The Role of the Demographic Transition to Changes in Income Inequality in Brazil

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Abstract

Brazil has one of the most unequal income distributions in the world, measured by any indicator. Fortunately, in the last years, after several decades of stability, the inequality level has been declining continuously. Many factors have been appointed to explain this trend, including the expansion of cash transfer programs, a better macroeconomic environment, and the reduction of labor income inequality. Nonetheless, other factors responsible for these improvements need to be examined more systematically, including demographic changes. In the context of a rapid demographic transition, one should expect large effects on social and economic measures from changes in population composition. In this article, we examine how changes in proportion and composition of adults within households have affected income inequality in Brazil. We use a counterfactual micro-simulation model to disentangle each one of these effects during different periods that were characterized by important economic and demographic contexts. We find that about 16% of the decline in inequality levels between 1985 and 2008 were due to demographic changes. Also, we predict that income inequality will decline further as demographic inequality reduces across income groups.

Introduction

During the XXth century, per capita income in Brazil increased about thirteenfold, from $272 in 1900 to $3,514 in 2000, measured in 2000 dollars (Boneli 2003). Yet, by the year 2000, about one third of the Brazilian population remained below the poverty line and the inequality level was close to its historical average (Barros et al. 2006), putting Brazil among the ten most unequal nations in the world (World Bank 2005). This scenario began changing in the last decade, when income inequality declined steadily, and as a consequence, poverty levels reduced substantially. Between 2001 and 2008, while the Gini coefficient declined almost 9%, from 0.596 to 0.545, the per capita income of the 10% poorest grew by 7% per year, almost three times faster than the national average (Barros et al. 2006).

There are different reasons for the recent improvement in income distribution (Barros et al. 2006; Ferreira, Leite and Litchfield 2007). First, during the 1990 decade, the government took a set of measures to stabilize the Brazilian economy, keeping inflation under control with positive effects for wages, mainly among the poorer. Second, since the early 2000s, there has been a policy of minimum wage increases which has favored low-wage workers and the poorest social security beneficiaries. Third, the development of two large cash transfer programs - *bolsa familia*, a program directed to poor families, and the *BPC-LOAS*, a non-contributory pension system – have significantly reduced poverty rates among children and the elderly. Finally, gradual increases in education attainment, and the reduction in regional, racial and gender inequality have reduced labor income differences within the country.

To date, social scientists have only partially examined the role of demographic changes on inequality levels in Brazil, despite the rapid demographic transition that has been in place since the early 1960s. Until the 1970s, most of the debate was centered on the traditional Malthusian concern about the relationship between population and economic growth, but little attention was paid to income inequality. Langoni (1973) was one of the first to posit the importance of the effects of age structure on income inequality in Brazil. According to the author, the younger age distribution of the poorer subgroups of the population was one of the factors responsible for keeping inequality at high levels during the 1960s and 1970s. Later, as the effects of the demographic transition started to unfold, different studies applied decomposition techniques to examine the consequences of population aging on the dynamics of inequality and poverty (e.g. Wajnman 1989; Barros and Mendonça 1995). There was a consensus at that time that inequality levels would improve as dependency ratios started to decline among poorer households. During the 2000s, when inequality levels begin to drop systematically, scholars tested for direct demographic effects. For example, Wajnman, Turra and Simões (2006) simulated the impact of changes in the age-gender composition of adults on inequality levels between 2004 and 2008. Although these authors have found a negative relationship between demographic variables and inequality, the impact is minor, probably due to the short period of analysis.

A review of the literature shows that most the research available has focused on short periods of time or has been unable to account for the whole demographic heterogeneity of the population. These are the case, for example, of two of the most comprehensive studies ever done on the evolution of inequality in Brazil. Barros et al. (2006) used a micro-simulation model to decompose the inequality decline into numerous components, including demographic factors. The primary focus of the study is the distributional dynamics during the 2000s, and thus, says little about earlier stages of the Brazilian economy. Ferreira, Leite e Litchfield 2007 examined the evolution of inequality in Brazil during a much longer period of time: 1981- 2004. The analysis looked at the effects of many economic and demographic factors, including changes in the age distribution of household heads and in the types of family arrangements, but was restricted to a single measure of dispersion and therefore, lacked a more disaggregated investigation of the entire distribution.

