Intergenerational Accounting and Economic Consequences of Aging in Brazil

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This paper is based on my Master's thesis presented at CEDEPLAR-Brazil. I owe a special debt of gratitude to my former advisor Professor Eduardo Rios-Neto. Also, I am deeply grateful to Professor Samuel Preston for his support and Professor Susan Watkins for her comments and encouragement.

Introduction

Over the last decades, population aging and intergenerational transfers have received increasing attention from demographers. Around the world, fertility and mortality transitions have resulted in significant changes in population age structures modifying the proportion of workers, consumers, capital owners, tax payers, beneficiaries of public sector transfers, and individuals who make or receive inter and intra-household transfers. The inevitable adjusting process to the new demographic scenario may imply in costs or gains for different cohorts.

Population aging is a new phenomenon in Brazil. Although the mortality transition started in the 1930's (increasing from e_0^o = 41.2 in 1930/40 to e_0^o = 68.4 in 1995/2000; both sexes), the fertility decline occurred mainly during the 1970's and 1980's. The Brazilian demographic transition has been characterized by rapid changes despite its delayed onset. Over the last thirty years, the average number of children per woman has been reduced to less than half (from TFR =5.8 in 1960/70 to TFR=2.45 in 1995/2000). The consequences are without precedents in the country's history. New projections indicate that in the year 2050, the population aged 65 and over will represent roughly 15% of the total, compared to 3% in 1970.

Despite these dramatic changes, the debate on the economic consequences of aging has just started in Brazil. Data limitation, including the absence of household surveys and official data, has precluded a larger number of empirical studies. Among previous investigations, the work done by Carvalho and Wong (1995) is the first real attempt to bring the economic effects of aging into the discussion. The authors, however, do not trace the age profiles nor measure the consequences of fertility and mortality changes. Studies focusing exclusively on Social Security issues have been more frequent, but do not offer a broad view of the intergenerational accounting in Brazil (Fernandes, 1993; Malvar, 1999).

In 1998, the Brazilian Census Bureau (IBGE) released a new survey (PPV) based on the Living Standards Measurement Study (World Bank). Collected under a stable economic environment, PPV provides the required socioeconomic data to assess transfer systems and aging in Brazil. In this study I use PPV along with official data sources to evaluate the expected costs and gains in public sector transfers, caused by age composition changes up to 2050.

The plan of this article is as follows. In the first section, I present a brief overview of the data used, and its potential biases. In the second section I examine the Brazilian demographic transition, from 1970 to 2050. What have been the main changes? How will the stable and projected age distributions differ over the next 50 years? In the third section, I review the accounting framework developed by Lee and his colleagues (Lee, 1980, 1994a, 1995a; Lee and Miller, 1993; Lee and Boomier, 1995b; Lee and Tuljapurkar, 1996). In this study I focus specifically on his formal analysis of the transfer systems.

In the last two sections I present the main findings. First, I offer a general view of the government transfers in Brazil in 1995/2000. Assuming the underlying stable population I apply the accounting framework and estimate the interage allocations through the public sector. Following, I evaluate the implications of fertility and mortality changes for the governmental systems. Besides investigating the effects on the stable populations, I also examine the consequences of the differences in the actual age distributions over the next 50 years.

Finally, I discuss the assumptions and shortcomings of the study, and their implications for the results. Intergenerational household transfers are brought into the discussion. Are the gains in the household transfers systems large enough to buffer the governmental costs?

The Data

The collection of household survey data in Brazil is rare. As a result of high operational costs, detailed household-level information on income, expenditure, durables, transfers, and capital investments have been collected, on average, every ten years. Over the last decade, the Brazilian Census Bureau (IBGE) released results of two new surveys: POF in 1995/96 and PPV in 1996/97. This study uses the last one, mainly because it covers a larger geographic region in the country (NE and SE regions, that correspond to almost 70% of population and 75% of GNP).

