ISSN 1415-4765

TEXTO PARA DISCUSSÃO Nº 755

DEMOGRAPHIC CHANGES AND POVERTY IN BRAZIL

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Rio de Janeiro, setembro de 2000

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Tiragem: 103 exemplares

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SUMMARY

RESUMO

Neste estudo, apresentam-se evidências do impacto dos fatores demográficos sobre a pobreza no Brasil. Dois fatores demográficos são investigados: o tamanho e a composição etária da população. O objetivo é estimar, por meio de micros-simulações com dados da PNAD, o impacto de mudanças nesses dois fatores sobre a distribuição de renda e conseqüentemente sobre a pobreza.

Os resultados encontrados revelam que as mudanças demográficas ocorridas ao longo das últimas décadas geraram importante e contínua redução na pobreza. Tal redução, fruto das mudanças na composição etária e no tamanho das famílias, é equivalente a um crescimento adicional da renda *per capita* em até meio ponto percentual ao ano. Dado que a taxa de crescimento anual da renda *per capita* ao longo do período analisado foi próximo a 3%, o efeito da mudança demográfica ocorrida nesse período sobre a redução da pobreza corresponde a aproximadamente 15% do efeito que o crescimento da renda teve sobre tal redução.

Os demais resultados encontrados no presente estudo revelam que a mudança secular na composição demográfica foi muito mais importante para a redução da pobreza do que as diferenças entre regiões de velocidade e de momento das transições demográficas e do que as diferenças demográficas ocorridas entre pobres e ricos.

ABSTRACT

In this study we present evidence of the impact of demographic factors on the level of poverty based on the Brazilian experience. Two demographic factors were investigated: *a*) the size and *b*) the age composition of the population. The goal was to estimate through the micro-simulation approach the impact of changes in these two factors on the distribution of income and consequently on the level of poverty.

We presented estimates of the impact on poverty of a series of alternative demographic changes. First, we consider the demographic changes that occurred over the previous decades. We showed that these changes led to a continuous reduction in poverty, which is equivalent to an additional 0.4 to 0.5 percentage point in annual growth in per capita income. Since the average growth rate in per capita income in Brazil over the studied period was close to 3.0% per year, the estimated direct impact of the demographic transition had an impact on poverty close to 15% of the corresponding impact of economic growth.

We also investigated: *a*) the importance of regional differences in demographic conditions and *b*) demographic differences between poor and rich families for explaining concomitant differences in poverty.

Accordingly to our estimates, we can conclude that overall secular demographic changes tend to have much greater impact on poverty than differences in the time and the speed of the demographic transition across regions and between poor and rich families.

1 - INTRODUCTION

Poverty is a consequence of economic and demographic conditions. The degree of poverty a society might experience depends on the volume and distribution of resources and on the size and distribution of the population among households. These two basics determinants of poverty, however, are not independently determined. On the one hand, the size and age structure of a population are consequences of fertility decisions taken over past decades which were influenced by the prevailing economic conditions. On the other hand, the volume of resources available today is influenced by the size and age composition of the labor force.

In this study we present evidence of the impact of demographic factors on the level of poverty based on the Brazilian experience. Two demographic factors are investigated: *a*) the size and *b*) the age composition of the population. The goal is to estimate the impact of changes in these two factors on the distribution of income and consequently on the level of poverty.

Demographic factors have a direct and an indirect impact on the distribution of income. As the size and age composition of the population change, the relative size of the labor force and the number of dependents also change, modifying the dependency ratio of families, and therefore their level of poverty. This is the direct effect of demographic changes. It captures the effect that demographic changes have on quantities: number of children, size of the labor force, and the number of elderly persons.

These changes in quantities, however, will in general influence prices in the economy. In particular, changes in the rate of growth of the population and in the age structure may have important impacts on labor supply and on savings. As a consequence, demographic changes may have considerable impact on the level of wages and on interest rates. Since these prices are important determinants of family income, they are bound to have a profound influence on the level of poverty. These are the indirect impacts of demographic changes on poverty, since they occur through the indirect effects of demographic changes on the level of labor supply, savings, wages and interest rates.[1]

There are essentially three approaches to investigate the impact of demographic changes on poverty. The first approach is based on macro regressions relating poverty to its determinants. In general, these regressions are estimated using cross-national panel data.[2] This approach has the advantage of offering estimates of the overall impact of demographic changes including all direct and indirect effects. The approach, however, faces two difficulties. First, it has either to assume that the demographic changes were exogenous or to base the inference on debatable choices of instrumental variables. Secondly, since this approach cannot separate

[1] Examples of empirical and theoretical studies of these indirect effects can be found in the works of Willis (1995); Cigno (1995); Lee (1997).

[2] See, for an example of this procedure, Lipton and Eastwood (1998).

direct from indirect effects of demographic changes on poverty, it can only provide estimates for the overall effect.

A second approach is to use poblacion based on household surveys to estimate the direct effect of demographic changes on poverty. This is the approach used in this study. It consists essentially of three steps. First, one must select alternative scenarios for the size and age composition of the population. Secondly, one must express the per capita family income as a function of the size and age structure of the family and of the average income of members by age group. Thirdly, one can simulate the direct impact of demographic changes, computing new values for the per capita income that would be observed if average income by age were the same but the demographic composition followed the alternative scenarios selected in the first step. Given the new per capita income for every family, the level of poverty can then be immediately re-computed. The major limitation to this approach is the fact that it cannot be used to estimate the indirect effect of demographic changes on poverty. Nevertheless, it provides an almost ideal procedure to estimate its direct effect.

A third approach that could be used to obtain separate estimates of the direct and indirect effect of demographic changes on poverty would be to use a computable general equilibrium (CGE) model. In this case, conditional on the correctness of the specification and parameters of the model, it is possible to obtain separate estimates for the direct and indirect effects of demographic changes on poverty. The main difficulty with this approach is precisely how to find a convincing procedure to specify and obtain estimates of the parameters of the model. Since the final estimates of the impact of demographic changes can be quite sensitive to the model specification and the choice of parameter values, the uncertainty behind these choices may become a serious limitation of the procedure.

Throughout this study we make use of a simple but useful expression, which connects family per capita income to the average income of family members by age and the family age structure. To obtain this expression we first have to divide the age spectrum into *m* non-overlapping age groups. Then we can write the family per capita income, y^f, as

$$y^f = \frac{\sum_{i=1}^{m} n_i^f \, y_i^f}{\sum_{i=1}^{m} n_i^f}$$

where n_i^f denotes the number of members of family *f* in the age group *i* and y_i^f the average income of family members in this age group.[3] According to this specification, the vector $(n_1^f,...,n_m^f)$ captures the demographic factors (that is, the size and age composition of the population), while the vector $(y_1^f,...,y_m^f)$ captures market prices and assets held by the family.

[3] If there is nobody in the family in a given age group we let $y_i^f = 0$.

In this study we pursue the impact on poverty of a series of alternative demographic scenarios. In Section 2, we investigate how poverty would look like today if demographic conditions were equal to those prevailing in previous decades. In other words, we investigate the impact of temporal changes in the size and age composition of the population on the level of poverty. In Section 3, we turn to investigate the impact of regional differences in demographic conditions on poverty. In Section 4, we then investigate to which extent poverty can be explained by demographic differences both, between and within income classes, with particular emphasis given to the demographic differences between rich and poor families. Finally, Section 5 presents a summary of the main findings of the study and its main conclusions.

2 - LONG-TERM DEMOGRAPHIC CHANGES

In this section we present estimates of the direct effect of long-term demographic changes in Brazil on its level of poverty. Estimates are presented both, for the country as a whole, as well as separately for the main regions of the country. The regional analysis is important since, due to very different levels of economic development, they begun their demographic transition at very different points in time and proceeded through the transition at different speeds.

To estimate the direct effect of long-term demographic changes on the level of poverty, we estimated what poverty today would be in Brazil if the size and age structure of the population were equal to that observed decades ago. In performing this counter-factual simulation we kept constant the average income of each age group in every family. For this reason the estimated impact captures only the direct effect of the demographic changes.

This section is organized in three sub-sections. In the first, we present in details the methodology being used. The second describes the demographic changes that occurred in Brazil over the past 50 years. Finally, in the third section we present the results of the counter-factual simulation, aiming to estimate the impact of these secular demographic changes on poverty.

