INDIRECT ESTIMATION OF MIGRATION FLOWS: AN EXPLORATORY ANALYSIS OF THE 1991 AND THE 2000 BRAZILIAN CENSUS DATA

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The indirect estimation methods of fertility and mortality rates are well known in demography *(UN ManuaXl, 1983)*. There is already ample literature on the indirect estimations of age-specific migration rates *(Rogers, Willekens, Castro*). However, no systematization and diffusion is as widespread as in the case of fertility and mortality.
In Brazil, despite the wealth of information on migration flows provided by census data, studies on migration flows have had relatively little methodological development, especially those aiming to establish migration model schedules, despite efforts on the part of researchers to understand and systematize them *(Machado, Carvalho, Rigotti)*.
This article sets out to contribute to the establishment of age-specific migration propensities in Brazil by applying and analyzing two methods proposed by *Rogers and al. (2003*), using the 1991 and the 2000 Brazilian demographic censuses' micro data. Data are disaggregated per 5-year age group and migration among the five major Brazilian regions (North, Northeast, South, Southeast and Center-West) are studied.

Introduction

The indirect estimation methods of fertility and mortality rates are well known in demography. From Brass's pioneering study *(Brass,1973)* to the UN mortality model schedules *(UN Manual X*, *1983)*, several other studies and manuals have solidified among demographers the 'culture' of indirect estimation of age-specific mortality and fertility rates whenever data are incomplete or inexistent.

There is ample literature on the indirect estimations of age-specific migration flows (*Rogers et. al, 1981, 2001, 2003, 2004*). However, no systematization and diffusion is as widespread as in the case of fertility and mortality.

In Brazil, despite the wealth of information on migration flows provided by census data, studies on migration flows have had relatively little methodological development, especially those aiming to establish migration model schedules, despite efforts on the part of researchers to understand and systematize them (*Carvalho et al., 1992, 1998*).

Most researchers continue to work with widely diffused indirect estimation methods. Those utilizing demographic censuses' microdata have mostly used the place of residence 5 years ago to directly estimate the migration flow in the regions under study. Therefore, establishing model schedules still is not a matter of great concern. Establishing such model migration schedules would prove useful, firstly in order to systematize and better understand the phenomenon underlying the act of migrating, and secondly because such model migration schedules could be used in regions where data are incomplete or inexistent.

As a contribution of the establishment of these schedules to the former, for example, it is worth mentioning the distinct migration patterns from the Northeast to the Southeast

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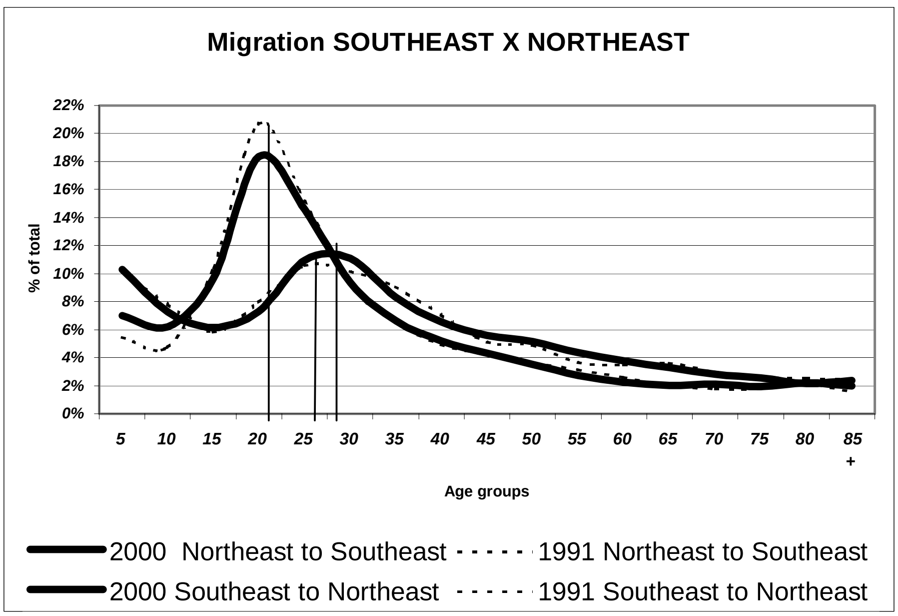
against the opposite flow from the Southeast to the Northeast (Map. 1) (fig.1): it can be observed that both in the 1991 and in the 2000 censuses, the age-specific migration propensities from the Southeast to the Northeast peak at more advanced ages, as opposed to the inverse migration flow, which peaks at younger ages. It can be roughly stated that Southeast bound migrants are seeking jobs and Northeast bound ones are returning back home.

To the latter, these age specific schedules could contribute to estimate patterns for small areas (e.g. migration between cities) where the samples of the complete census form (which captures the migration phenomenon) do not enable one to establish directly an age-specific pattern. As an example, the age pattern of migration of a ‘pole’ city in the Northeast would follow a similar pattern from the Southeast to the Northeast, although the city is located in the Northeast. The opposite would, naturally, hold true for a ‘pole’ city located in the Southeast.

FIGURE 1



This article sets out to contribute to the establishment of age-specific migration curves in Brazil by applying methods proposed by Rogers and al. (2003), using the 1991 and the 2000 Brazilian demographic censuses’ microdata. Data are disaggregated per 5-year age group and migrations among the five major Brazilian regions (North, Northeast, South, Southeast and Center-West (map 1) are studied.

The following strategy has been adopted for the application of these methods to the Brazilian data: the 1991 census was regarded as complete, i.e. as having both the dependent and the independent variables for the application of the schedules. The dependent variables, thus, were estimated for the 1991 data. These dependent variables were then estimated to the 2000 census, as if it only contained the independent variables. As the 2000 census is also complete, the performance of each in predicting migration will be examined.

Methodology

Method 1- Infant Migration Propensities

The first method developed by Rogers and Jordan, 2003 uses the information on the birthplace of 0–4 year olds as a parameter for the indirect estimation of all others age-specific migration propensities. The method relies on the following assumptions:

1) regardless of their level and of the place where they take place, migration rates have a very similar age pattern;
2) for children aged 0 to 4, the census question about birthplace is present in practically all censuses and, because it is a 4-year period, it is representative of recent migration
3) as these children migrate with their young adult parents such migrations mirror adult migrations to a large extent.

Relying on these sets of assumptions, and analogous with the indirect estimation of mortality, which estimates the age-specific schedule of mortality through a single mortality rate in childhood, Rogers and Jordan,2003 propose an extremely simple methodology:

Through a linear regression between the ratio of children aged 0 to 4 who were born in i and lived in j (independent variable), we obtain for each age group the ratio of people that lived in i 5 years ago and that live in j at census time (dependent variable):

$$S_{ij}(x) = a + bS_{ij}(-5) + \alpha$$

for x = 5,..., 85 + years old, where

$S_{ij}(-5)$ = ratio of children aged 0 to 4 that were born in i and lived in j at census time;

$S_{ij}(x)$ = ratio of people aged (x,x + 4) that lived in i, five years ago and lived in j at census time, and

α = error term.

To obtain more robust results, the authors added a second independent variable:

${}_iK_j$ (+)% = percentage of births in i of all ages enumerated in j at the census time:

$$S_{ij} = a + bS_{ij}(-5) + c\,{}_iK_j(+)\% + \alpha$$

to ensure both that the ratios of survivorship are always non-negative and that they range between 0 and 1, the authors use a logistic regression:

$$\ln[S_{ij}(x)/(1-S_{ij}(x))]=a+bS_{ij}(-5)+c_i K_j(+)\%+\alpha$$

To illustrate the method, using the 1991 census, figure 2 presents the ratio of survivorship from i to j (the 20 possible flows (5 regions x 5 regions – 5 internal flows of each region = 20) aggregated (all ages) *(y)* as a function of the ratio of children aged 0 to 4 born in i and living in j at the time of census *(x)*. There is a correlation coefficient of 93% for a linear regression, which leads us to regard the method as a promising one.

Correlation coefficients for each age group of the linear regression applied to the 1991 census, for the 5 regions are presented in table 1.