PPV was developed according to the Living Standards Measurement Study (LSMS), sponsored by the World Bank. Its sample comprises 4,940 households or 19,409 individuals. To avoid seasonal effects the Brazilian Census Bureau gathered data over a entire year (from March 1996 to March 1997). The survey provides information on demographic and socioeconomic characteristics, household budget and wealth, as well as labor supply, mortality, fertility, and migration. Since PPV is a cross-sectional survey, I assume data reflect the behavior of a hypothetical cohort. This assumption would imply in accurate results, if, and only if, the economic profiles were steady along time. Changes in the technological rate, labor market, and savings behavior are some causes of potential divergences between estimations and the actual results.

In this study PPV data is adjusted to suit the framework application. Household variables are transformed to individual units, following two different procedures: equivalence scales estimated for Brazil as proposed by Deaton (1997) and the headship method as described by Lee and Miller (1993). Data is also homogenized to an annual basis and converted to US dollars as of 1996.

Biases are likely to happen in the LSMS surveys (Deaton, 1997). Sampling errors such as frame or selection errors have been reported in the literature. Stecklov (1996), for example, detected the underestimation of poor households and the overestimation of large households in the Cote D'Ivoire's survey. Deaton (1997) showed that estimated and actual age distributions in the Taiwanese household survey differ by about 60% in some ages.

The use of a biased sampling frame, that does not represent the actual cross-section of the target population, is not true for PPV. When compared to the 1996 Brazilian census, the proportionate age distribution in PPV does not show any significant deviation. The age distributions are almost coincident, and the most important differences (age groups 25-29, and 30-34) are lower than 14%.

In addition, tests do not indicate any significant bias in the household composition. Compared to the 1996 Brazilian census the PPV average household size is roughly the same: 3.88 members in PPV against 3.96 members in the census. Also the regional distribution of households is similar. In PPV, 36.61% of households are in the NE region against 36.14% in the census. Finally, the average educational background of the household head – a feasible proxy for socioeconomic differentials – is comparable in both data sources: 5.07 years of schooling in PPV against 5.14 in the census.

To estimate more precise economic age profiles I combine the PPV data with official data from the Brazilian government. The additional information is obtained from the official reports about taxes, and social insurance programs in Brazil such as social security, health care, and unemployment insurance. To make both data sources consistent, the official data refers exclusively to years 1995 and 1996, as well as to NE and SE regions in Brazil.

CEDEPLAR- Brazil supplies the demographic data, in addition to the mortality and fertility assumptions used to project the population and estimate the underlying stable age distributions. There is no information about fertility and mortality rates after 2015/2020. Therefore, I assume they are the same between 2015/2020 and 2045/2050 (the last period of my projections). The data is the result of a forthcoming study of economic and demographic interrelations in Brazil[1]. The study applies the cohort-component projection method, and the medium demographic scenario.

[1] Conducted by Cedeplar and funded by Pronex/CNPq/Capes/Finep

The Brazilian Demographic Transition

Demographic transition corresponds to one of the most important structural changes in Brazil. Following the classical demographic transition model, mortality decline preceded fertility transition in the country. From 1930 to 1960 large changes in mortality, resulted in high population growth rates, and quasi-stable age distributions. During this period, life expectancy at birth increased by 12.5 years changing from 41.2 to 53.7. Mortality decline resulted in two opposite effects: an older shape for the survival schedule, and higher growth rates. The latter effect was dominant, offsetting the slight decrease in the total fertility rate (TFR), and making the proportionate age distribution similar to the stable equivalent distribution. The high growth rates also implied in a very young age distribution, marked by a large proportion of persons aged 0-15 (almost 50%).

After the 1960's, despite the initial disbelief of part of the scientific community, consecutive declines in fertility reduced the TFR to less than half (from 5.80 to 2.45 children). The proportional decline in fertility during 20 years (1970-90) is comparable to the variation observed in developed countries over a much longer period, about 50 years (Carvalho and Wong, 1995). In the stable equivalent populations, fertility changes have resulted in significant lower intrinsic growth rates: from 2.70% in 1970 to 0.44% in 1995/2000. However, because of the previous regime of rates, the crude growth rate has not reduced in the same pace: from 2.8% in 1970 to 1.55% in 1995/2000. The disparity between the actual and the stable equivalent age distributions is evident in Figure 1. From 1990 to 2000 the proportion of people aged 0 to 35 in the actual populations was nearly 25% higher than in the stable equivalent populations.