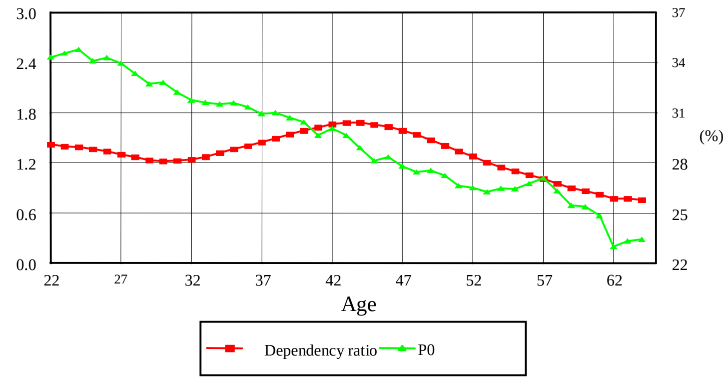
2.1 - Methodology

Since over the life cycle of families[4] the level of poverty varies as the dependency ratio varies, as can be seen in Figure 1, the overall level of poverty is influenced by the distribution of families according to their positions in the life cycle.[5] Hence, demographic changes have a direct effect on poverty through two channels: *a*) first, by modifying the demographic composition of families over their life cycle — *the internal effect*; and *b*) secondly, by modifying the distribution of families according to their positions in their life cycle — *the composition effect*.

[4]A common procedure for determining the location of a family in its life cycle is the age of the head. That is the procedure being used in this study.

[5] Lam (1997) has a similar study, in which he is concerned, however, with how income inequality is influenced by the distribution of families according to their positions in the life cycle.

Figure 1
Dependency Ratio and P0 by Age of Household Head



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.
Note: Dependency Ratio is: number of persons under 22 and above 64 divided by number of persons between 22 and 64 years.

In studying the direct impact of demographic changes on poverty, it is of fundamental importance to sort out these two effects, since the internal effect is of much greater substantive importance than the composition effect. Although the composition effect does influence the overall level of poverty at a given point in time, it has no effect on the evolution of the poverty level of a cohort of families over their life cycle. Hence, it has no effect on the lifetime level of welfare of families.

To concentrate attention on the internal effect, one must either standardize the distribution of families according to their positions in the life cycles or to focus only on families at a given point in the life cycle. For sake of simplicity we opt for the second alternative. In other words, to isolate the internal effect, we limit our investigation only to families with heads in a narrow age group. Since the demographic changes occurring in Brazil over this century had their stronger effects on the demographic composition of families with heads age 36 to 40 years,[6] we concentrate our attention on this group of families. At this point, it is worth mentioning that although all estimates of the impact of demographic changes on poverty are going to be presented only for the 36-40 age group as a whole, the entire underlying procedure treats each individual age group separately, aggregating then only at the end. Hence, even the small differences within these age groups are taken into consideration.

As already introduced, the basic ingredient for the counter-factual simulations is the expression

$$y^f = \frac{\sum_{i=1}^{m} n_i^f y_i^f}{\sum_{i=1}^{m} n_i^f}$$

[6] See, for instance, Barros *et alii* (in progress).

for per capita family income. In order to fully specify this expression it is necessary to choose a partition for the age spectrum. Our choice was to divide the age spectrum into four groups: *a*) 0 to 14; *b*) 15 to 21; *c*) 22 to 64; and *d*) 65 and more.

The goal of the counter-factual simulation is to compare the level of poverty based on y^f (the original poverty level), with the level of poverty that would prevail if per capita family income were given by

$$y_t^f = \frac{\sum_{i=1}^{4} n_{it}^f \, y_i^f}{\sum_{i=1}^{4} n_{it}^f}$$

where n_{it}^f is chosen in order to ensure that the aggregated size and age composition of members of family f match that of the cohort born t years ago. More specifically, we made

$$n_{it}^f = \frac{n_i^f \, N_{it}}{N_i}$$

where N_i is the number of members in age group i per family today. Note that N_i is simply the average value of n_i^f. N_{it} is the corresponding average t years ago. As a consequence, one has by construction that the average of n_{it}^f equals to N_{it}, indicating that after the transformation from n_i^f to n_{it}^f the aggregated family size and age composition match that of observed t years ago. This transformation is conducted separately for families at each point in the life cycle.

This transformation captures the overall change in family size and age composition. A similar procedure can be used to isolate the change at each age group and its specific impact on poverty. To isolate the effect of changes in age group j we constructed the following counter-factual family per capita income

$$y_{jt}^f = \frac{\sum_{i \neq j, i=1}^{4} n_i^f \, y_i^f + n_{jt}^f y_j}{\sum_{i \neq j, i=1}^{4} n_i^f + n_{jt}^f}$$

Note that in this expression only one of the n_{it} has been changed, allowing the effect on poverty of the changes in this specific age group to be evaluated.

These expressions revealed that to implement the counter-factual simulations it is necessary to count with estimates for N_{it} for as many points in time as one wished to simulate. We opted for going back 50 years in time. In other words, we investigate the impact on poverty of the demographic changes that took place over the last 50 years. We estimated not just the situation 50 years ago but also how it has evolved over this past five decades. As a result, we ended up with estimates of the entire evolution over these decades of the impact that demographic changes had on poverty. Based on this information, it is possible, for instance, to identify when the impact of demographic changes on poverty was particularly important.

To measure poverty we used three poverty measures: *a*) the headcount ratio, P_0; *b*) the average income gap, P_1; and *c*) the average squared income gap, P_2. These measures are the first three members of the Foster, Greer, and Thorbecke (1984) family. They are defined by

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z - Y_i}{Z}\right)^\alpha$$

where α = 0, 1 or 2, Z is the poverty line, q is the number of persons living in families below the poverty line (the poor), and n the size of the overall population. For the poverty line we use R$ 60 per-person per-month. Since the exchange rate was close to 1.00 R$/US$ in 1996, this poverty line is close to US$ 2,00 per day per person.

Next, we discussed how estimates for N_i were obtained covering the past 50 years. From a current household survey it is possible to obtain estimates for n_i^f for the family f. The average value of n_i^f is then an estimate of N_i. In principal, estimates for N_{it} can be obtained applying the same procedure to a corresponding household survey collected t years ago. Since the Brazilian Annual Household Survey (PNAD) has been collected on a regular basis only over the past 20 years, this procedure could only provide a partial answer. Some kind of extrapolation became necessary.

To describe the procedure used to extrapolate, we change our notation momentarily letting N_{ist} denote the average number of members in age group i in families with heads age s at time t. Based on the 18 available household surveys covering the period 1976/96 we obtained estimates of N_{ist} for all age groups (i = 1,...,4), for families with heads 20 to 80 years old, and for all years between 1976 and 1996. Based on this information we estimated the following regression:

$$\ln(N_{ist}) = a_i + b_i{*}s + c_i{*}h + d_i{*}s^2 + e_i{*}sh + f_i{*}h^2 + u_{ist}$$

where $h = t\text{-}s$ is the year of the birth of the head. Since all coefficients are allowed to vary by age group, we actually estimate a separate regression for each age group. Table 1 shows the coefficients for these regressions. Based on these regressions we were able to obtain estimates for the evolution of N_{ist} over the past 50 years by

$$_{ist} = \exp(a_i + b_i{*}s + c_i{*}h + d_i{*}s^2 + e_i{*}sh + f_i{*}h^2 + \bar{u}_{ist})$$

where $\bar{u}_{ist}$ is the average of the regression residuals across all birth cohorts with available information relative to a given age group, *i*, and family position in the life cycle, *s*. This average error term was included in the estimates for N_{ist} to reduce the difference between these estimates and the values actually observed.

Table 1

Regression Coefficients — Brazil
Dependent Variable: Log of the Average Number of People in Each Age Range

	Dependent Variables							
Regressors	0 to 14 Years		15 to 21 Years		22 to 64 Years		65 + Years	
	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
Intercept	–442,52	0,78	3225,92	0,48	592,21	0,76	–4915,18	0,18
Age	47,98	0,55	–126,09	0,59	–11,29	0,91	196,62	0,29
Birth Date	451,49	0,78	–3248,11	0,48	–602,27	0,75	4973,32	0,17
Age^2	–3,90	0,00	–0,85	0,78	–3,75	0,00	1,08	0,65
$Birth\ Date^2$	–115,50	0,77	817,07	0,48	152,41	0,75	–1258,98	0,17
Age*Birth Date	–21,85	0,59	65,31	0,57	9,57	0,84	–100,58	0,28
Number of Observations	1008		1008		1008		1008	
R^2	0,84		0,14		0,71		0,89	

Table 2

Regression Coefficients — Region
Dependent Variable: Log of the Average Number of People in Each Age Range

	Explicative Variables							
Regressors	0 to 14 Years		15 to 21 Years		22 to 64 Years		65 + Years	
	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
Intercept	-109,68	0,91	2693,61	0,20	509,87	0,58	-3349,82	0,09
Age	31,91	0,50	-90,44	0,39	-9,75	0,84	122,28	0,23
Birth Date	118,93	0,90	-2715,47	0,19	-517,12	0,58	3396,93	0,09
Age^2	-3,90	0,00	-1,52	0,26	-3,77	0,00	2,57	0,05
$Birth\ Date^2$	-32,55	0,89	683,77	0,19	130,40	0,58	-861,95	0,09
Age*Birth Date	-13,62	0,57	47,56	0,37	8,79	0,71	-63,80	0,21
Regions								
North	0,67	0,00	0,50	0,00	0,05	0,00	0,00	0,90
Northeast	0,57	0,00	0,34	0,00	-0,03	0,07	0,03	0,36
South	0,00	0,79	-0,03	0,38	-0,06	0,00	0,03	0,39
West Central	0,26	0,00	0,22	0,00	-0,03	0,01	-0,27	0,00
Number of Observations	5039		5034		5039		4865	
R^2	0,80		0,21		0,68		0,84	

Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.
Note 1: The variable "birth date"is the calendar year divided by 1.000.
Note 2: The variable "age"is the age of head divided by 50.