FIGURE 2

Ratio of Survivorship from i to j aggregated (all ages) (Y)

Ratio of children aged 0 to 4 born in i and living in j - Brazil -1991 (X)

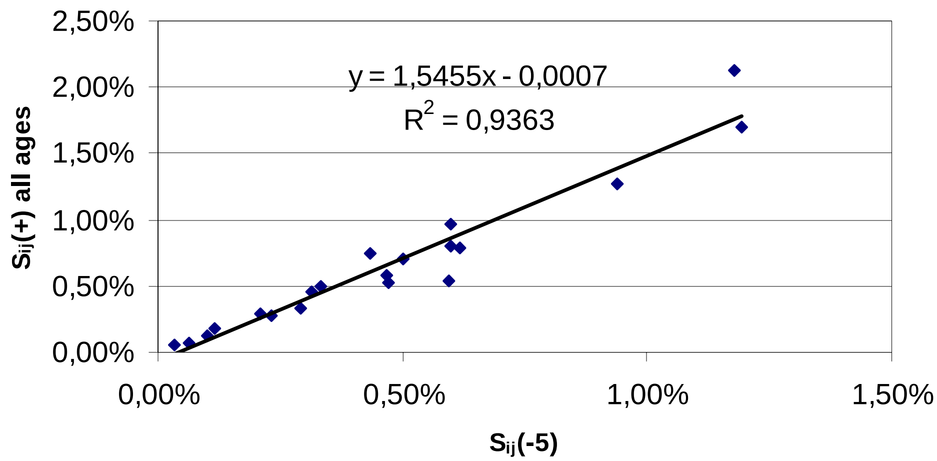


TABLE 1

Brazilian 1991 Census Data
Application of method 1 equation by age group
Correlation Coefficients

Age group(*)	r coefficient
Y 00-04	89,2%
Y 05-09	89,5%
Y 10-14	88,7%
Y 15-19	90,1%
Y 20-24	90,3%
Y 25-29	89,9%
Y 30-34	88,7%
Y 35-39	89,5%
Y 40-44	90,2%
Y 45-49	90,8%
Y 50-54	85,5%
Y 55-59	89,3%
Y 60-64	92,0%
Y 65-69	92,0%
Y 70-74	89,8%
Y 75-79	87,4%
Y 80 +	89,3%

(*) Age group at the beginning of the time interval

Method 2 –Net migration stocks or proportions + method 1

The second method proposed by the authors tries to estimate the age-specific migration propensities from the net migration rates.

The net migration is generally obtained by means of the difference between the actual population and the estimated population, at time t, from the projection of the population at a prior date, say t-5, if no migration whatsoever had taken place. i.e. only the knowledge of the fertility and mortality patterns are necessary.

Although widely diffused and well known, net migration presents a series of inconveniences for a system of several regions. For our purposes one of the greatest inconveniences is: the sum of net migrations of the several regions, regarded as a 'closed' system (not considering international migration, for instance) may not be equal to zero, though theoretically it should be.

Nonetheless, there is no doubt that the net migration flows are an excellent independent variable to estimate specific migration flows, since it does not need any information on migration: knowing fertility and mortality regimes and the population at the time of census, one can estimate net migration flows. Another inconvenience with its application, however, lies in the fact that for every net migration rate of an i region, there are 2x(n(number of regions)-1) parameters to be estimated.

Representing matricially a system with 3 regions:

		Place of Residence t - 5			Population at the end of the time interval
		Region 1	Region 2	Region 3	
Place of Residence time t	Region 1	S_{11}	S_{21}	S_{31}	$K_{1,t}$
	Region 2	S_{12}	S_{22}	S_{32}	$K_{2,t}$
	Region 3	S_{13}	S_{23}	S_{33}	$K_{3,t}$
Population at the beggining of the time		$K_{1,t-5}$	$K_{2,t-5}$	$K_{3,t-5}$	$K_t = K_{t-5}$

Migration flows from i to j among all the regions are not known. What is known is the matrix marginals. The sum of each line makes up the population in the year t of the region j (census population) and, the sum of each column makes up the population of region i at the time t-5 (considering only the survivors at time t). The population in the year t is generally known and the population in t-5 is:

$$P_{t-5} = P_t(1 \pm NMR)$$

Where NMR = net migration rate.

What we want to know is the specific migration propensities i to j of all regions (6 rates, in this case). For the purpose of population projection and even for a retrospective analysis, we need to know the recent migration, i.e. generally the last 5 years.

Assuming that the first inconvenience, i.e., the fact that the sum of net migration may be different from zero, is bypassed by some later adjustment, there still remains the problem related to the excess of parameters to be estimated. To try to solve this problem, we use, in the matrix cells, migration propensities of a known region, or of a prior time period of the same region. In this paper, we use the age-specific migration propensities estimated by method 1. The matrix marginals are known through the population at census time and the net migration rate which gives us the population at the beginning of the time period. Through successive biproportional adjustments, we 'make' the sum of both the elements of the columns and the lines coincide with the values of the marginals that were pre-established.

Net migration in this paper was calculated in a direct manner, as we knew from the census data where the surviving population at census time lived 5 years ago. Thus, the results found for this method were slightly superior to those found by method 1, as we started off with values obtained in one method and adjusted it with other known information, the result was obviously better.

The researcher must watch out for the following fact: in applying the method in one region with incomplete data, the net migration rates are obtained in an indirect manner and are possibly laden with errors that may even worsen the results obtained through method 1.

The application of improved convergence methods is well worth an in-depth study, as the values seemed to converge very slowly and sometimes with some wide disparities against the actual value expected.

Method 1 Modified: separating level and age specific patterns

We can separate the indirect estimation of specific rates of migration according to the necessity of estimating or “discovering” two major components: firstly, *the level* of migration, wherein what matters is the intensity of migration (% of population migrating from i to j in the last 5 years, for example); and secondly, *the form* of the migration curve, or the distribution of the migration per age group.

The level of migration is a much more difficult component to be compared among countries or even to regions in the same country, since it is not related solely to the social-economic dynamics of a given region and/or personal and psychosocial behavior. It is also important to take notice of the geographical boundaries adopted. The smaller a given area is in a multiregional system, the greater the migration. With some exaggeration, if we consider the household as the smaller geographical unit observable, we could say that almost every individual has migrated at least once in his lifetime. On the other hand, if we consider only the North x South migration of a country, for example, or if we include international migration, the number of migrants turns out to be very low. Therefore, once the level of geographical disaggregation that will be adopted in a specific study is defined, any indirect information such as the place of birth of children aged 0-4 or the net migration rates, as seen in methods 1 and 2, could give us an indication of that level.

The second component, i.e., the distribution of migration per age group, presents more universal patterns of behavior. This is because it is more directly related to social-economic characteristics of a certain region and also to the motivations or psychosocial behavior of individuals in their life cycle. As such, once the level or volume that is very specific for each multiregional system is eliminated, the standardized rates of specific migration per age group can be compared to those in other countries or among different regions of the same country.

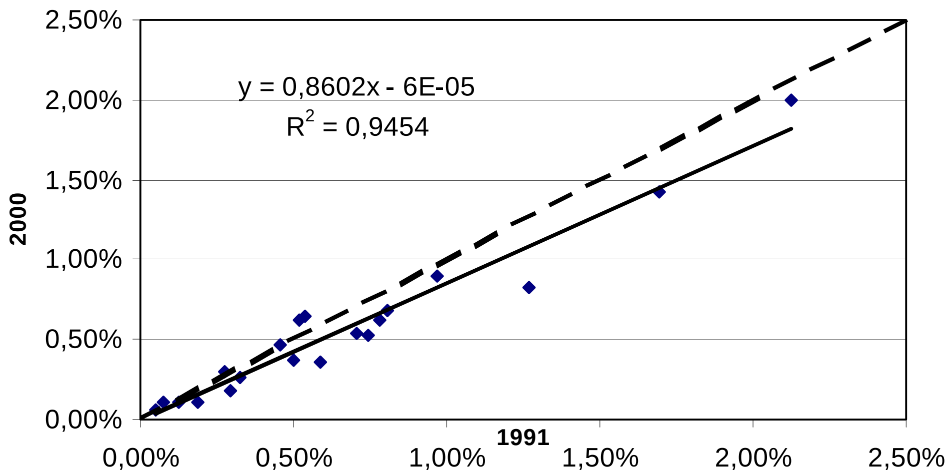
In this modified method, in order to search the migration pattern for Brazil, the components of migration level and standardized age specific migration propensities were evaluated separately.