During the same period, mortality decline was also considerable, and life expectancy at birth increased from 53.7 years in 1960-1970 to 68.4 years in 1995-2000. However, despite these changes, the relative effect of fertility decline was dominant, reducing the growth rates, and making the age distributions older.

According to the projection assumptions, the total fertility rate may decline from 2.45 children in 1995/2000 to a below replacement level - 2.0 children per woman - in 2020/2025. In addition, life expectancy at birth may increase from 68.39 years for both sexes in 1995/2000 to 74.34 years in 2015/2020. Estimations indicate that the proportional changes in the survival schedule will gradually favor older ages. As shown in Figure 2, in 2000/2005, 40% of the total increase in the life expectancy at birth will occur at ages above 65 compared to 56% between ages 15 and 65. However, in 2015/2020 the first proportion will increase to 56%, while the latter will reduce to 40%. Since mortality is already low at younger ages (0-15), changes in the person years lived in these ages will also be low.

Assuming that fertility and mortality transitions will last until 2020, differences between the proportionate age distributions – actual and stable - will slow the aging process in Brazil (Figure 1). After the constant set of vital rates is imposed in 2020/2025, the projected age distribution will finally converge to the stable scenario.

Figure 3 summarizes the consequences of the demographic transition to the projected age distributions. By 2020/2025 the proportion of persons in the economically productive ages (15-65) will increase to 68.3% as a result of the previous high fertility rates. In the following decades, this proportion will remain constant and eventually reduce to 65% in 2045/2050. At the same time as Brazilian population "forgets its past", the population above age 65 will gradually increase, representing 15% of total population in 2045/2050 against 3% in 1970. The relative increase of persons aged 65 and over, and the striking decline in the proportion of children aged 0-15 will make the elderlies stand for 43% of the dependent population, compared to 7% in 1970. Finally, the total dependency ratio (TDR)[2] - a good synthesis for all the age structure changes - will decline from 84.16% in 1970 to 46.53% in 2020/2025. Because of the continuous increase in the proportion of older cohorts, the TDR downward trend will be reverted, increasing to 53.57% in 2045/2050.

The Accounting Framework

In this study I employ the intergenerational accounting framework developed by Lee (1980, 1994a, 1995a) and his different co-authors (Lee and Miller, 1993; Lee and Boomier, 1995b; Lee and Tuljapurkar, 1996). In its more complex version only two assumptions are essential: population is stable and economy is steady state (Lee and Miller, 1993). In this study, however, I use a simplest version, assuming additionally that economy is closed and golden rule, and the rate of technical progress is null.

In Lee's model, all capital income is directed to new investments and the population consumption is limited to the weighted sum of individual labor income. Given the assumptions, in the perspective of the life cycle, a newborn's return to the society is exactly the same as any investment in real capital. The demographic growth rate is in its

[2] TDR = (Pop 0-15 + Pop 65 and over) / (Pop 15-65)

optimum level, equivalent to the market interest rate. New births do not represent additional economic costs or gains.

In order to smooth their consumption over life cycle, individuals count on three forms of resources reallocations across time or age: transfers, operations in the credit market, and investments in real capital. These mechanisms are typically processed in three different spheres: market, family and public sector (Lee and Miller, 1993). Since is not the purpose of this paper to present the whole life cycle accounting in Brazil, I will skip part of Lee's derivations, and focus on the transfer systems[3].

Transfer systems include all allocations based on social and familiar norms: bequests (treated as *inter vivos*), transfers through the government, and intra and inter-household allocations. Governmental transfers comprise public debt, and all age-related in-cash and in-kind transfers[4]. To maintain the intergenerational equity, Lee and Miller (1993) assume that the government does not issue new bonds, and the public debt increases at the same pace as population[5].