To obtain regional estimates, N_{istr}, we enlarged the regression model as follows:

$$\ln(N_{istr}) = a_{ir} + b_{ir}*s + c_{ir}*h + d_i*s^2 + e_i*sh + f_i*h^2 + u_{istr}$$

where, as above, $h=t-s$ is the year of birth of the head. Table 2 shows the coefficients for each age group regression. Based on this regression we obtain estimates for N_{istr} for any point in time via

$$N_{istr} = \exp\left(a_{ir} + b_{ir}*s + c_{ir}*h + d_i*s^2 + e_i*sh + f_i*h^2 + \bar{u}_{istr}\right)$$

where $\bar{u}_{istr}$ is the average of the regression residual across all birth cohorts with available information for a given age group, i, family position in the life cycle, s, and region r.

This specification imposes that the parameters of the quadratic terms are common to all regions. Only the intercept and the parameters of the linear terms are allowed to vary across regions. This parsimonious assumption was imposed in order to improve the ability of the model to provide reliable estimates outside the sample range. When we relaxed this assumption, in many cases non-plausible estimates were obtained for N_{istr}.

2.1.1 - Data sources

The data was obtained from *Pesquisa Nacional por Amostra de Domicílios — PNAD* (The Brazilian Annual National Household Survey) for the years 1976 to 1996, which are available for the public in magnetic files. This is an annual national household survey performed in the third quarter that interviews 100,000 households every year. It is conducted by IBGE, the Brazilian Census Bureau. It begun at national level in 1971 and underwent a major revision between 1990 and 1992. This revision makes difficult to have compatibility between PNAD concepts before and after 1992.

This survey contains extensive information on personal characteristics, including information on all sources of income, labor force participation and educational attainment and attendance. Being a household survey it also contains detailed information on family structure. The large number of PNAD surveys and their large sample sizes make them, like the demographic censuses, very useful for isolating life cycle variations from time trends.

In addition to a basic questionnaire, which repeated every year, most PNADs have a supplement considering a special topic. Many of these supplements have a considerable amount of retrospective information on fertility, marriage, and educational outcomes among others that can be particularly useful to describe the life cycle of family structure and the demographic change in Brazil.

2.2 - Demographic Changes

Estimates, based on the methodology previously exposed, for the evolution of N_{ist} over the past 50 years for families with heads ages 36 to 40 years are presented in Figures 2 to 5. These estimates are the base of the counter-factual simulations investigated in this section. Hence, before discussing the results of these simulations, we first present a short description of the basic patterns of the demographic changes over the past decades.

All these figures consider only the case of families with heads 36 years old. The patterns for families with heads with other ages than those in the bracket 36-40 are not presented in these figures, since they are almost identical to those for families with heads in the chosen age group. It is worth mentioning that, except for this sub-section, throughout the study all results are for all age groups in the bracket 36-40.

These figures reveal a clear decline in the number of persons per family in all age groups, except for the oldest (65 and more). Figure 2 reveals that families with heads born near the beginning of the century (1910) had, on average, 3.5 members under 15, while those with heads born around 1960 had just two members under 15 years of age.

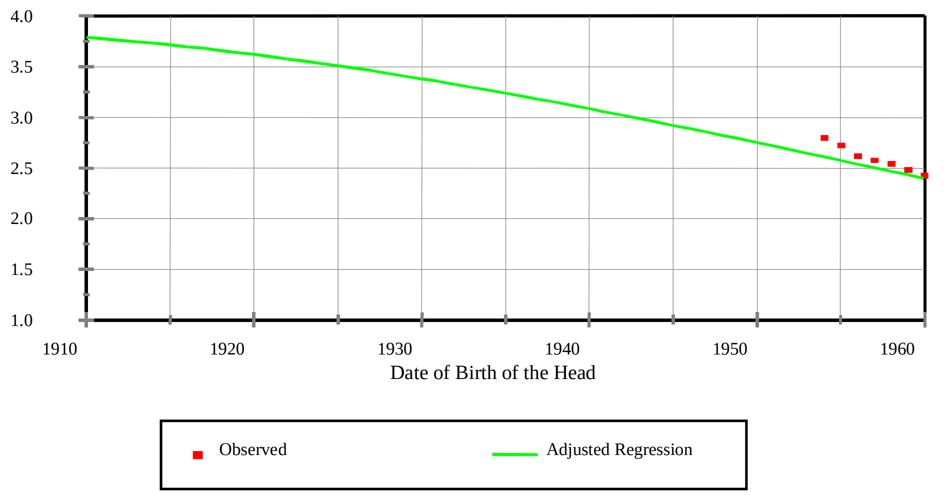
Figure 3 reveals a similar pattern for the number of teenagers per family. In fact, households whose heads were born near the beginning of the century (1910) had on average 2.5 members aged 15 to 21, while those with heads born around 1960 had just 0.5 member in this age group. Taking together these two figures indicate a sharp decline in number of persons under 22 per family, with the number of persons per family in this age group going from 6.0 to 2.5 over a period of five decades.

The same decline in size is also observed for the working age group — persons aged 22 to 64 years old. As Figure 4 reveals, the decline for this age group was much less intense, with the number of persons per family in this age group declining from 2.5, for families headed by persons born at the beginning of the century (1910), to 1.9, for those whose heads were born in 1960.

The results for the oldest group presented in Figure 5 indicate a reverse trend, with the number of elderly persons per family increasing over time. The relative importance of this group is, however, still extremely limited, with the average number of persons in this age group being smaller than 0.1 per family.

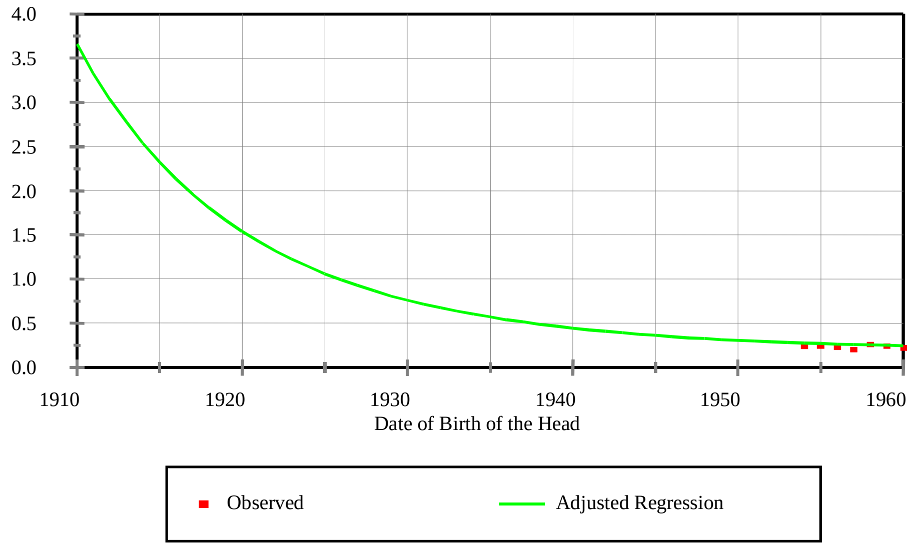
As a result of these temporal patterns, the size of families and the dependency ratio declined considerably over this five decades. Looking at the Figures 2 to 5 as a whole, one can see that the family size declined from 8.5 to 4.5, while the dependency ratio (defined as the ratio between the number of family members younger than 22 or older than 64 and the working age family members) also declined considerably from 2.10 to 1.20. In sum, over these five decades both the family size and the dependency ratio declined considerably reaching at the end of the period values close to one half of its initial value. The impact of these trends on poverty is bounded to be significant. An assessment of this impact is precisely the objective of the following sub-section.