The following analysis was carried out:

-The levels of migration of 1991 and 2000 were tested in order to find out whether there was a significant change in this component. The variable used to represent this level was the proportion of migrants of all ages that lived in the region i five years ago and lived in j at census time per total population of region i at the beginning of the period (Sij(all ages)). If we plot these variables for 1991 and 2000 in the x and y coordinated axés, we can see that: if the values obtained are 100% adjusted to a straight line passing through the point of origin at a 45º angle, it means that the level of migration was the same for at any of the ij flows. If the plotted points are below that curve, it means that there was a decrease in the proportion of migrants, and vice-versa.

Figure 3 shows the application of this analysis for Brazil: the points adjusted to a straight

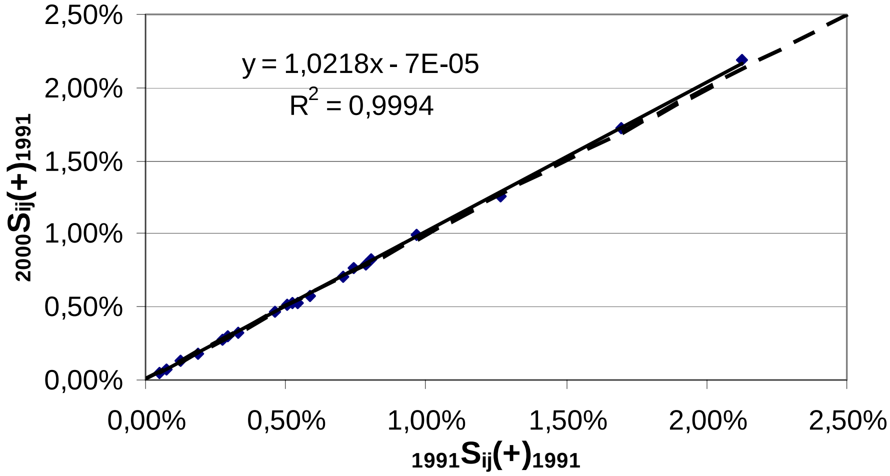
FIGURE 3
S_{ij} all ages - 1991 x 2000



line of regression, with r^2 = 0,9454. The intercept is practically null and the slope is equal to 0,86, which tells us that, on average, at this level of regional disaggregation, migration proportion fell by 14% from the 1991 to the 2000 censuses.

The very same age specific migration curve standardized applied to populations with different age structures can present distinct migratory levels. As in this paper we have adopted the 1991's age specific migration propensities to represent 2000's migration, it is important to learn about the influence of the change of age structure on the estimation of migration level. To check this influence, we applied 1991's migration propensities to the population of 1991 and 2000. We later calculated the proportion proposed above Sij(all ages) for the 20 flows and plotted it in an *x* and *y* graph (Figure 4). We observed a regression straight line with almost 100% correlation with an almost null intercept and a slope equal to 1,02, i.e., the age structure of 2000 applied to the 1991 same age specific migration pattern generates 2% more percentage of migrants. We consider this value of little importance for our purposes. That is why we did not make such an adjustment. We do stress, however, the need for an adjustment to the parameters that will define the migration level before applying them to a standardized age-specific curve.

FIGURE 4
Testing influence of 2000 age distribution on 1991 age-specific migration pattern



The following steps were taken for the indirect definition of migration flows between the Brazilian regions:

Estimation of the level

The standardized age specific curve, that is, whose sum of the $\mathbf{S_{ij}}(x)$ is equal to 100% or 1, is obtained by:

$$S^{st}_{ij}(x) = S_{ij}(x).100 \Big/ \sum_x S_{ij}(x)$$

Thus, the level parameter α_{ij} is defined as:

$$\alpha_{ij} = 100 \Big/ \sum_x S_{ij}(x)$$

The $\alpha_{ij,t}$ represents the level of migration from i to j, at the time t (Census time). Assuming that $\alpha_{ij,1991}$ are known we must associate another indicator for migration level that is known both in 1991 and 2000.

As seen in Method 1 proposed by Rogers and Jordan, the birthplace–specific residence-specific distribution of the first age group is an indicator of a spatial pattern and of migration level $S_{ij}(-5)$. This information, as seen in method 1, is available in almost all censuses and may be the link to find $\alpha_{ij,2000}$.

Thus, the level of migration for 2000 can be found by (Table 2 and Figure 5) :

$$\alpha_{ij,2000} = \alpha_{ij,1991} . \left(S_{ij,2000.}(-5) / S_{ij,1991}(-5) \right)$$

FIGURE 5

2000 ALPHA ESTIMATED X ACTUAL

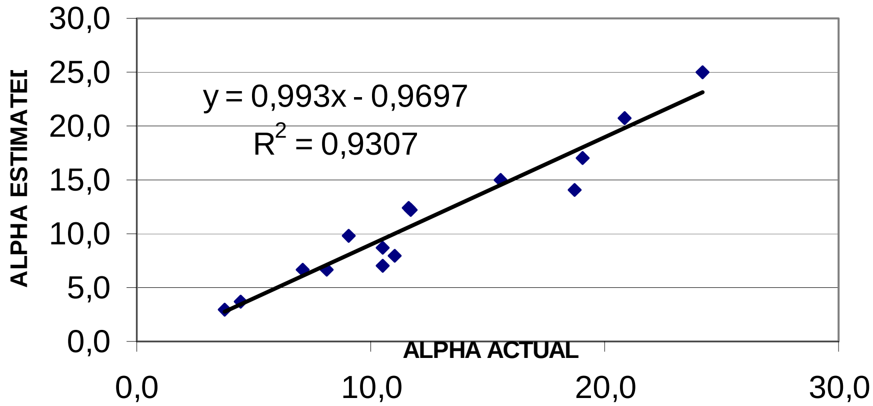


TABLE 2

2000 ACTUAL AND ESTIMATED ALPHA

Origin	Destination	1991		2000		
		Sij(-5)	ALPHA	Sij(-5)	actual ALPHA	estimated ALPHA
NORTH	NORTHEAST	0,60%	7,6	0,47%	9,1	9,8
NORTH	SOUTHEAST	0,43%	8,4	0,29%	11,6	12,5
NORTH	CENTER-WEST	0,60%	6,4	0,58%	7,1	6,7
NORTHEAST	NORTH	0,33%	13,6	0,32%	18,7	14,1
NORTHEAST	SOUTHEAST	1,18%	3,4	1,39%	3,8	2,9
NORTHEAST	CENTER-WEST	0,31%	15,7	0,33%	15,5	15,0
SOUTHEAST	NORTHEAST	0,59%	12,7	0,86%	10,5	8,7
SOUTHEAST	SOUTH	0,23%	22,9	0,26%	20,9	20,8
SOUTHEAST	CENTER-WEST	0,29%	20,0	0,23%	24,2	25,0
SOUTH	SOUTHEAST	0,94%	5,4	0,75%	8,1	6,7
SOUTH	CENTER-WEST	0,47%	12,0	0,33%	19,0	17,1
CENTER-WEST	NORTH	0,62%	8,7	0,67%	11,1	8,0
CENTER-WEST	NORTHEAST	0,47%	11,6	0,77%	10,5	7,1
CENTER-WEST	SOUTHEAST	1,19%	3,6	1,14%	4,4	3,8
CENTER-WEST	SOUTH	0,50%	9,3	0,38%	11,7	12,3

Estimation of age specific migration propensities

The estimation of the age specific pattern component is obtained through the application of standardized age-specific migration schedules that the researcher regards as representative of that region. In this paper, for the sake of simplicity, we adopted the Brazilian migration propensities for 1991 as representative of the migration in 2000.

As the strategy is the application of the 1991's migration pattern per age to the 2000's population, we need to know if the patterns are similar. Figures 6 to 25 present migration curves per age of each of the 20 flows among the Brazilian regions in 1991 and 2000.