The framework is based on two constraints. First, there is a perfect balance between the cross-sectional outflow and inflow in the transfer systems. This is what Lee (1995a) defines as a conservative reallocation system and can be described by the following expression:

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[3] See Turra (2000) for a complete and detailed discussion of the application of Lee's accounting framework for Brazil.
[4] Non-age-related transfers might be included as well in the empirical estimations (Lee and Miller, 1993).
[5] Because of the lack of data, I am unable to determine the outflow and inflow age profiles for Brazilian governmental debt, and it will not be treated in this study. Implications of this decision are discussed later.

$$b\int_{0}^{w} e^{-nx} p(x)t(x)dx = 0 \qquad (1)$$

Where:
n =intrinsic growth rate ;
b=intrinsic birth rate ; p(x)=survival schedule;
$t(x) = t^{+}(x) + t^{-}(x)$;
$t^{+}(x)$ = resources inflow;
$t^{-}(x)$ = resources outflow

Moreover, since the model assumes a golden rule path, the net present value of transfers at birth is also zero, characterizing a competitive reallocation system (Lee 1995a):

$$\int_{0}^{w} e^{-ix} p(x)t(x)dx = 0 \qquad (2)$$

Where:

i = market interest rate
n=i

When combined, equations (1) and (2) describe the relation between the life cycle measure (net present value at birth) and the population measure (per capita value). The life cycle measure is equal to the population measure discounted at the intrinsic growth rate for a period of time equivalent to the life expectancy at birth. In the stable population model, this discounting factor is simply the inverse of the intrinsic birth rate, as we can see by making (1) equal to (2):

$$\frac{t_p}{b} = t_c \qquad (3)$$

Where:

t_p = per capita value (population); t_c = net present value at birth (cohort)

Changes in the age structure modify the proportion of individuals who make and receive transfers in the population. Given the model's constraints (equations 1 and 2), the age profiles must necessarily change to restore the equality of the cross-sectional outflow and inflow. The adjustment may imply in costs or gains depending on the age profiles of the transfer systems, and how mortality and fertility changes.

In a stable population, a fertility change affects exclusively the intrinsic growth rate. Therefore, the effect of a fertility change on the transfer systems is equal to the partial derivative of the population constraint (equation 1) with respect to the intrinsic growth rate, while keeping fixed the survival schedule. It is given by (Lee, 1994a):

$$\int_0^w e^{-nx} p(x)\left(\frac{\partial t^+(x)}{\partial n} - \frac{\partial t^-(x)}{\partial n}\right)dx = \frac{t^+(A_{t^+} - A_{t^-})}{b} \qquad (4)$$

n =intrinsic growth rate
b=intrinsic birth rate
p(x)=survival schedule
$t^+(x)$ = resources inflow
$t^-(x)$ = resources outflow
$A_{t+}(x)$ = average age of receiving transfer
$A_{t-}(x)$ = average age of making transfer

Equation (4) shows that consequences of a change in fertility depend on the average ages at receiving and making transfers. If, on average, the flow is from younger to older cohorts, any decrease in fertility rates results in an increase in the proportion of beneficiaries and, therefore, implies in costs. On the contrary, if there is a negative flow (At- > At+), fertility decline results in gains.

A change in mortality has two effects on the stable population. First, it generally changes the probability of surviving at childbearing ages and consequently the intrinsic growth rate. In addition, it modifies the shape of the survival schedule. When mortality varies, usually the proportional change in the person-years lived is not the same in every age.