Figure 2
Average Number of People 0 to 14 Years Old in Families Whose Head is between 36 and 40 Years Old — Brazil



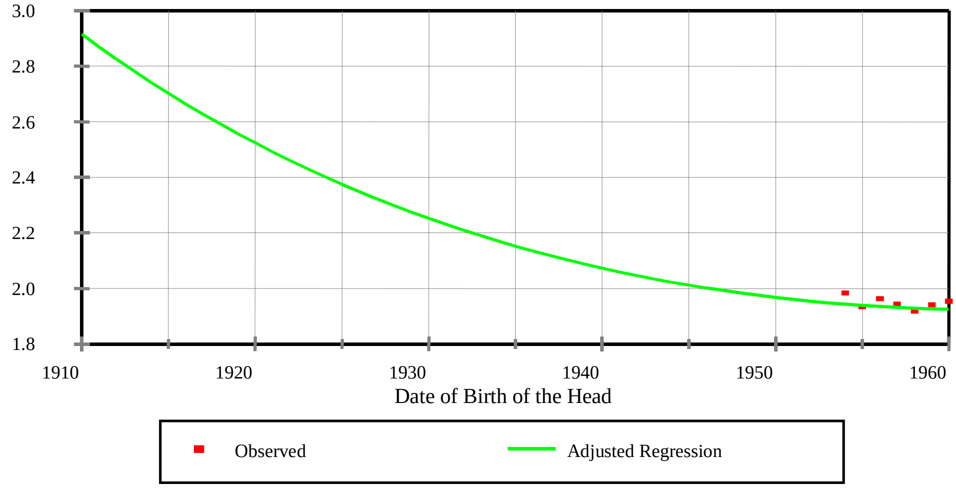
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.

Figure 3
Average Number of People 15 to 21 Years Old in Families whose Head is between 36 and 40 Years Old — Brazil



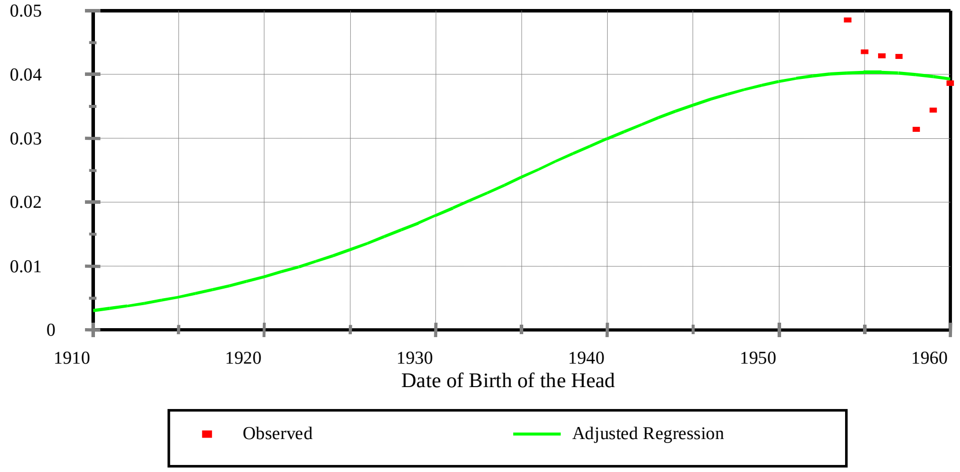
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.

Figure 4
Average Number of People 22 to 64 Years Old in Families whose Head is between 36 and 40 Years Old — Brazil



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.

Figure 5
Average Number of People 65 + Years Old in Families whose Head is between 36 and 40 Years Old — Brazil



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.

The regional patterns are very similar to the overall pattern for Brazil, showing no great differences between Brazilian regions over the family size reduction movement. These patterns are summarized in Table 3. This table shows that the greatest changes occurred at the Northeast and West Central regions, where the dependency ratio fell around 50% in half a century.

Table 3
Average Number of People by Age Groups in Families whose Head is between 36 and 40 Years Old

	Brazil	South	Southeast	North	Northeast	West Central
Heads Born in 1910						
0-14	3,64	4,41	4,22	5,45	5,91	4,67
15-21	1,54	1,06	1,14	1,90	1,50	1,37
22-64	2,49	2,56	2,55	2,54	2,52	2,50
65+	0,01	0,02	0,02	0,02	0,02	0,01
Dependency Ratio	2,08	2,15	2,11	2,90	2,95	2,42
Heads Born in 1960						
0-14	2,08	1,90	1,82	2,35	2,55	2,01
15-21	0,24	0,20	0,21	0,35	0,28	0,26
22-64	1,95	1,93	1,93	1,92	1,90	1,89
65+	0,03	0,03	0,03	0,04	0,03	0,02
Dependency Ratio	1,20	1,10	1,07	1,43	1,50	1,21
Absolute Variation						
0-14	–1,56	–2,51	–2,40	–3,10	–3,36	–2,66
15-21	–1,31	–0,87	–0,93	–1,54	–1,22	–1,12
22-64	–0,55	–0,63	–0,63	–0,62	–0,62	–0,61
65+	0,02	0,01	0,01	0,01	0,01	0,01
Dependency Ratio	–0,88	–1,04	–1,04	–1,47	–1,44	–1,21

Source: PNAD 1976/96.

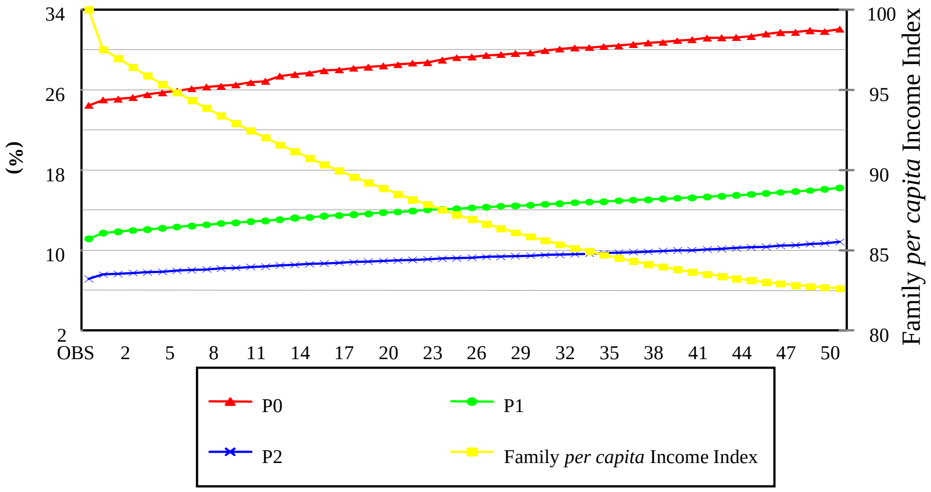
2.3 - Demographic Change and Poverty

We discuss first the results for the country as a whole. In turn, we discuss the regional specific results.

2.3.1 - Brazil

Figure 6 presents how poverty would be today among families with heads 36 to 40 years old if the number and age composition of the family members were as *t* years ago. This figure reveals that the headcount ratio (average income gap) would be seven (five) percentage points higher today if the number and age composition of family members were that prevailing 50 years ago.

Figure 6
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Age Structure of *t* Years Ago — Brazil



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

In the same figure we also presented by how much the income of all family members would have to be reduced annually in order to simulate the effects of the maintenance of the *t* years ago demographic structure on poverty. Since the time evolution of poverty in this case would be very similar to that resulting from the demographic change, we concluded that the effect of the demographic change on poverty over the past 50 years was equivalent to an additional 21% growth in per capita income. In fact, if there had been no demographic changes over the past 50 years, but an additional growth in per capita income of 0.4% per year, then the evolution of poverty would have remained close to the same.

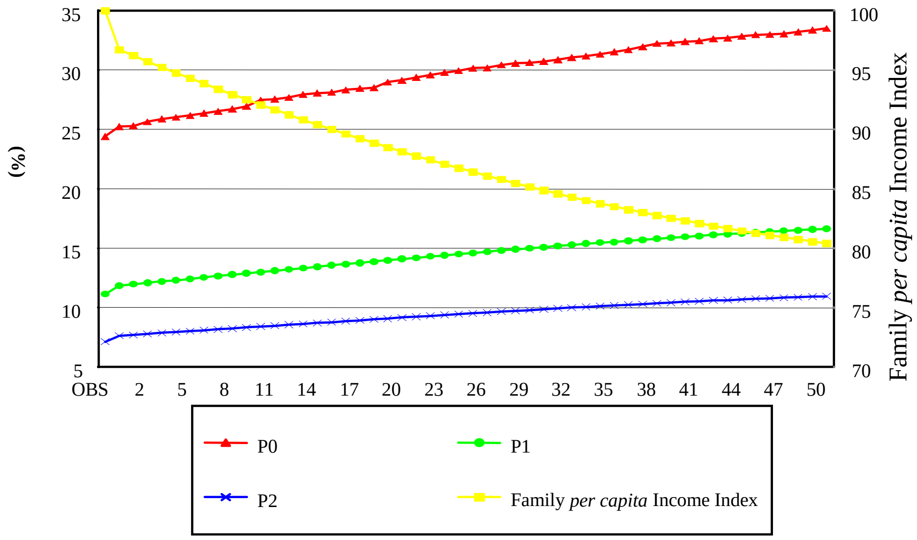
The results just presented are estimates of the impact on poverty of all changes in the size and age composition of families. Next, we present estimates of the impact on poverty of changes in the size of each age group. Estimates of these partial effects are presented in Figures 7 to 10. These figures present how poverty would be today among families with heads 36 to 40 years old if the number of family members in age group *i* were as *t* years ago. From these figures it is possible to identify which demographic group is responsible for the greatest impact on poverty.