This study attempts to fill this void in the literature by examining how changes in the proportion and in the age-gender composition of adults in each household have affected the evolution of inequality in Brazil between 1985 and 2004. To do that, we use a counterfactual micro-simulation model developed by IPEA (2006) to disentangle the demographic effects from income effects. We provide estimates for the whole 1985-2008 period as well for distinct stages (1985-1993, 1993-2001, and 2001-2008), which cover a good range of the process of demographic transition and different scenarios of the social policy and the macroeconomic parameters in Brazil. In order to speculate about the potential magnitude of future demographic effects, we also estimate what would be income inequality levels if demographic heterogeneity across families were reduced sharply.

Demographic Factors in the Analysis of Income Inequality

A long line of research has looked at the relationship between population composition and inequality. Decades ago, Paglin (1975) posited that age adjustments of inequality measures based on cross-section data were necessary to avoid the miscalculation of inequality levels. Later, several authors (e.g. Bourguignon 1979, Shorrocks 1980, Mookherjee and Shorrocks 1982) developed decomposition techniques to measure the proportion of the inequality explained by demographic variables (static decomposition), as well as the role of demographic changes for variation in inequality levels (dynamic decomposition). Lam (1984, 1986) applied a similar methodology to estimate intra and inter-age group effects on total inequality for Brazil and the U.S.

The increasing availability of survey data has allowed researches to examine more in depth the associations between demographic variables and income inequality. A well-known work in this field was carried out by Burtless (1999). In a study for the United States, he found that most of the increase in income inequality between 1976 and 1999, was due to household composition effects, including an increasing correlation between spouses' wages and a growing proportion of the population living in one-adult households. Martin (2006) also examined the American case and found that the increasing number of families headed by women, who are generally more vulnerable to poverty, helped rise inequality levels. Garner and Terrell (2001) examined the case of Slovakia during the transition from a centrally planned economy to a free market. In this period, the structure of Slovakian families changed significantly. On one hand, there was a decline in family size and in the proportion of households with children. On the other hand, the proportion of one-adult households and households headed by pension beneficiaries increased. Interestingly, however, these demographic changes did not affect all income groups, but mainly the wealthiest ones, increasing the gap between the poor and the rich. Other international examples of dynamic decomposition include studies for Taiwan (Shultz 1997), New Zealand (O'Dea 2000) and Italy (Brandolini and D'Alessio 2001).

As mentioned earlier, in Brazil, Barros et al. (2006) and Wajnman, Turra and Simoes (2006) decomposed the effect of changes in the proportion of adults on inequality levels between 2004 and 2008. Both studies show that families with large number of children are largely prevalent among the bottom deciles, which favors the high concentration of income in Brazil. Accordingly, demographic changes helped reduce inequality in the last decade by making the demographic composition of income groups more homogenous with respect to the proportion of children within families. Ferreira, Leite, Littchfield (2007) also applied dynamic techniques to decompose the variation of inequality levels into economic and demographic factors in Brazil, but the authors found only a very minor explanatory power for the demographic factors.

Many of earlier studies use the individual as the unity of analysis rather than family, and they typically examine only labor income. One underlying premise of the more recent research is that individual's well-being depends on the individual's own income as well as on the income of other family members. The mechanism is straightforward: children generally do not earn income and thus, the larger the share of adults in the family, the larger the per capita family income should be. Since poor families tend to have more offspring than wealthy families, their higher age dependency ratios reduce the weight of potential income earners, contributing to larger inequality and poverty rates in the population. When family is the unity of analysis, not only the proportion of adults matter for individual's wellbeing, but also the composition of adults in each family. Comparative research has extensively documented that income levels vary across adults. For example, younger and older adults have lower income than middle-age adults, while males receive higher income than females. Therefore, studies of demographic effects on inequality should not be limited to the classical analysis of dependency ratios.

Methodology

Data

We use household-level micro-data from *Pesquisa Nacional por Amostra de Domicílios* (PNAD), a nationally representative stratified random sample of the Brazilian population collectedly annually since the late 1970s, except for the census years. It contains a comprehensive and comparable set of demographic and socioeconomic variables, including detailed information on employment status, occupation, income, and education for all members of the household. This high quality data set has been used extensively in the literature on social sciences (see, for example, Marteleto 2010; Torche 2010; Barros et al.

2006). Our analysis is based on different sample sizes for each survey year, ranging from 322,205 to 523,465 individuals.