It can be observed that in general the patterns are similar. The patterns that change the most are those with little interaction (between the South and the North/Northeast). That is associated with the small number of observations, as the census' complete form is a sample that ranges from 10% to 15% of the population, due to the population size of the cities. Fortunately the greatest errors are in the smallest flows and are therefore of little influence on the demographic dynamics.

The remaining flows are relatively similar, with little variation. Most keep migration peaks at the same ages. What can be considered to be the greatest change to have taken place in this interim is the shift from the migration peak to one or two older five-year-age groups, i.e. a slight aging can be observed at those ages which are more prone to migrating.

Despite some differences pointed out above, we adopted 1991's migration curves per age group as representative of 2000's migration pattern

Analysis of the results.

To evaluate the capacity of prediction of the three methods proposed, we adopt the following strategy: we back-casted the surviving population in 2000 to 1995 through the return of the migrants who were in j at census time to their regions of origin i, in 1995. To that population of 1995 we apply the age-specific multiregional survival ratios obtained through the three different methods in order to estimate 2000's population.

The results obtained are in Table 3. On the whole, the deviations are small. It affects a maximum 5,9% in the age group 20-24 of the region Center-West, estimated by the method l.

The smallest deviations are those of the method 2. That is obvious in theory, for if we have two pieces of information, we can better estimate a pattern than if we have only one. In the present paper we directly estimate net migration rates, as we had all the elements to do so. In fact, the deviations must be equal to zero. That did not occur because of convergence problems during the application of the method.

We point out that in practice the researcher must be careful in applying this method on account of the precariousness with which the net migration rates may have been obtained. That means that correcting method 1 by using these rates does not necessarily mean improving the estimations.

Brazilian age-specific migration patterns

The previous methods seemed promising in their capacity to predict the level and the direction of migration flows based on simple information virtually available in all countries. We used the infant migration obtained through the information on place of birth and the net migration rate of each region, obtained most times without the knowledge of any information on migration.

Concerning the estimation of an age specific pattern, there is no escaping the necessity to adopt a schedule that is known, whether it be by ‘borrowing’ a past pattern of the same region, or by ‘borrowing’ a pattern of another region that bears similarities (social, economic, cultural and so on) with the region of which the age migration pattern is being estimated.

In that sense, it can be suggested that standardized age-specific migration patterns be built so as to promote an international comparative study, i.e. the sum of the age specific migration propensities add to 1 or 100%. As such, the level and the direction that are very peculiar to a determined region and highly influenced by the regional disaggregation adopted are eliminated (though they may be retrieved, with relative ease, through the methods previously seen). The only concern that one must have is to keep the same number and interval of age groups to allow comparability.

These age-specific migration patterns must be related to the social and economic characteristics of the region, which must be comparable to the existing characteristics in other regions or countries where data are incomplete or inexistent.

In order to contribute to this discussion and enable a future comparison with age specific migration patterns in several countries, we divided the age specific standardized migration schedules of the 20 flows among Brazil’s five great regions, in 2000, into five groups. This division was based on a classification of the regions’ population attraction and expulsion power due to their economic and social characteristics. We can quite superficially characterize Brazil’s 5 regions as such:

- The Southeast is the most developed region concentrating almost 70% of the country’s GDP, with a large industrial park and with more upscale services rendered. Both Rio de Janeiro and São Paulo are located in this region. Despite the existence of a nationwide crisis over the last two decades, which has decreased its force of attraction to some extent, the region still exerts considerable attraction.
- The Center-West and the North historically with low population density have proportionally received a great populational contingent. In the Center-West, there is a high concentration of important mechanized harvesting associated with a growing agribusiness industry. In the North region, mostly occupied by the rain forest, there is an expansion of the agricultural boundaries; the setup of important steel and mining industries and hydroelectric power plants, incentivized by the government and the existence of a duty free zone in Manaus with an industrial park of electrical appliances, which was set up there as a result of such benefits.
- The Northeast is the poorest region of the country with the lowest levels of human development. It is constantly struck by long dry spells, which expels its poorest population. Despite the setup of a growing tourism industry and Federal as well as local incentives for the implementation of industries, this region still remains one with great power of expulsion.

- Though the South presents a relatively good level of development, it has a small negative net migration flow. Its population mostly goes to the Center-West and Southeast and there is hardly any interaction with the North and the Northeast.

On account of these characteristics, we created the following age specific migration schedules for Brazil (Figure 26 and Table 4):

- **(Great flow) expulsing region>attracting region**: it is the curve that characterizes the migration from the Northeast (pushing region) to the Southeast and Center-West (attracting regions). It is a great flow between the ages of 15 to 30, peaking at 20-24 year age group (17%). No doubt the main reason must be the search for employment in the more developed regions.
- **(Usual flow) expulsing region>attracting region**: it has the same characteristics of the previous flow but there is not as strong a concentration of migration at the ages between 15 and 30. The age groups of 20-24 and 24-29 each make up 115 of the migration percentage. In this category can be fitted the flow from the Northeast to the Center-West and the flows from the South to the Center-West and Southeast.
- **Attracting region>attracting region**: it is the flow between the Southeast, Center-West and the North regions which attracts populations. It has a pattern that is very close to the Brazilian average, which may mean that the reason for migrating includes a mix of all possibilities with no predominance of one over the others.
- **Attracting region> expulsing region**: the Northeast and the South both have negative net migration rate, but the opposite flow, i.e. of the regions that attract population to the ones expulsing population also exists. Its main characteristic is that migration peaks after the age of 30. Several studies have shown that this migration is associated mostly with the return of migrants to their place of origin. The following flows were classified under this category: North > Northeast; Southeast > Northeast; Southeast > South; Center-West > Northeast and Center-West > South.;

- **No interaction**: as the South interacts very little with the North and the Northeast, we did not create a pattern for those flows, for the curves have a high sampling variability because they present very small flows. In addition, there is no sense in finding the migration pattern of a place with little or no migration at all. (flows: North > South; Northeast > South; South > Northeast; South > North).

Conclusion

The methods used presented a good predictive capacity when applied to the Brazilian data. Infant migration and net migration rate are information that can be obtained with greater ease than percentages of migrants from i to j in a 5-year period, for example. This fully justifies the adoption of the method for regions or countries with incomplete or inexistent data

The separation of the component *level* from the component *distribution* per age enables us to create standard schedules of migration per age, which can be directly used in comparisons among regions or countries. Once the level has been estimated, one can ‘lend’ the known age structure of a region to another with similar characteristics, where the age structure is unknown.

The association of the social economic characteristics of the region to the shape of age-specific migration curves is a promising strategy for the task of choosing the best schedule for a specific region.

Future studies can head in three directions:

- Comparative studies of the 4 types of age-specific migration propensities found for Brazil in relation to propensities found for other countries;

- Comparative studies within Brazil itself, checking whether the migration flows on other levels of geographical aggregation present similar patterns (for instance, the interior x metropolitan area; interstate migration, intrastate migration and so on);

- Application of mathematical models that eliminate random outliers of the age-specific distribution and better systematize the schedule models found.