These figures reveal that the greatest impact on poverty comes from the reduction in the number of younger (0-14) family numbers. Just this change is responsible for a decline in the headcount of six percentage points. Despite this fact, Figure 8 reveals that the decline in the number of family members age 15 to 21 years old has also been responsible for a significant (four percentage points) reduction in poverty, although smaller than the impact of the reduction in the number of younger family members.

On the other hand, the reduction in the number of family members ages 22 to 64 has led to an increase in the headcount of three percentage points, as Figure 9 shows. Finally, it is worthy noticing that for the group whose members age 65 or more, the demographic changes were too small to have any significant impact on poverty.

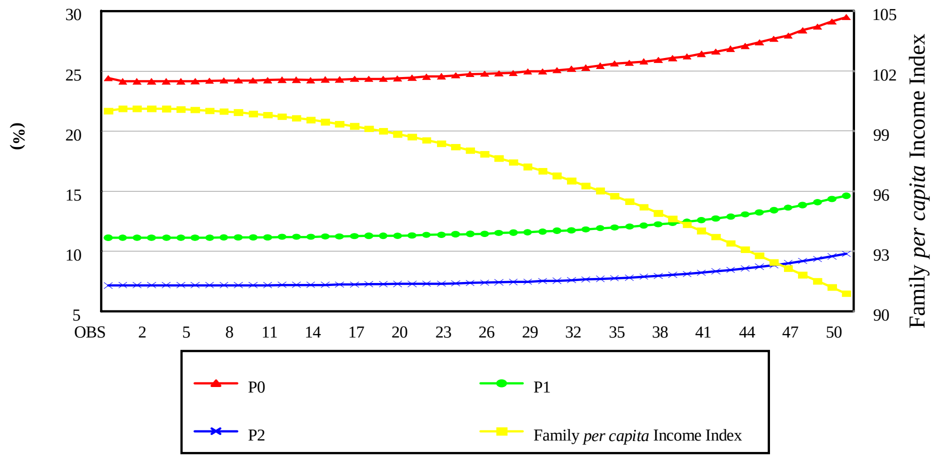
In sum, the demographic changes over the past 50 years led to a decline in the headcount ratio of seven percentage points. This change, however, is the result of two opposing forces, On the one hand, the decline on the number of young dependents (persons younger than 22) brought a decline of 10 percentage points in the headcount. On the other hand, the decline in the number of working age members (22-64) led to an increase in the headcount of three percentage points.

Figure 7
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Average Number of People between 0-14 Years Old per Family of *t* Years Ago — Brazil



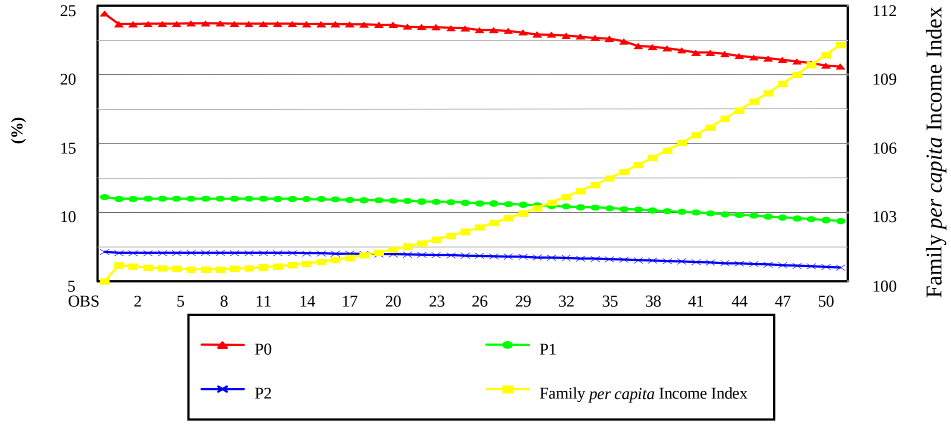
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Figure 8
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Average Number of People between 15-21 Years Old per Family of *t* Years Ago — Brazil



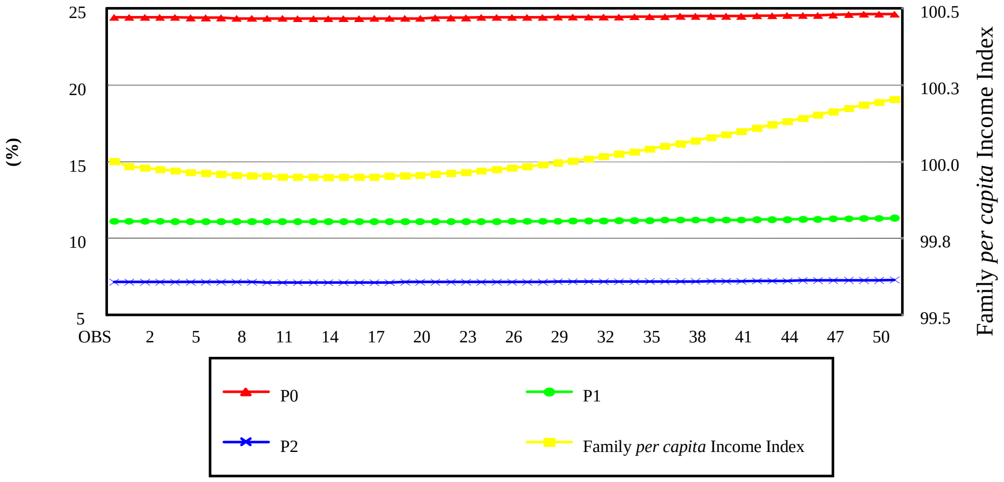
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Figure 9
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Average Number of People between 22-64 Years Old per Family of *t* Years Ago — Brazil



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Figure 10
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Average Number of People Age 65 and More per Family of *t* Years Ago — Brazil

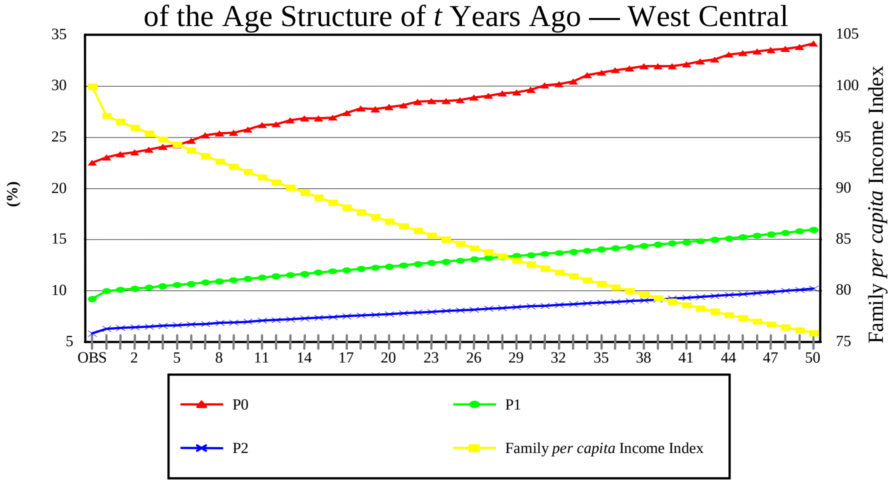


Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

2.3.2 - Regional patterns

Regional disparities in poverty are very large as Figures 11 to 15 clearly reveal. While in the Northeast 50% of the population live in families with per capita income below the poverty line, in the Southeast, less than 15% of the population is below the poverty line.[7]

Figure 11
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Age Structure of *t* Years Ago — West Central

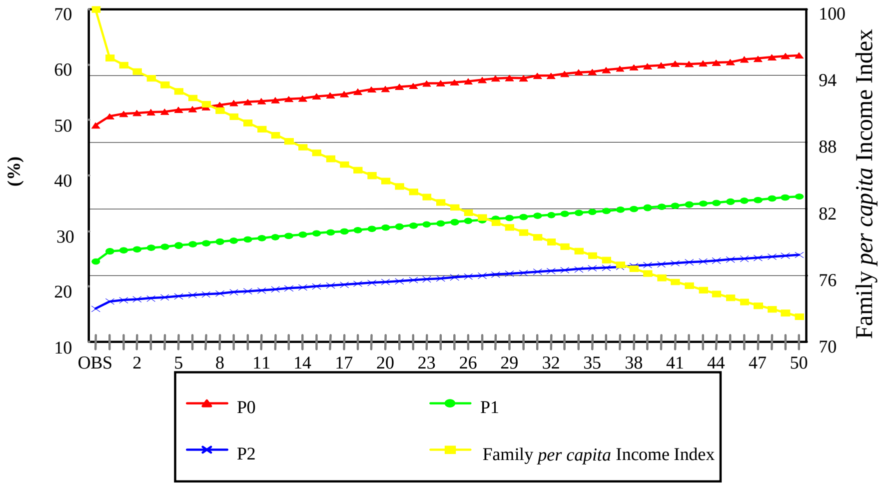


Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

[7] Estimates of the impact on poverty of changes in the size of each age group for each region were calculated. Once more the interested reader can find them at the mimeo version of this paper.