Although we employ the concept of family income inequality throughout this article, it should be noted that our unit of analysis in the simulations is, in fact, the household. Usually, family refers to groups connected by bonds of kinship (including non-biological offspring and conjugal relationships which may or may not be legally established) not limited by the boundaries of the physical household (Medeiros and Osorio, 2000). Given the difficulty of identifying kinship bonds in the PNAD survey, we use the concepts of household and family as they were interchangeable in our analysis. While a household may be made up of several families, in the case of Brazil, we expect extended families to constitute a minor proportion within the sample.

Therefore, the definition of income throughout the analysis is gross monthly household income per adult, which includes income from labor, transfers, and other sources, such as land rents and capital. Our definition of adults includes individuals 15 and older and individuals aged 10 to 14 who reported to be household heads and to have received income during the period of reference. The definition of children includes individuals 9 years old or younger, for whom PNAD did not collect any data on income, and individuals 10 to 14 years old who were not household heads or did not received income during the period of reference.

Empirical Model

We use counterfactual micro-simulation models to answer "what if" type of questions by asking what would happen to income inequality in each period of analysis if the demographic composition of each household as well as per adult income levels had not changed over time. Assuming that *per capita* income is $y = a.r$ where a equals the proportion of adults in the household and r is per adult income in the household, we perform two micro-simulation rounds. In the first one, we account only for changes in the share of adults within the households, in addition to changes in per-adult household income levels. In other words, we are interested to learn how much of the variation in inequality during each period of time is explained by replacing children by adults, regardless of the demographic characteristics of adults. Therefore, per capita household income becomes the product of the share of adults and per-adult income: $y = \frac{n^A}{n}\left(\frac{1}{n^A}\sum y\right)$, where n^A is the number of adults in the household, n is household size, and y is the amount of income received by each adult in the household.

Following the methodology proposed by IPEA (2006), we use data from two survey years to estimate three effects: the marginal change in the share of adults; the marginal change in per-adult household income; and the interaction between both marginal changes. We measure each of the marginal effects based on the construction of a random variable x, which bears the order of each household according to different distributions. For example, to measure the marginal change in the share of adults, households are ordered according to the distribution of the proportion of adults in each survey year. Following the ranking order, we then replace the share of adults from one year into the other. We use the same methodological procedure to measure the marginal effect of income changes. We summarize the three effects on inequality by means of the Gini coefficient.

Since sample sizes vary across surveys, we define a number of sample points to represent the original micro data; one that is large enough to capture all demographic heterogeneity without violating STATA 10 limitations. We assign the mean values of the variables of interest to represent the values from the original data sets. After simulating the results based on different sample points, we concluded that 5.000 points would be large enough for the Gini coefficients to be accurate at the third decimal place.

The share of adults within the households is a broad measure that summarizes a wide range of demographic changes which potentially affect household size and structure. Because we recognize that income varies for different types of adults, in the second simulation round we measure, simultaneously, the effects of changes in the share and composition of adults on inequality levels. Thus, per capita household income becomes the product of the proportion of adults and per-adult income by age and gender: $y = \sum_{i=1}^{k} \frac{n_i^A}{n} \left(\frac{1}{n_i^A} \sum_{j \in i} y_j \right)$. To keep our analysis parsimonious while still capturing the compositional effects, we categorize adults according to six groups: men and women aged 25 to 34, 35-60 and 60+ years old. We follow the same methodological steps described in the first simulation to estimate the marginal and interaction effects on the Gini coefficient.

Results

The first period of analysis (1985-1993) has been characterized by the literature as a stage of "unacceptable stability" of inequality levels. Table 1 shows that the Gini coefficient did not vary significantly between 1985 and 1993, rising slightly from 0.595 to 0.608. The simulated effects indicate that changing only the share of adults within households to the 1993 levels, while holding income constant at the 1985 levels, would have reduced income inequality by 0.005. Not surprising, given the highly unstable macroeconomic setting in the 1980s, when we vary only per-adult income levels, the Gini coefficient increases by 0.0160, an amount equivalent to 133.7% of the total variation over the period. In addition, interactions between both income and demographic changes explain another 6% of the rise in inequality. These results suggest that lower dependency ratios was not a force strong enough to reverse the rising concentration of income that characterized the 1980s.