FIGURE 26

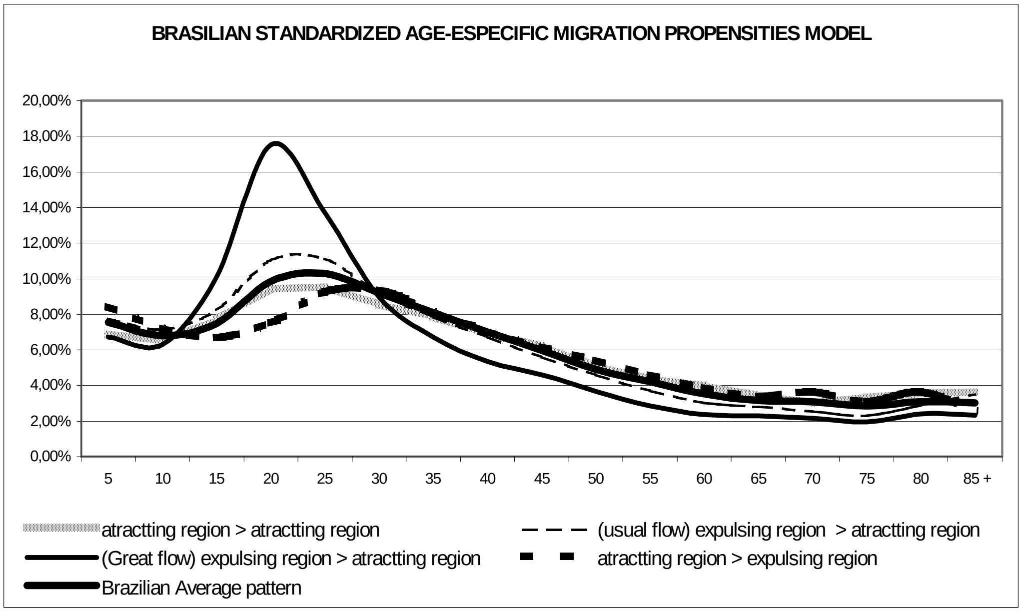


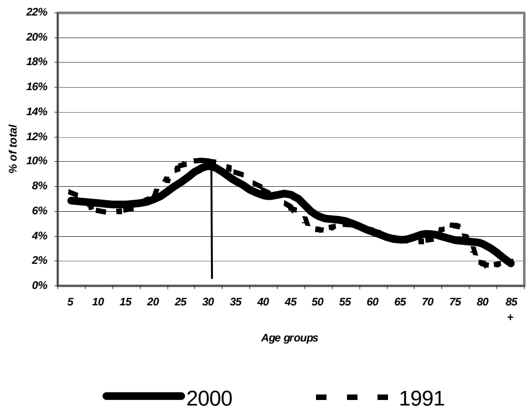
TABLE 4

AGE GROUP (*)	Attracting region> attracting region	(Usual flow) expulsing region>attracting region	(Great flow) expulsing region > attracting region	Attracting region > expulsing region	No interaction	Brazilian Average pattern
5	6,89%	7,75%	6,74%	8,43%	7,39%	7,56%
10	6,53%	7,15%	6,31%	7,20%	6,57%	6,81%
15	7,67%	8,22%	10,07%	6,69%	6,50%	7,46%
20	9,45%	11,06%	17,52%	7,50%	9,07%	9,84%
25	9,55%	11,13%	13,73%	9,27%	10,48%	10,31%
30	8,54%	9,20%	8,94%	9,36%	9,87%	9,19%
35	7,88%	7,86%	6,72%	8,15%	9,16%	8,10%
40	6,89%	6,71%	5,34%	7,03%	8,08%	6,99%
45	6,22%	5,60%	4,59%	6,17%	6,30%	5,97%
50	5,09%	4,59%	3,67%	5,41%	4,71%	4,89%
55	4,37%	3,72%	2,86%	4,58%	4,53%	4,22%
60	3,97%	3,01%	2,36%	3,87%	3,41%	3,52%
65	3,42%	2,81%	2,28%	3,40%	3,14%	3,15%
70	3,01%	2,52%	2,17%	3,64%	3,17%	3,07%
75	3,33%	2,30%	1,97%	3,09%	2,70%	2,84%
80	3,56%	2,87%	2,39%	3,64%	2,09%	3,07%
85 +	3,64%	3,50%	2,33%	2,58%	2,83%	3,01%