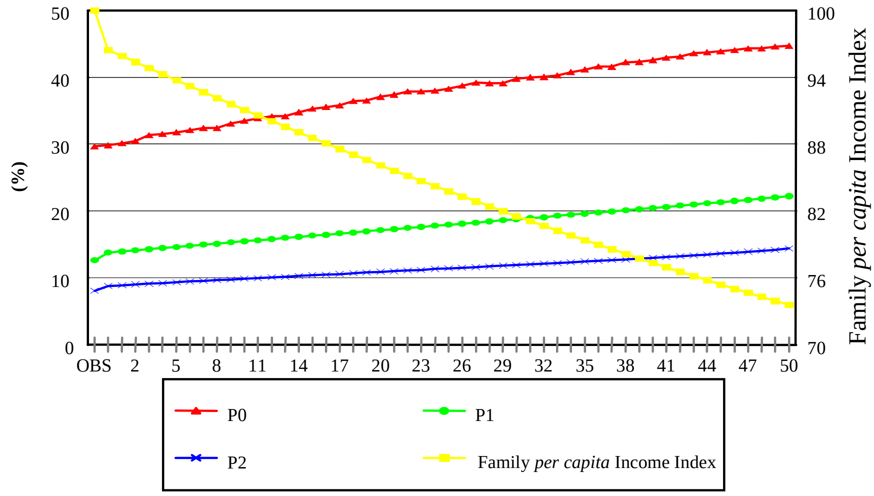
These figures reveal that the demographic changes that occurred over the past 50 years benefited all regions. In all of them, the demographic changes brought a considerable decline in poverty.

Figure 12
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Age Structure of *t* Years Ago — Northeast



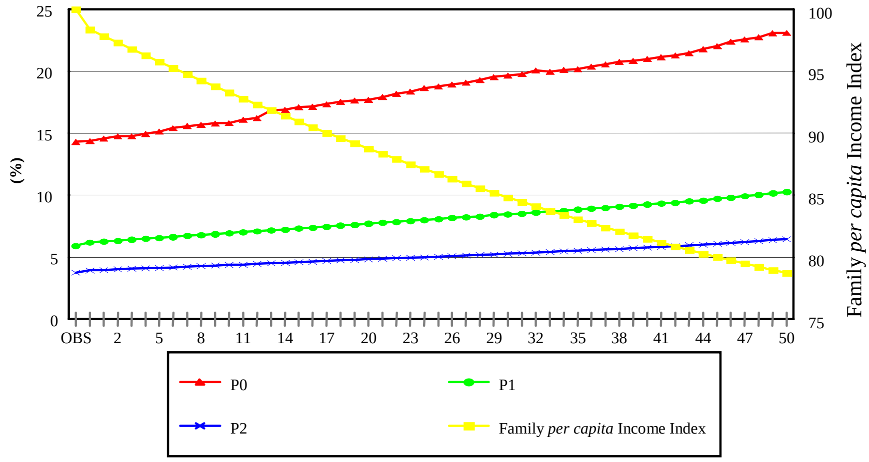
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Figure 13
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Age Structure of *t* Years Ago — North



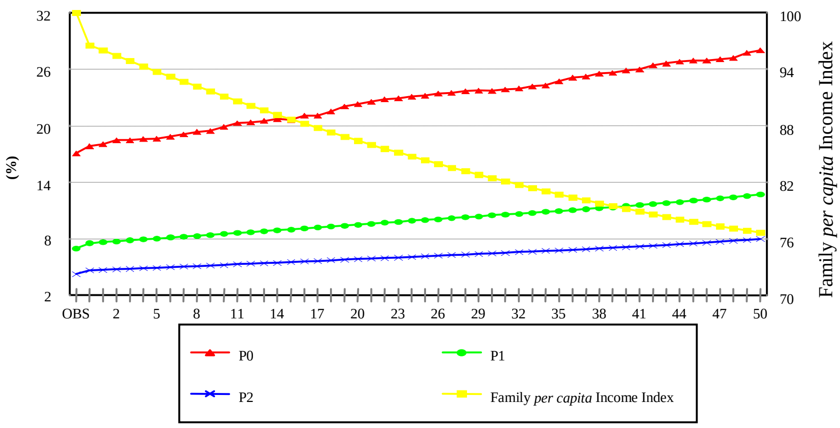
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.

Figure 14
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Age Structure of *t* Years Ago — Southeast



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.

Figure 15
Counter-Factual Poverty Measures: Effects on Poverty of the Maintenance of the Age Structure of *t* Years Ago — South



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

This impact, however, were not of the same magnitude in all regions. It tended to be greater in the less developed regions. For instance, while the demographic changes in the Northeast led to a decline in the headcount of more than 14 percentage points, in the Southeast, the decline in the headcount as a consequence of the demographic transformations was about eight percentage points.

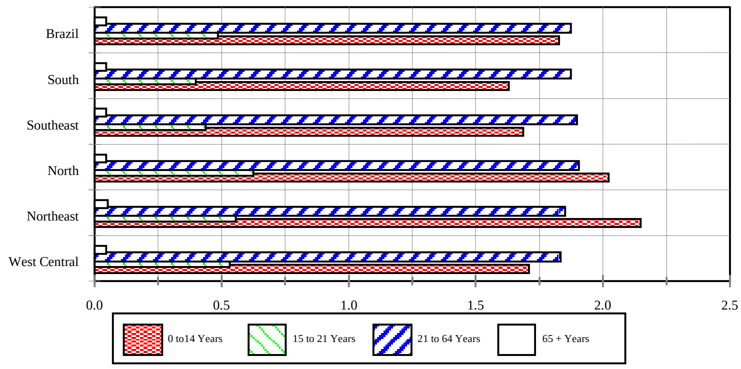
As a consequence of this differential impact favoring the less developed regions, the demographic transformations that occurred in the past 50 years were a relevant factor in reducing regional disparities in poverty. In fact, over this period demographic transformations have been working in the direction of eliminating regional disparities in poverty.

3 - CONTEMPORANEOUS REGIONAL DISPARITIES

As mentioned in the previous section, regional disparities in Brazil are large. While in the Northeast 50% of the population are poor, in the South only 15% is below the poverty line. The objective of this section is to investigate to which extent these sharp differences are caused by concomitant demographic differences.

Figure 16 presents some evidence on the size and age composition of families in Brazil for each age group. This figure reveals important regional demographic disparities, which are clearly related to the level of economic development. In the more developed regions (South and Southeast) the average number of young dependents per family (persons under 22 years of age) is well below the average for the less developed regions (North and Northeast). There are also regional differences in the number of persons per family in the working age group favoring the more developed regions. These differences, however, are relatively smaller.

Figure 16
Average Number of Members of Each Age Group per Family



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.

As a consequence of these demographic differences, the dependency ratio is considerably greater in the less developed regions than in the more developed ones. Next we investigate to which extent this sharp regional differences in demographic composition is the main cause of the concomitant large regional differences in poverty.

In order to estimate the impact of regional differences in the size and age distribution of the population on the concomitant differences in poverty, we perform counter-factual simulation aiming to estimate how poverty in each region would look like if all regions had the same demographic composition.

To empirically implement this idea we constructed a counter-factual income given by

$$y_r^f = \frac{\sum_{i=1}^{4} n_{ir}^f \, y_i^f}{\sum_{i=1}^{4} n_{ir}^f}$$

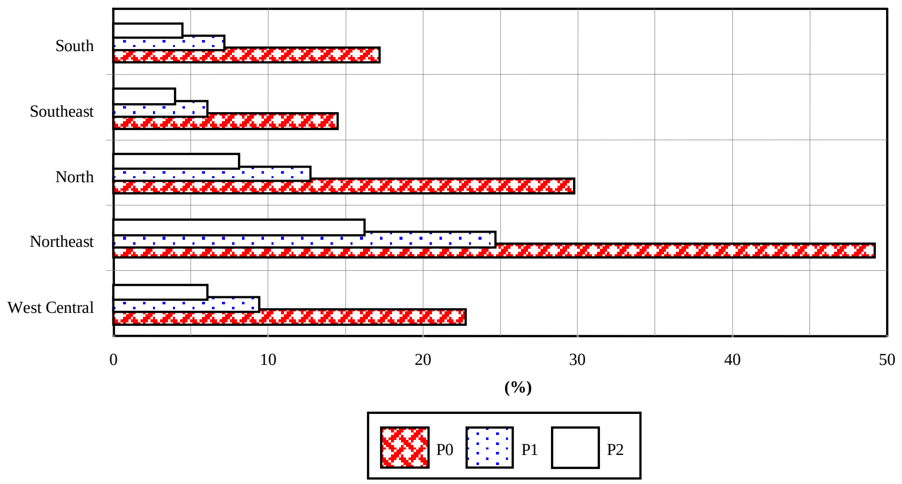
where n_{ir}^f was chosen in order to ensure that the aggregated size and age composition of family members in region *r* matched the national average. More specifically, we made

$$n_{ir}^f = \frac{n_i^f N_i}{N_{ir}}$$

where N_i is the average number of members in age group *i* per family for the country as a whole and N_{ir} is the corresponding average for region *r*. As a consequence, one has by construction that the average of n_{ir}^f in region *r* equals to N_i, indicating that, after the transformation, the aggregated size and age composition of family members in region *r* match the national average.