(Table 1 about here)

The second period of analysis (1993-2001) comprehends the adoption of the macroeconomic stabilization program (*Plano Real*), which eliminated inflation and improved wages among the poorer. According to Table 1, the Gini coefficient declined by 0.012 or about 2%. Demographic changes kept pushing inequality down: they explain 38.7% of the negative variation in the coefficient. Contrary to the previous decade, however, varying the income distribution alone, while holding the share of adults within households constant at the 1993 levels, produced a large negative effect on inequality, explaining about 139% of the total decline.

The third stage (2001-2008) is characterized by a sharp and continuous decline in income inequality. The Gini coefficient reduced by 0.05 or about 9.3%, from 0.5959 to 0.5455. According to our simulation results, changing the share of adults within households to the 2008 levels, while holding income constant at 2001 levels, would make the Gini coefficient only 0.003 lower (or about 7.7% of the total variation), which is expected given the short observation period for such substantial variation. On the other hand, the marginal effect of changes in per-adult income was responsible for reducing the coefficient by 0.045, about 12 times more.

The demographic transition is a long lasting process, and its effects are better captured over periods longer than a decade. When we simulate the results for the whole period (1985-2008), the marginal effect of demographic changes turns out to be nontrivial, representing almost a quarter of the reduction in inequality levels (Table 1). Not surprising, however, the marginal effect of income still represented a much larger fraction of the Gini variation: about 90%. To learn more about these effects, we plotted in Figure 1 the proportional changes in the share of adults and in the per-adult income levels by income deciles between 1985 and 2008. As expected, the largest relative variation in the proportion of adults occurred in the bottom income deciles, whereas the lowest variation occurred for the 40% wealthiest households. Yet the most strikingly consistent finding in Figure 1 is the dominant importance of per-adult income, which increased sharply among the 40% poorest.

(Figure 1 about here)

As mentioned earlier, the demographic variables should not be limited to the share of adults within the households. Table 2 compares what would be the marginal effects of demographic and income changes, when we accounted for seven different age-gender subgroups. While the marginal demographic effect is still substantial, it reduces after we refine our demographic measures[1]. In this second simulation round, compositional changes explain 16% of the total variation (0.008) compared to 22% (0.011) before.

(Table 2 about here)

What accounts for the differences in the results from the two simulations? According to Figure 3, changes in the composition of adults were not homogenous across income deciles. In the bottom income groups, most of the increase in the share of adults within households was due to larger proportions of young adults. Among the 50% wealthiest households, on the other hand, there was a relatively larger increase in the share of middle age adults and elderly. Given that young adults receive, on average, lower income than middle age adults and elderly, it is not surprising that the marginal effect of demographic changes is smaller in the second simulation model. These results reflect primarily the fact that households of different socioeconomic status are at different stages of the demographic transition.

(Figure 3 about here)

It is also worth noting that between 1985 and 2008, there was a relatively larger increase in the mean income of elderly and middle age adults compared to young adults (Figure 4), which also explains why the demographic effect is less progressive on the second

[1] We also simulated the demographic effects considering a larger number of subgroups in the household: children and 14 age-gender specific subgroups of adults. The results were consistent with those showed in Table 2.

simulation round. This pattern is due primarily to the fast expansion of social security benefits among the elderly over the last three decades in Brazil (Turra and Rocha 2010) .

(Figure 4 about here)

As the proportion of elderly increase among the poorer, inequality levels may decline further. This is exactly what shows the results from the third simulation model in Table 2. Changing the share/composition of adults within households in 1985 according to the levels of the top income decile in 2008, while holding income constant at the 1985 levels, would make the Gini coefficient 0.03 lower. This effect is three times larger than the one estimated based on the actual distributions for 1985 and 2008. In other words, if age-gender structure becomes homogenous across all income groups, the Gini coefficient could still decline by another 0.02, which is about half of the much-celebrated decline that occurred during the 2000s.

Discussion

Dependency ratios within the households started to decrease in Brazil in the 1970s with the steady decline in birth rates. Over the decades, other demographic forces, such as higher longevity, larger proportion of divorces and higher economic dependency of the youth, as well as the increasing financial autonomy of the elderly, have reinforced this compositional change. As we showed in our simulations, changes in the proportion of adults within households have contributed for the improvement in income distribution in the 1980s, but were not enough to compensate for the worsening distribution of income during that time. In the following years, the demographic effects kept improving inequality levels, but they have gradually lost relative importance to the effects of new social policies and structural changes that have made the profile of income distribution less regressive in Brazil. Overall, changes in share and composition of adults within households explained about 16% of the inequality decline between 1985 and 2008.