(*) Age group at the end of the time interval

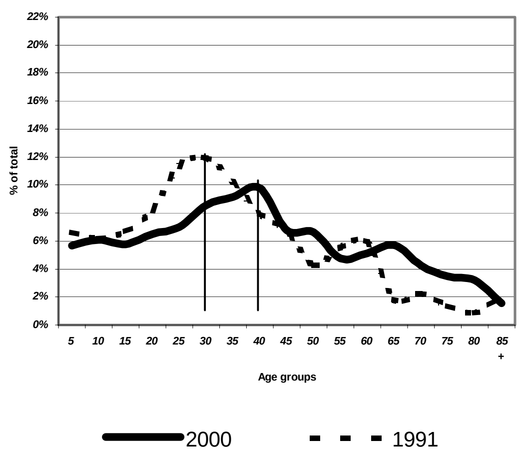
FIGURES 6 TO 25

Migration NORTH to NORTHEAST

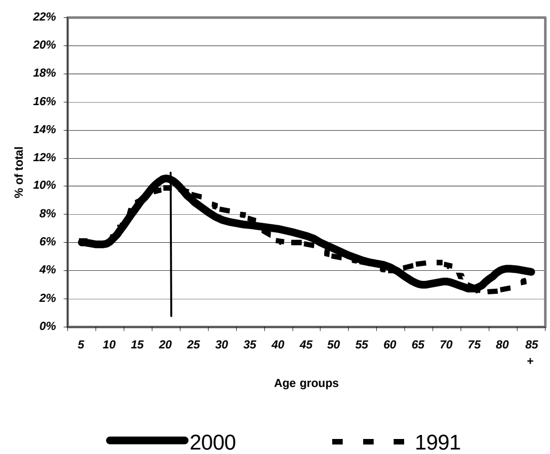


Migration NORTH to SOUTHEAST

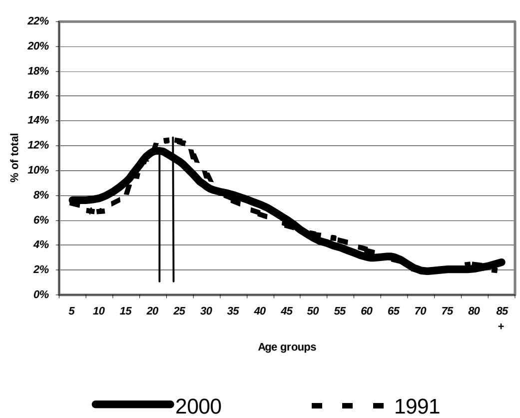
Migration NORTH to SOUTH



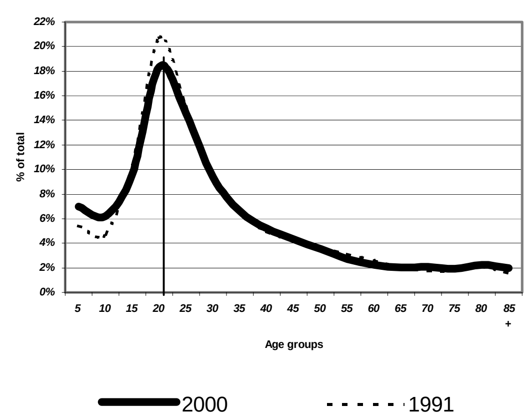
Migration NORTH to CENTER-WEST



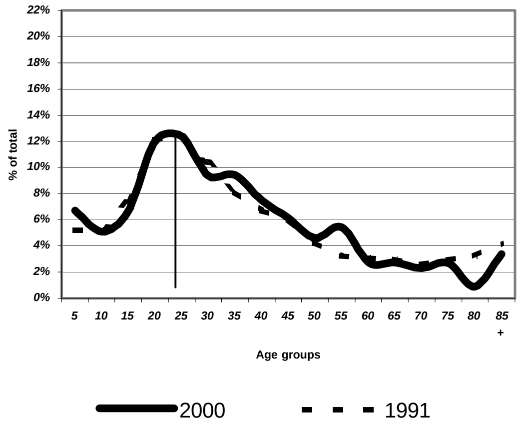
Migration NORTHEAST to NORTH



Migration NORTHEAST to SOUTHEAST

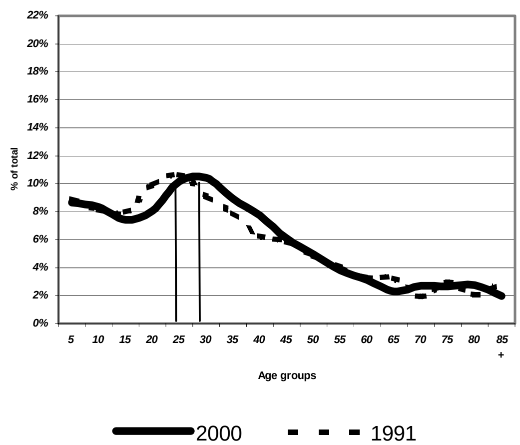


Migration NORTHEAST to SOUTH

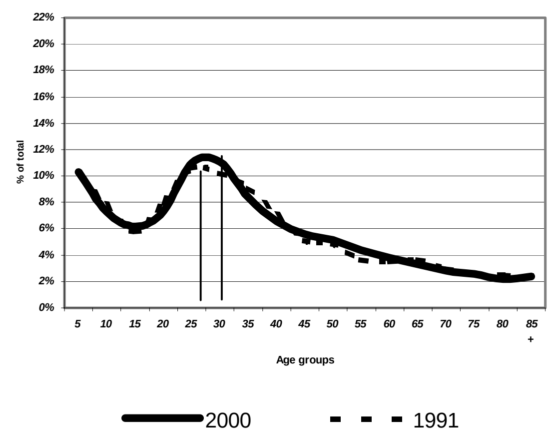


Migration NORTHEAST to CENTER-WEST

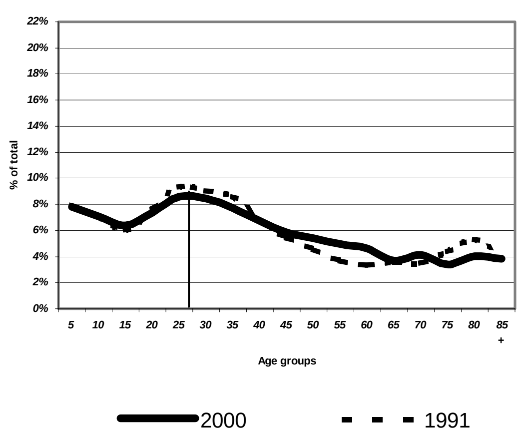
Migration SOUTHEAST to NORTH



Migration SOUTHEAST to NORTHEAST



Migration SOUTHEAST to SOUTH



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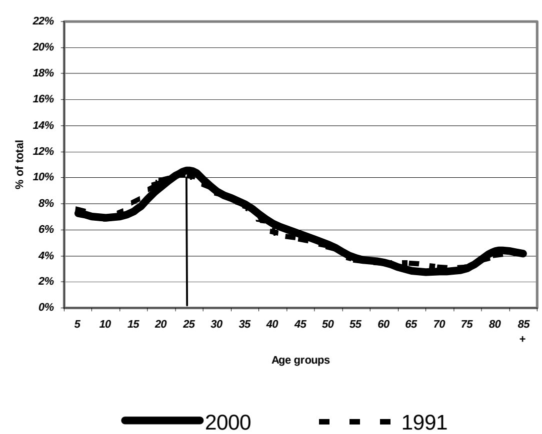
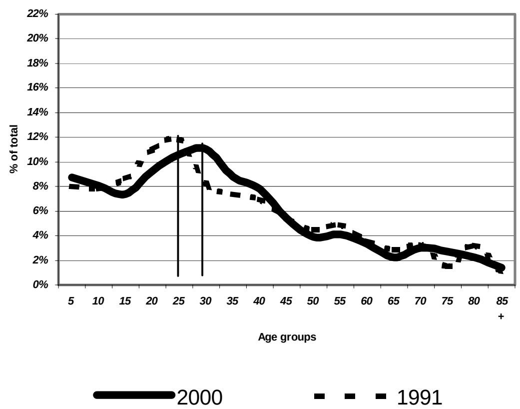
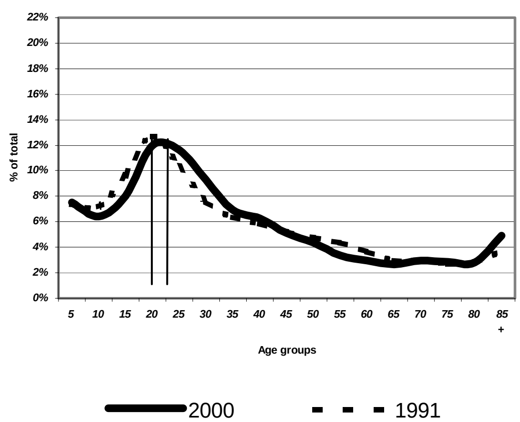


Migration SOUTH to NORTH

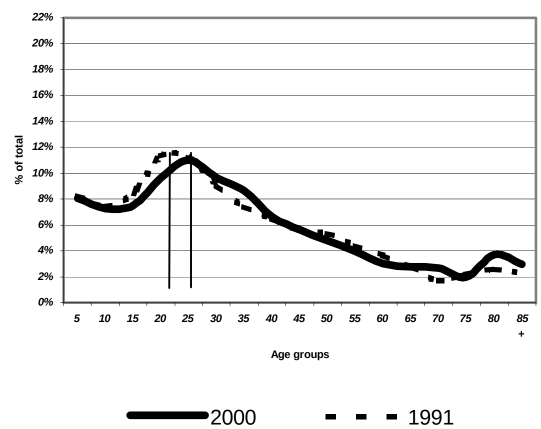


Migration SOUTH to NORTHEAST

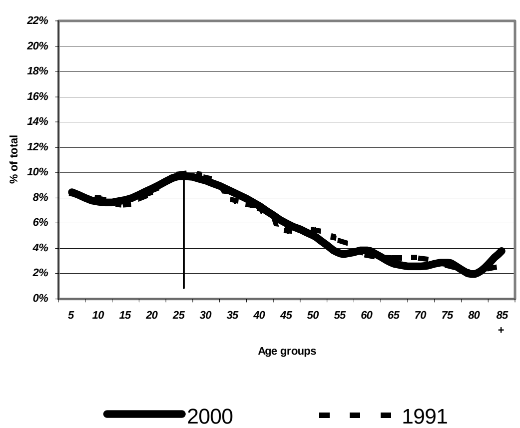
Migration SOUTH to SOUTHEAST



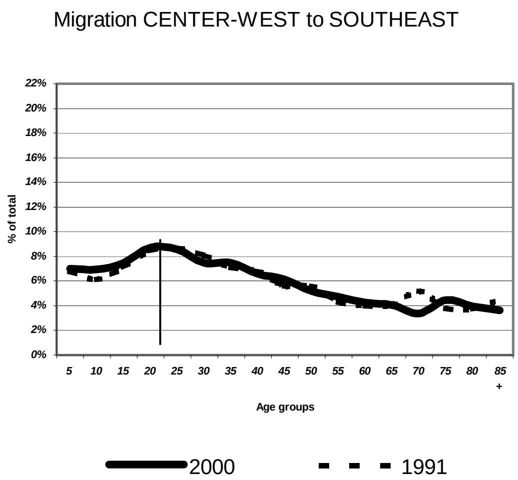
Migration SOUTH to CENTER-WEST



Migration CENTER-WEST to NORTH



Migration CENTER-WEST to NORTHEAST


Migration CENTER-WEST to SOUTHEAST
% of total
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85+
Age groups
2000
1991

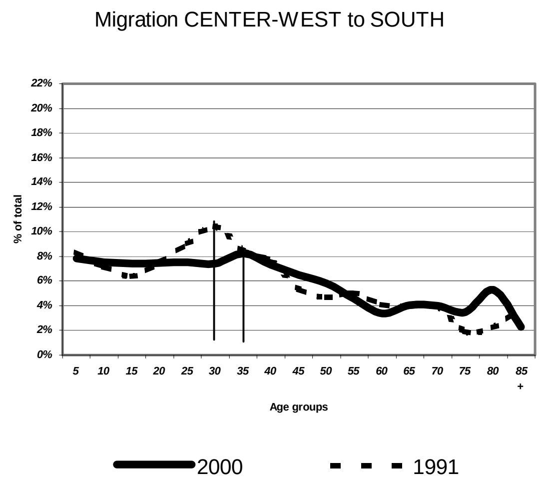

Migration CENTER-WEST to SOUTH
% of total
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85+
Age groups
2000
1991