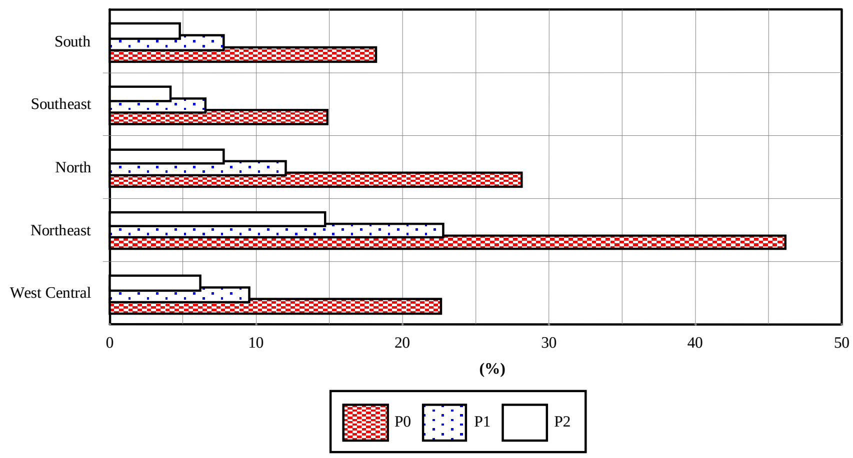
Figures 17 and 18 present estimates for the level of poverty in each region before and after this standardization. These figures reveal that the regional differences in poverty would be something smaller if all regions had the national demographic composition. For instance, if the Northeast had the national demographic composition, poverty would be three percentage points smaller, whereas the level of poverty in the Southeast would remain essentially the same if the demographic composition in the region equate the national average. As a consequence, we obtained that one tenth of the poverty gap (35 percentage points) between the Northeast and the Southeast could be explained by demographic differences between these two regions.

Figure 17
Original Regional Poverty Measures



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Figure 18
Counter-Factual Regional Measures of Poverty:
Standardization with the Brazilian Age Structure



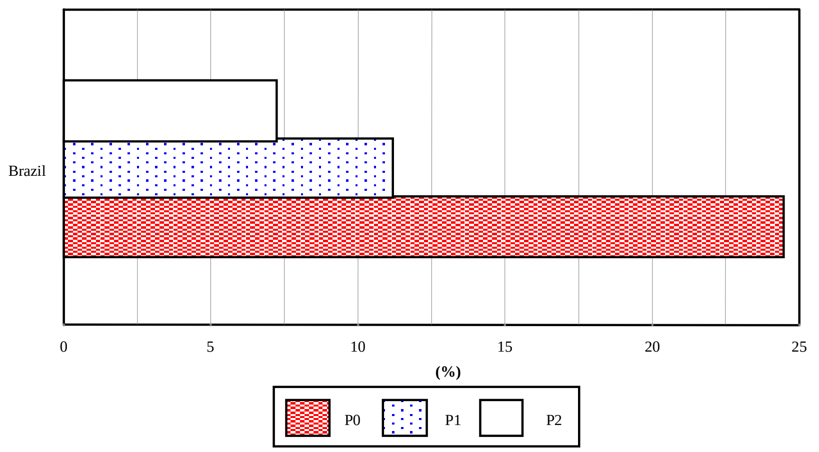
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Part of the differences between the North and Southeast regions are also explained by demographic differences. In fact, while the North has 20 percentage points of the population in poverty in addition to the Southeast, almost one tenth of this difference is accounted for by demographic differences.

Demographic differences also explain part of the differences in poverty between the Southeast the Center-West and between the Southeast and the South. In this case, however, the original disparities are smaller, as well as the contribution of demography in explaining these differences.

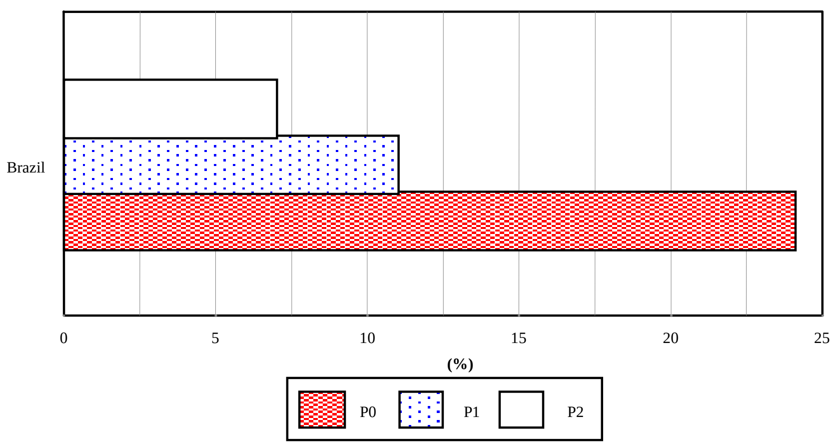
Finally, Figures 19 and 20 present how the elimination of regional differences in demographic structure would affect the overall level of poverty in the country, that is, what would be the level of poverty in Brazil in the case that all regions have the an identical demographic composition. These figures reveal that the elimination of regional differences in demographic composition would have a very small effect on the overall level of poverty. More specifically the elimination of these disparities would reduce the headcount ratio just from 24% to 23%.

Figure 19
Original Current Measures of Poverty — Brazil



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

Figure 20
Counter-Factual Measures of Poverty — Standardization with the Brazilian Age Structure



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1976 to 1996.
Note: Poverty Line: R$ 60,00 of 1996.

4 - DEMOGRAPHIC DIVERSITY AND POVERTY

In the previous section we illustrated the relationship between regional differences in demographic structure and regional differences in poverty. Regional differences, however, are just one example of demographic diversity. In this section we further explore this connection between demographic diversity and poverty.

Two aspects of the demographic diversity are investigated. First, we investigate to which extent poverty would be reduced if all income groups had on average the same demographic composition. In other words, we investigate the impact of eliminating all demographic differences between income groups on the level of poverty. Secondly, we investigate to which extent poverty would be reduced if all families had exactly the same demographic composition, that is, we investigate the effect on poverty of eliminating all demographic diversity.

4.1 - Eliminating Demographic Differences between Income Groups

In this sub-section we examine the effect on poverty of eliminating demographic differences between rich and poor families. To implement this objective we have to divide families in income groups. To construct these income groups we have to choose a notion of income to construct a partition of the income spectrum.

The natural choice for income may seem to be the family per capita income. Nevertheless, this income is itself heavily influenced by demographic aspects. It derives from the fact that the family per capita income incorporates earnings of child labor. By its turn, child labor tends to occur more frequently in families with a large number of children, which is one of the used demographic indicators.

In order to avoid this above-mentioned problem, we decided to construct income groups based on the average income of adults (people age 22 to 64) in the family. This decision has also a normative justification. We are interested to classify families as rich or not taking in consideration only the income of people in the working age, since children’s earnings, although increase the family income, must reflect a family welfare loss. We also decided to split the income spectrum into 100 non-overlapping groups using the percentiles of the distribution as boundaries.

We equated the average demographic composition of all income groups to the overall average and re-compute the level of poverty to assess the impact of differences in demographic composition between income groups on poverty. In order to implement this objective we constructed the following counter-factual income:

$$y_d^f = \frac{\sum_{i=1}^{4} n_{id}^f y_i^f}{\sum_{i=1}^{4} n_{id}^f}$$

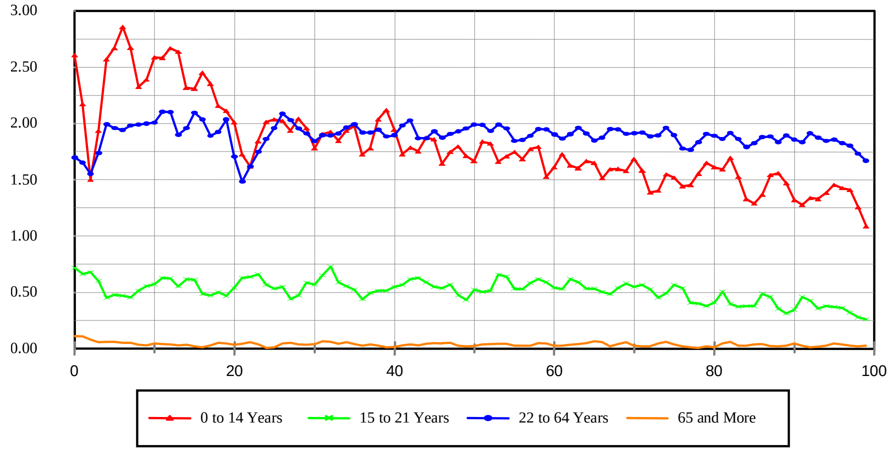
where n_{id}^f was chosen in order to ensure that the aggregated size and age composition of family members of income group d match that prevail in the overall population. To ensure that this property holds, we make

$$n_{id}^f = \frac{n_i^f N_i}{N_{id}}$$

where N_i is the average number of members in age group i per family in the population and N_{id} is the corresponding average for families in the income group d. As a consequence, one has by construction that the average of n_{id}^f among families in the income group d equal to N_i, indicating that the transformation from n_i^f to n_{id}^f ensures that the aggregated size and age composition of family members in income group d match that observed in the overall population.