Our findings have at least one important policy implication. The population aging currently in progress in Brazil, combined with the strong social protection mechanisms available for the elderly will result in even better income distribution in the future. This is true particularly if we consider that there is more room left for population aging among the poorer than among the wealthier. However, this result depends on two main challenges: to keep the current flows of public transfers to the elderly, even under the strong fiscal pressure coming from the population aging, and to guarantee that old people reallocate resources within families. The tendency of elderly people living alone may compromise private transfers to younger members of the family.

With regard to the methodological limitations of this kind of study, one should note that our counterfactual simulations measure only the first order effects of demographic variables and per-adult income. Income and demographic composition, however, are known to be correlated. There is considerable literature examining the effects that changes in income, including non-labor income, exert on the decisions regarding the union and dissolution of families. Also, changes in income affect both mortality and fertility rates, which are closely-related determinants of household composition. On the other hand, changes in the number of offspring, life expectancy and household mobility are not neutral regarding the choice between leisure and work, and the supply of labor, affecting the availability of income for families. There are also institutional aspects, such as the development of social insurance programs, which may simultaneously affect demographic composition and adult income. Our simulations do not, therefore, take into consideration any inter-relations among demographic variables or between them and the income of adults.

From a methodological point of view, however, our results demonstrate the usefulness of micro-simulations in studies that combine demographic and economic variables to examine changes in socioeconomic differences among individuals or families in a population. Compared to the usual macro-simulations, the micro approach is much less limited in measuring the variations in the distribution of attributes across the population. Also, the use of counterfactual simulations is simple and instructive, measuring each effect individually in complex and multi-factorial events.

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Table 1 – Simulated effects of Demographic (share of adults within households) and Income Changes on Inequality Levels, Brazil, 1985 through 2008

	1985-1993	1993-2001	2001-2008	1985-2008
Gini at t_0	0.5959	0.6079	0.5962	0.5959
Gini at t_1	0.6079	0.5962	0.5455	0.5455
Gini Variation	0.0120	-0.0117	-0.0507	-0.0504
%	1.97%	-1.96%	-9.29%	-9.24%
Amount of Gini variation due to demographic changes				
Absolute	-0.0047	-0.0045	-0.0039	-0.0111
%	-39.69%	38.68%	7.74%	22.11%
Amount of Gini variation due to changes in income levels				
Absolute	0.0160	-0.0163	-0.0458	-0.0458
%	133.66%	139.41%	90.37%	90.78%
Amount of Gini variation due to changes from both sources				
Absolute	0.0007	0.0091	-0.0010	0.0065
%	6.03%	-78.09%	1.89%	-12.89%

Table 2 – Simulated Effects of Demographic and Income Changes on Inequality Levels, according to three simulation scenarios, Brazil, 1985-2008

	Simulation 1: 1985-2008 Share of adults within families	**Simulation 2: 1985-2008 Share and composition of adults within families**	**Simulation 3: 1985-top income decile of 2008 Share and composition of adults within families**
Gini at t_0	0.5959	0.5959	0.5959
Gini at t_1	0.5455	0.5455	0.3147
Gini Variation	-0.0504	-0.0504	-0.2813
%	-9.24%	-9.24%	-89.39%
Amount of Gini variation due to demographic changes			
Absolute	-0.0111	-0.0079	-0.0258
%	22.11%	15.66%	9.16%
Amount of Gini variation due to changes in income levels			
Absolute	-0.0458	-0.0587	-0.2271
%	90.78%	116.45%	80.76%
Amount of Gini variation due to changes in both sources			
Absolute	0.0065	0.0162	-0.0284
%	-12.89%	-32.12%	10.08%

Figure 1: Proportional changes in demographic and income distributions by income deciles. Brazil, 1985-2008