TABLE 3

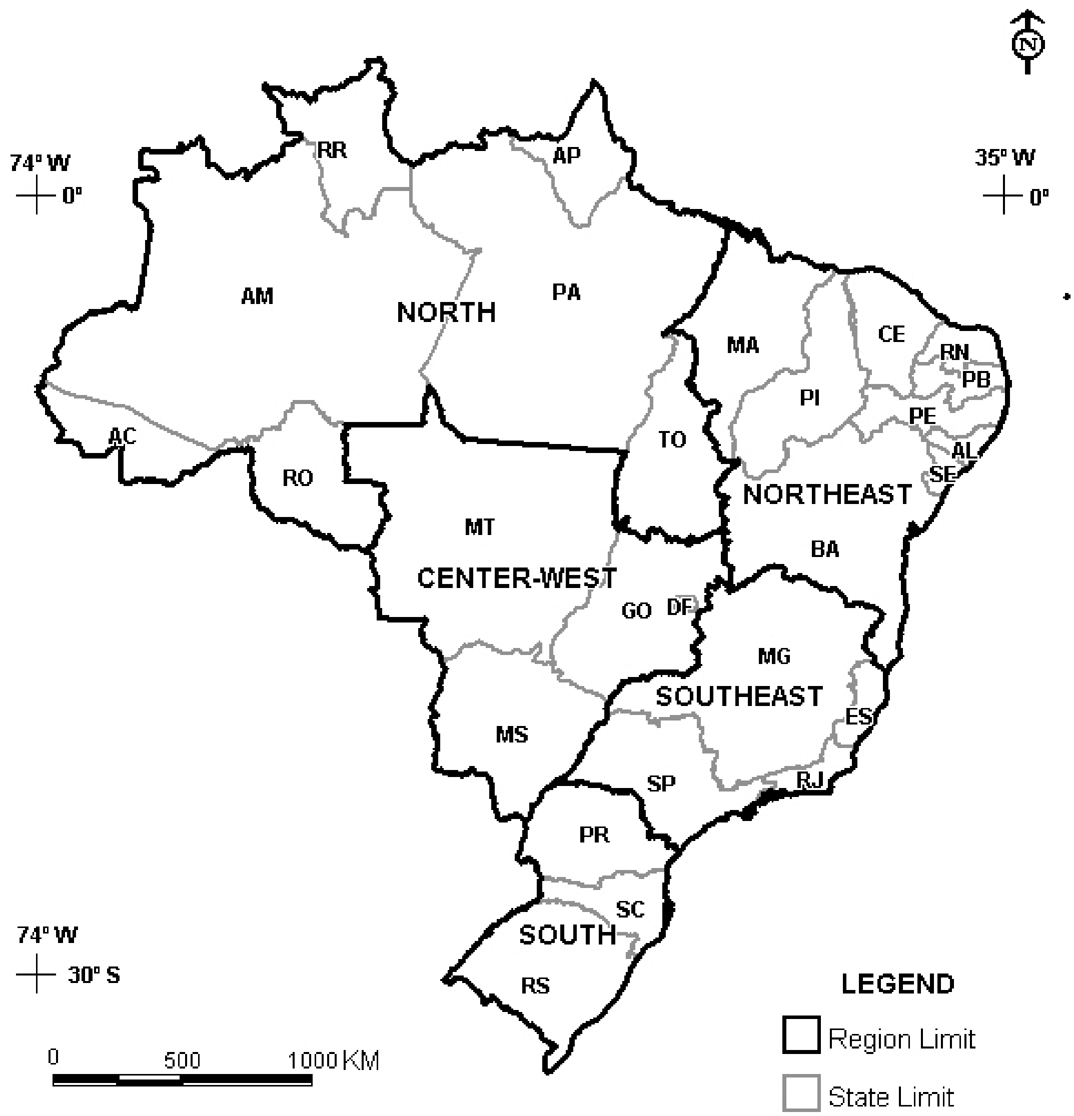
	Age Groups	ACTUAL 2000	METHOD 1		METHOD 2		METHOD 1 MODIFIED	
Place of Residence	(*)	POPULATION	POPULATION	Error (%)	POPULATION	Error (%)	POPULATION	Error (%)
CENTER-WEST	05 - 09	**1.158.543**	1.121.965	-3,2%	1.156.814	-0,1%	1.150.630	-0,7%
CENTER-WEST	10 - 14	**1.175.682**	1.141.900	-2,9%	1.173.252	-0,2%	1.169.176	-0,6%
CENTER-WEST	15 - 19	**1.233.510**	1.178.109	-4,5%	1.231.476	-0,2%	1.237.818	0,3%
CENTER-WEST	20 - 24	**1.179.587**	1.109.555	-5,9%	1.178.688	-0,1%	1.178.933	-0,1%
CENTER-WEST	25 - 29	**1.045.817**	996.564	-4,7%	1.045.157	-0,1%	1.037.433	-0,8%
CENTER-WEST	30 - 34	**969.001**	930.816	-3,9%	968.113	-0,1%	958.569	-1,1%
CENTER-WEST	35 - 39	**872.879**	842.919	-3,4%	871.714	-0,1%	864.893	-0,9%
CENTER-WEST	40 - 44	**715.681**	694.231	-3,0%	714.150	-0,2%	708.380	-1,0%
CENTER-WEST	45 - 49	**570.285**	556.225	-2,5%	568.463	-0,3%	567.120	-0,6%
CENTER-WEST	50 - 54	**443.840**	433.354	-2,4%	442.014	-0,4%	441.706	-0,5%
CENTER-WEST	55 - 59	**335.595**	328.250	-2,2%	333.964	-0,5%	334.958	-0,2%
CENTER-WEST	60 - 64	**273.998**	269.388	-1,7%	272.473	-0,6%	273.446	-0,2%
CENTER-WEST	65 - 69	**193.981**	190.872	-1,6%	198.190	2,2%	193.842	-0,1%
CENTER-WEST	70 - 74	**137.243**	134.538	-2,0%	136.277	-0,7%	136.319	-0,7%
CENTER-WEST	75 - 79	**82.383**	81.241	-1,4%	81.727	-0,8%	82.324	-0,1%
CENTER-WEST	80 - 84	**46.208**	45.311	-1,9%	45.732	-1,0%	45.997	-0,5%
CENTER-WEST	85 +	**34.454**	33.453	-2,9%	34.137	-0,9%	33.825	-1,8%
Subtotal		**10.468.687**	**10.088.688**	**-3,6%**	**10.452.339**	**-0,2%**	**10.415.371**	**-0,5%**
NORTHEAST	05 - 09	**5.148.138**	5.177.240	0,6%	5.157.892	0,2%	5.158.646	0,2%
NORTHEAST	10 - 14	**5.552.584**	5.578.211	0,5%	5.564.127	0,2%	5.565.621	0,2%
NORTHEAST	15 - 19	**5.576.164**	5.472.988	-1,9%	5.586.002	0,2%	5.512.979	-1,1%
NORTHEAST	20 - 24	**4.625.899**	4.448.900	-3,8%	4.630.854	0,1%	4.519.008	-2,3%
NORTHEAST	25 - 29	**3.680.563**	3.647.810	-0,9%	3.683.930	0,1%	3.630.627	-1,4%
NORTHEAST	30 - 34	**3.351.299**	3.384.388	1,0%	3.355.116	0,1%	3.328.168	-0,7%
NORTHEAST	35 - 39	**3.019.188**	3.077.225	1,9%	3.023.364	0,1%	3.019.266	0,0%
NORTHEAST	40 - 44	**2.487.834**	2.537.364	2,0%	2.491.802	0,2%	2.489.022	0,0%
NORTHEAST	45 - 49	**2.060.884**	2.088.985	1,4%	2.064.096	0,2%	2.055.901	-0,2%
NORTHEAST	50 - 54	**1.756.664**	1.770.894	0,8%	1.759.703	0,2%	1.751.470	-0,3%
NORTHEAST	55 - 59	**1.413.263**	1.424.269	0,8%	1.415.817	0,2%	1.406.218	-0,5%
NORTHEAST	60 - 64	**1.234.499**	1.246.031	0,9%	1.236.644	0,2%	1.230.695	-0,3%
NORTHEAST	65 - 69	**923.517**	934.352	1,2%	904.938	-2,0%	923.974	0,0%
NORTHEAST	70 - 74	**749.294**	759.772	1,4%	750.759	0,2%	749.620	0,0%
NORTHEAST	75 - 79	**524.556**	528.362	0,7%	525.473	0,2%	524.626	0,0%
NORTHEAST	80 - 84	**328.320**	327.774	-0,2%	328.709	0,1%	327.871	-0,1%
NORTHEAST	85 +	**262.765**	265.058	0,9%	263.488	0,3%	263.255	0,2%
Subtotal		**42.695.431**	**42.669.622**	**-0,1%**	**42.742.714**	**0,1%**	**42.456.968**	**-0,6%**
NORTH	05 - 09	**1.606.769**	1.613.935	0,4%	1.597.349	-0,6%	1.618.970	0,8%
NORTH	10 - 14	**1.558.653**	1.565.344	0,4%	1.548.059	-0,7%	1.570.111	0,7%
NORTH	15 - 19	**1.522.837**	1.538.828	1,1%	1.513.549	-0,6%	1.536.835	0,9%
NORTH	20 - 24	**1.297.175**	1.320.271	1,8%	1.292.322	-0,4%	1.318.780	1,7%
NORTH	25 - 29	**1.056.939**	1.075.868	1,8%	1.053.700	-0,3%	1.074.163	1,6%
NORTH	30 - 34	**905.191**	919.979	1,6%	901.514	-0,4%	915.398	1,1%
NORTH	35 - 39	**780.857**	792.304	1,5%	776.649	-0,5%	785.261	0,6%
NORTH	40 - 44	**637.854**	645.527	1,2%	633.046	-0,8%	642.603	0,7%
NORTH	45 - 49	**503.339**	510.509	1,4%	498.901	-0,9%	508.682	1,1%
NORTH	50 - 54	**379.938**	384.557	1,2%	375.985	-1,0%	384.869	1,3%
NORTH	55 - 59	**297.109**	300.568	1,2%	293.919	-1,1%	300.735	1,2%
NORTH	60 - 64	**236.888**	239.614	1,2%	234.283	-1,1%	239.076	0,9%
