nos anos 90: discriminação, segmentação e heterogeneidade dos trabalhadores." Pp. 159-176 in *Desigualdade e pobreza no Brasil*, edited by R. Henriques and A.R. Barros. Rio de Janeiro: IPEA.
Rocha, S. 1996. "Renda e pobreza: os impactos do plano Real." Pp. 1-26 in *Texto para Discussao do IPEA*. Rio de Janeiro: IPEA.
—. 2000. "Estimação de linhas de indigência e de pobreza: opções metodológicas no Brasil." Pp. 109-127 in *Desigualdade e pobreza no Brasil*, edited by R. Henriques and A.R. Barros. Rio de Janeiro: IPEA.
—. 2003. *Pobreza no Brasil: afinal, de que se trata?* Rio de Janeiro: FGV.
Roemer, J.E. 1998. *Equality of opportunity*. Cambridge, Mass.: Harvard University Press.
Ruggles, S., M. Sobek, T. Alexander, C.A. Fitch, R. Goeken, P.K. Hall, M. King, and C. Ronnander. 2004. "Integrated Public Use Microdata Series: Version 3.0 [Machine-readable database]." Minneapolis, Minnesota: Minnesota Population Center [producer and distributor].
Schwartzman, S. 2002. "Vantagens e desvantagens das linhas de pobreza." in *IETS publications*. Rio de Janeiro.
Shorrocks, A. 1982. "Inequality Decomposition by Factor Components." *Econometrica* 50(1):193-211.
—. 1983. "The Impact of Income Components on the Distribution of Family Incomes." *Quarterly Journal of Economics* 98(2):311-326.
—. 1984. "Inequality Decomposition by Population Subgroups." *Econometrica* 52(6):1369-1385.
Shorrocks, A.F.and G. Wan. 2005. "Spatial Decomposition of Inequality." *Journal of Economic Geography* 5(1):59-81.
Soares, S., R.G. Osorio, F.V. Soares, M. Medeiros, and E. Zepeda. 2007. "Conditional Cash Transfers in Brazil, Chile and Mexico: Impacts upon Inequality." in *Working paper number 35*: International Poverty Centre.
Sorensen, A. 1991. "On the Usefulness of Class Analysis in Research on Social-Mobility and Socioeconomic Inequality." *Acta Sociologica* 34(2):71-87.
Wright, E.O. 1997. *Class counts: comparative studies in class analysis*. Cambridge; New York; Paris: Cambridge University Press; Maison des sciences de l'homme.
—. 2005. *Approaches to class analysis*. Cambridge, UK; New York: Cambridge University Press.