Estimates of N_{id} are presented in Figure 21. This figure reveals that the number of children (persons younger than 14 years old) and the number of teenagers (persons 15 to 21 years old) are decreasing functions of income, that is, the richer the family the smaller the number of young dependents in the family. More specifically, this figure reveals that the number of young dependents per family is close to 3.0 among very poor families and close to 1.7 among the very rich families. At the same time, the number of persons in the working age per family tends to increase with the income level, going from 1.7 among the very poor to more than 2.0 among the very rich.

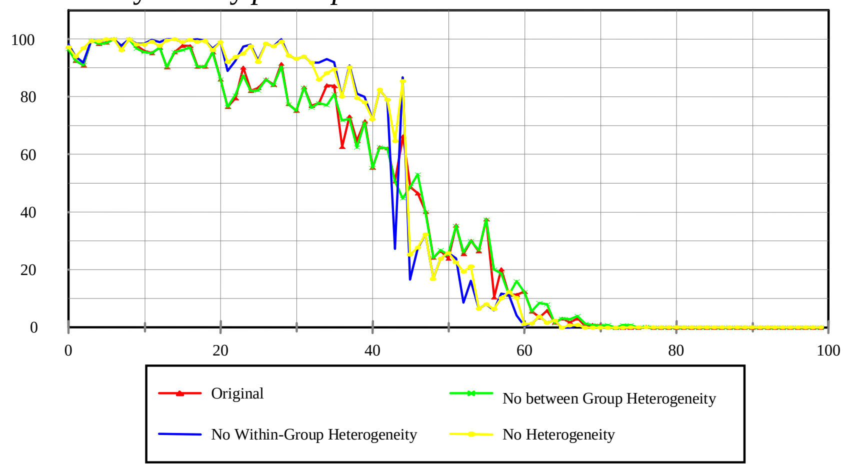
Figure 21
Average Number of Family Members per Income Centile



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.

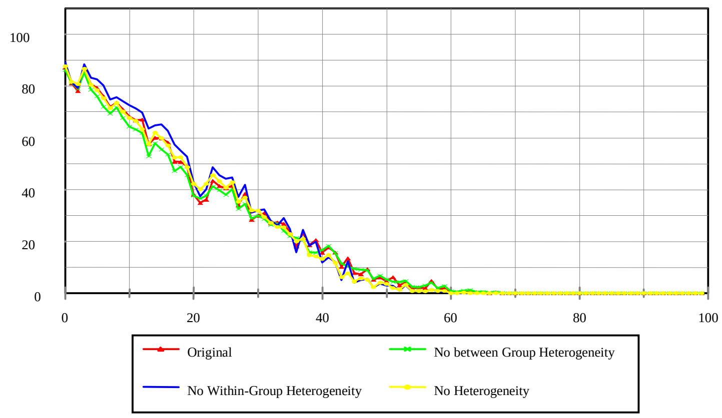
Figures 22 to 24 present estimates of poverty before and after we eliminated the demographic differences between income groups. These figures reveal that, similar to the regional analysis, differences between income groups have little effect on poverty. More specifically one can see that, for almost all income groups as well as for all groups together, the impact on poverty of eliminating demographic differences between income groups is almost insignificant. This result is rather important, it says that poverty is not, by any significant amount, a consequence of differences in demographic structure between poor and rich families.

Figure 22
P0 by Family *per capita* Income of Adults Distribution



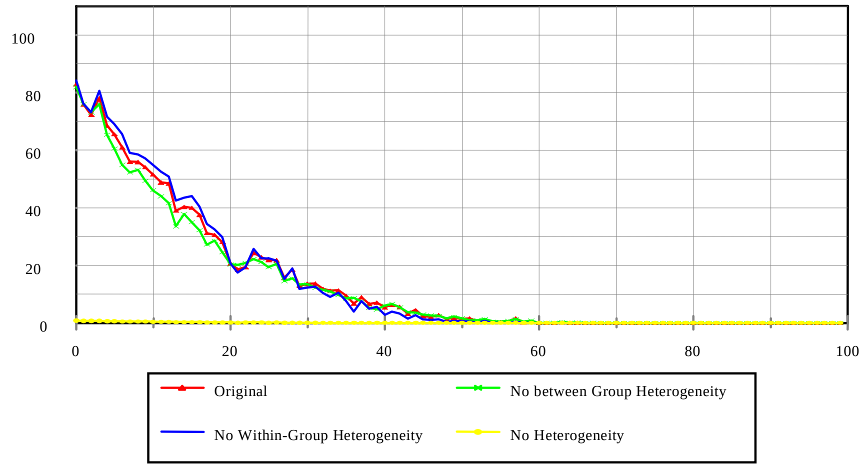
Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.

Figure 23
P1 by Family *per capita* Income of Adults Distribution



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.

Figure 24
P2 by Family *per capita* Income of Adults Distribution



Source: Based on Pesquisa Nacional por Amostra de Domicílios (PNAD) of 1996.

4.2 - Eliminating all Demographic Differences

In the previous sub-section we obtained the rather unexpected result that differences in demographic structure between rich and poor families were not important in explaining poverty. In this sub-section we pursue further the connection between demographic diversity and poverty. More specifically, in this sub-section we investigate the effect on poverty of eliminating all differences among families, in size and age composition.

Since overall disparities can always be decomposed in between groups and within groups, we can also contrast the results of this sub-section with those obtained in the previous sub-section, to obtain measures of the impact of demographic disparities within income groups.

To assess the impact on poverty of eliminating all differences in demographic composition among families we equate the demographic structure of all families to the overall structure and re-compute the level of poverty. In order to implement this objective we construct the following counter-factual income:

$$\bar{y}^{f} = \frac{\sum_{i=1}^{4} N_i \, y_i^f}{\sum_{i=1}^{4} N_i}$$

where N_i is the average number of members in age group *i* per family in the population.

Figures 22 to 24 present estimates of poverty before and after we have eliminated all demographic differences among families. These figures reveal that, for low-income groups, once all demographic differences are eliminated, poverty did not decrease. It actually increases slightly. These figures also reveal that for the middle income groups, the elimination of all heterogeneity reduces the degree of poverty. And as we move along the income classes, in the direction to the richer ones, the reduction of poverty due to the elimination of all heterogeneity goes on, but with a lower impact.

5 - SUMMARY AND CONCLUSIONS

In this study we presented evidence of the impact of demographic factors on the level of poverty based on the Brazilian experience. The main objective was to isolate and estimate the *direct* impact of changes in demographic factors on the distribution of income and consequently on the level of poverty. To obtain estimates of this impact we rely on micro-simulations based on a series of household surveys.

We presented estimates of the impact on poverty of a series of alternative demographic changes. First, we consider the demographic changes that occurred over the previous decades. We showed that these changes led to a continuous reduction in poverty. In order to evaluate the substantive importance of these demographic changes on the level of poverty, we also estimate what additional economic growth would be necessary to produce the same reduction in poverty. We obtain that the demographic changes occurring over the past decades had an effect on poverty, which is equivalent to an additional 0.4 to 0.5 percentage point in annual growth in per capita income. Since the average growth rate in per capita income in Brazil over this period was close to 3.0% per year, the demographic change in the period had an important *direct* impact to reduce poverty. In sum, the estimated direct impact of the demographic transition had an impact on poverty close to 15% of the corresponding impact of economic growth.

We also investigate the importance of regional differences in demographic conditions for explaining concomitant differences in poverty. We showed that despite some important regional differences in the moment and in the speed of the demographic transition, current demographic regional differences explain only a very small fraction of the sizeable regional differences in poverty.

Finally, we investigate to which extent poverty can be explained by demographic differences between poor and rich families. We found that when families are ranked by their average income per adult, the demographic differences between poor and rich families are very small. As a consequence, these demographic differences revealed unimportant in explaining the level of poverty.

In sum, accordingly to our estimates, overall secular demographic changes tend to have much greater impact on poverty than differences in the time and the speed of the demographic transition across regions and between poor and rich families.

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