NORTH	65 - 69	**179.211**	180.968	1,0%	187.143	4,4%	180.590	0,8%
NORTH	70 - 74	**126.791**	128.058	1,0%	125.216	-1,2%	127.306	0,4%
NORTH	75 - 79	**79.990**	80.631	0,8%	78.963	-1,3%	80.373	0,5%
NORTH	80 - 84	**45.652**	46.188	1,2%	45.090	-1,2%	46.187	1,2%
NORTH	85 +	**37.562**	37.713	0,4%	37.024	-1,4%	37.648	0,2%
Subtotal		**11.252.755**	**11.380.862**	**1,1%**	**11.192.714**	**-0,5%**	**11.367.585**	**1,0%**
SOUTHEAST	05 - 09	**6.327.300**	6.328.169	0,0%	6.338.956	0,2%	6.319.203	-0,1%
SOUTHEAST	10 - 14	**6.680.039**	6.683.552	0,1%	6.693.465	0,2%	6.672.614	-0,1%
SOUTHEAST	15 - 19	**7.149.912**	7.296.887	2,1%	7.161.920	0,2%	7.212.435	0,9%
SOUTHEAST	20 - 24	**6.814.992**	7.041.699	3,3%	6.821.803	0,1%	6.914.915	1,5%
SOUTHEAST	25 - 29	**6.040.182**	6.100.952	1,0%	6.045.608	0,1%	6.083.476	0,7%
SOUTHEAST	30 - 34	**5.774.500**	5.763.623	-0,2%	5.781.605	0,1%	5.794.298	0,3%
SOUTHEAST	35 - 39	**5.588.607**	5.552.490	-0,6%	5.597.763	0,2%	5.592.702	0,1%
SOUTHEAST	40 - 44	**4.974.419**	4.942.200	-0,6%	4.984.808	0,2%	4.979.319	0,1%
SOUTHEAST	45 - 49	**4.137.092**	4.118.918	-0,4%	4.147.077	0,2%	4.144.323	0,2%
SOUTHEAST	50 - 54	**3.298.651**	3.294.017	-0,1%	3.307.616	0,3%	3.306.692	0,2%
SOUTHEAST	55 - 59	**2.510.557**	2.506.489	-0,2%	2.517.786	0,3%	2.519.158	0,3%
SOUTHEAST	60 - 64	**2.118.421**	2.110.971	-0,4%	2.124.546	0,3%	2.123.903	0,3%
SOUTHEAST	65 - 69	**1.694.068**	1.686.091	-0,5%	1.694.704	0,0%	1.693.747	0,0%
SOUTHEAST	70 - 74	**1.319.757**	1.311.703	-0,6%	1.323.259	0,3%	1.320.650	0,1%
SOUTHEAST	75 - 79	**820.212**	817.407	-0,3%	822.404	0,3%	819.788	-0,1%
SOUTHEAST	80 - 84	**452.302**	453.566	0,3%	453.812	0,3%	452.289	0,0%
SOUTHEAST	85 +	**326.208**	324.631	-0,5%	326.843	0,2%	326.061	0,0%
Subtotal		**66.027.219**	**66.333.365**	**0,5%**	**66.143.975**	**0,2%**	**66.275.574**	**0,4%**
SOUTH	05 - 09	**2.313.279**	2.312.719	0,0%	2.303.017	-0,4%	2.306.580	-0,3%
SOUTH	10 - 14	**2.369.258**	2.367.209	-0,1%	2.357.314	-0,5%	2.358.694	-0,4%
SOUTH	15 - 19	**2.447.138**	2.442.750	-0,2%	2.436.613	-0,4%	2.429.493	-0,7%
SOUTH	20 - 24	**2.200.480**	2.197.709	-0,1%	2.194.466	-0,3%	2.186.497	-0,6%
SOUTH	25 - 29	**1.998.508**	2.000.815	0,1%	1.993.613	-0,2%	1.996.310	-0,1%
SOUTH	30 - 34	**2.004.008**	2.005.193	0,1%	1.997.651	-0,3%	2.007.566	0,2%
SOUTH	35 - 39	**1.977.549**	1.974.142	-0,2%	1.969.589	-0,4%	1.976.959	0,0%
SOUTH	40 - 44	**1.717.101**	1.713.568	-0,2%	1.709.084	-0,5%	1.713.565	-0,2%
SOUTH	45 - 49	**1.444.064**	1.441.026	-0,2%	1.437.129	-0,5%	1.439.639	-0,3%
SOUTH	50 - 54	**1.166.815**	1.163.087	-0,3%	1.160.590	-0,5%	1.161.171	-0,5%
SOUTH	55 - 59	**900.137**	897.086	-0,3%	895.174	-0,6%	895.591	-0,5%
SOUTH	60 - 64	**744.405**	742.208	-0,3%	740.265	-0,6%	741.091	-0,4%
SOUTH	65 - 69	**586.686**	585.180	-0,3%	592.487	1,0%	585.310	-0,2%
SOUTH	70 - 74	**440.143**	439.158	-0,2%	437.717	-0,6%	439.334	-0,2%
SOUTH	75 - 79	**277.427**	276.927	-0,2%	276.001	-0,5%	277.456	0,0%
SOUTH	80 - 84	**151.267**	150.910	-0,2%	150.406	-0,6%	151.405	0,1%
SOUTH	85 +	**101.964**	102.098	0,1%	101.461	-0,5%	102.164	0,2%
Subtotal		**22.840.229**	**22.811.784**	**-0,1%**	**22.752.579**	**-0,4%**	**22.768.824**	**-0,3%**
Total		**153.284.321**	**153.284.321**		**153.284.321**		**153.284.321**	

(*) age group at census time

Source: IBGE, 2000 Brazilian Demographic Census

MAP 1

BRAZIL - 5 GREAT REGIONS AND STATES



		Population (X 1.000)		
Region	Area (km^2)	1991	2000	Δ%
North	3,869,637	9,939	12,901	2.9
Northeast	1,561,177	42,443	47,741	1.3
Southeast	927,286	62,709	72,412	1.6
South	577,214	22,192	25,108	1.4
Center-west	1,612,077	9,385	11,636	2.4
Total	8,547,391	148,659	171,798	1.6

Source: Adapted from IBGE, 2004.
Cartographic Data Base/GIS: LAB. GIS I - PUC Minas/ TIE - ABREU, J. F.
Final Art/ MapInfo: LAB. GIS I - PUC Minas/ TIE - CARVALHO, I. F.

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