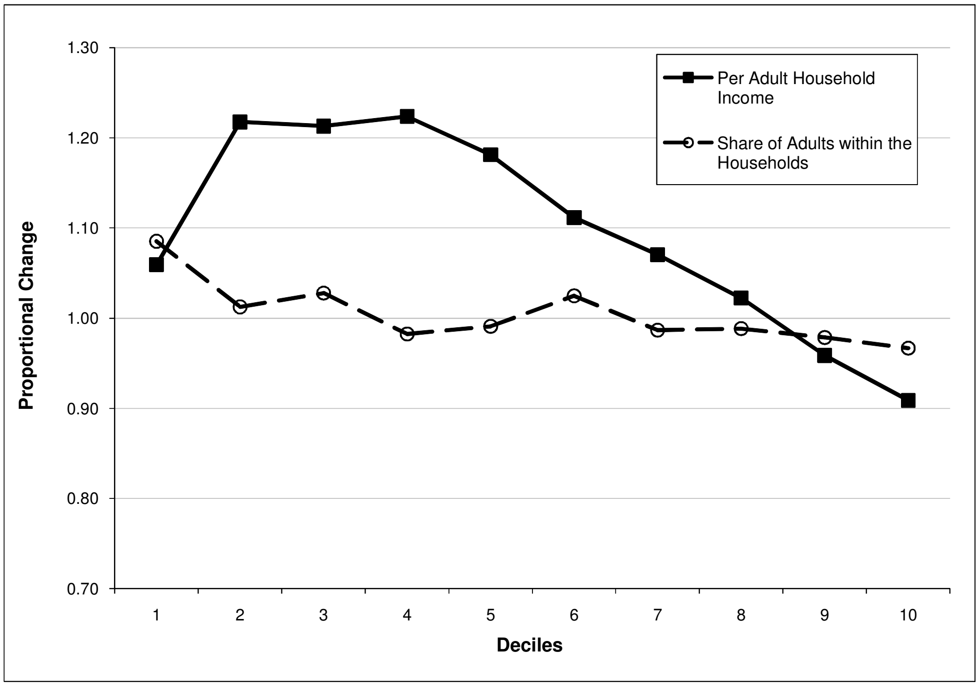
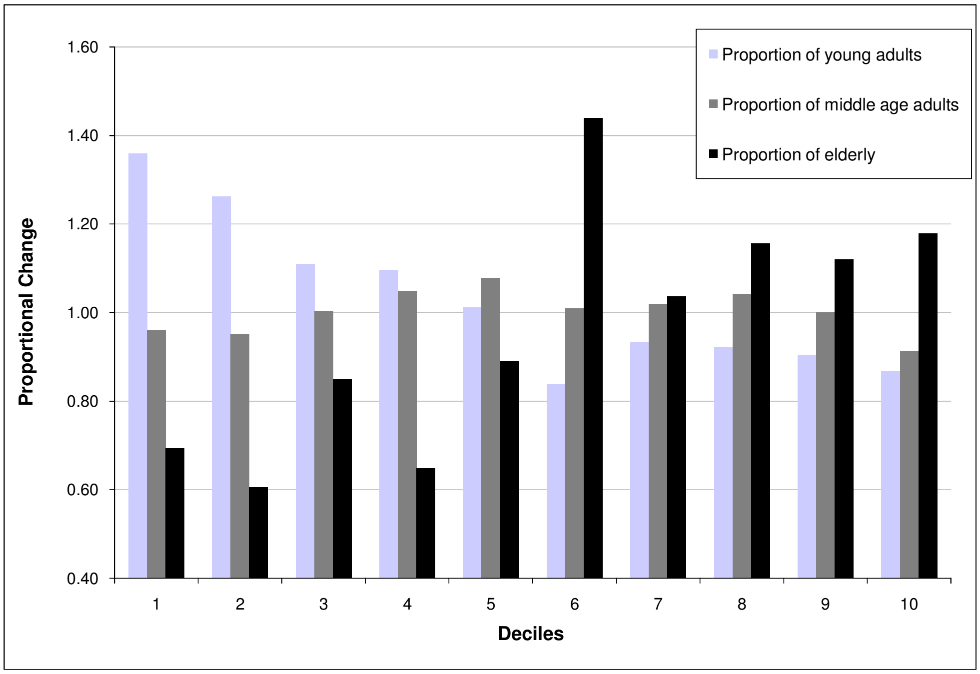


Figure 2: Proportional changes in demographic and income distributions by income deciles. Brazil, 1985-2008

a) Men



b) Women

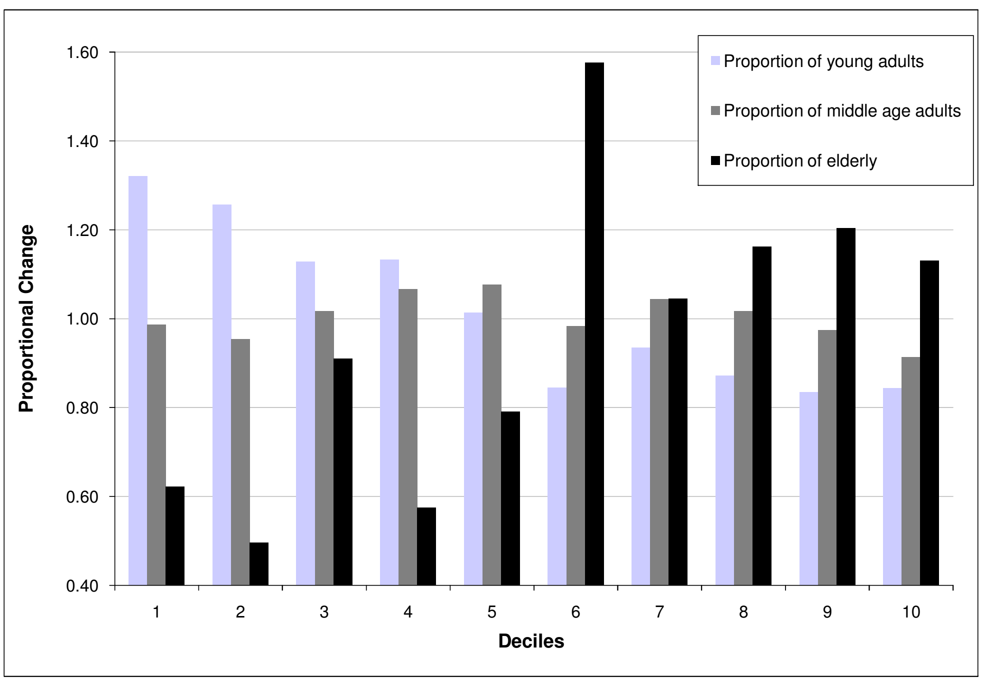
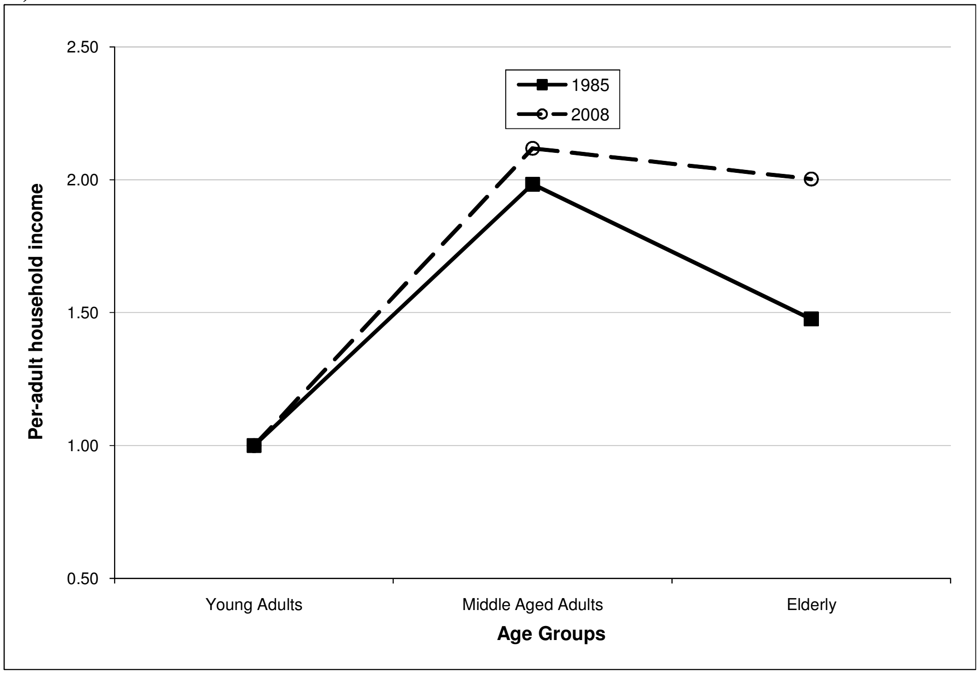


Figure 3: Per-adult household income, as a ratio to the income of young adults
Brazil, 1985-2008

a) Men



b) Women