The effects of mortality change on the transfer systems are equal to derivative of the population constraint with respect to the mortality level (Equation 5). The first term of the equation - the growth rate effect - is similar to the fertility effect discussed previously. The second effect is simply the sum of the differences between inflow and outflow in each age weighted by the changes in the survival schedule. The overall effect to the transfer systems is the difference of these two terms (Lee 1994a):

$$\int_0^w e^{-nx} p(x)\left(\frac{\partial t^+(x)}{\partial i} - \frac{\partial t^-(x)}{\partial i}\right)dx = \\ = \left(\frac{\partial n}{\partial i}\right)\frac{t^+(A_{t^+} - A_{t^-})}{b} - \int_0^w e^{-nx} p(x)\left(\frac{\partial p(x)}{\partial i}\right)t(x)dx \qquad (5)$$

n =intrinsic growth rate
b=intrinsic birth rate
p(x)=survival schedule
$t(x) = t^+(x) + t^-(x)$;
$A_{t+}(x)$ = average age of receiving transfer
$A_{t-}(x)$ = average age of making transfer
i = mortality level

Government Transfers in Brazil

Governmental revenues in Brazil comprise, among other sources, more than eighty federal, state and local taxes. In 1996, total governmental taxes summed US$ 218 billion, about 28% of the GNP. Of this total, federal government collected 68%, states collected 28%, and local administrations just 4% (Turra,2000).

Previous studies have frequently employed simplistic assumptions to trace the age profiles of government transfers. Several times, labor income has been used as the age incidence for all kinds of taxes (Lee and Cohen 1988; Stecklov, 1996). In this study, however, I use more complex procedures. To allocate taxes by age, I make assumptions about their incidence and define which one is used to fund each government service or transfer. The incidence of taxation helps define how labor income, consumption, and capital earnings are burdened by each tax. I assume labor income and payroll taxes are fully passed on to wages, capital income taxes are fully passed on to wealth and profits, and sales taxes burden exclusively consumption. To estimate the tax age profiles I combine PPV data with information about the Brazilian legislation[6]. After determining which group of taxes funds each public expense, I calculate the weighted sum of the tax age profiles to get the final transfer outflows[7].

Governmental expenditures with education, health care and social security amount 13% of the Brazilian GNP, and are comparable to the proportions spent in developed countries (Lee, 1995a). This amount rises to 18% of the GNP when other social insurance

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[6]To calculate taxes or benefits by age, I use the total population in each age group as the denominator. In this study I use 10-year age groups.
[7] See Turra (2000) for further explanations of how the curves are calculated.

programs are added, such as unemployment insurance and the social security of public employees. Among the government transfers, non-age-related items, such as police, transportation, research, and defense, constitute the larger proportion of the total governmental expenditures: about 51% (Turra, 2000). There is no consensus whether these items should be included in the accounting simulations (Lee and Miller, 1993). In this study they are taken into account. As will be made clear in the following section, this decision does not change the main conclusions.

The public health program in Brazil amounted 3% of the GNP in 1996. To estimate health care benefits by age, I separate them into three items: (i) costs with hospital, including doctors, and all other medical and care procedures (12% of total expenditures); (ii) costs with health centers (13% of total expenditures); (iii) other costs, including administrative expenses (75% of total expenditures). The Ministry of Health in Brazil provides information only for the first group. To calculate the second group I employ PPV data, which reports the health center utilization for each individual in the sample. I also assume that all utilization have the same average cost. The other costs are almost entirely composed by administrative expenses, which I assume to be proportional to the age profile described by the first two items.

The social security program in Brazil (private workers) amounted near US$50BN in 1996 (6% of the GNP), covering 16 million of beneficiaries. It includes a wide array of benefits: old age, length of service, disability, special retirement, illness, death, maternity, and dependents. Distinct rules apply for men and women, as well as rural and urban workers. To allocate the social security benefits by age I use official data

(MPAS/DATASUS[8] annual reports). The age profiles are a combination of the number of beneficiaries by age and benefit type, and the average benefit paid.

Public education represented almost 4% of the GNP in 1996. To estimate the age profiles I combine the number of beneficiaries by age and grade (PPV data) with the distribution of public expenditures by grade (official reports).

The other groups of public sector transfers are allocated by age according to different procedures. The unemployment insurance age profile is based on the official number of beneficiaries by age in 1996. Because of the lack of data, I use the social security of private workers as a proxy for the social security of public employees[9]. Finally, the other non-age-related expenditures are allocated by age according to age profile of consumption (PPV data)[10].

Figures 4 to 9 show the age profiles for each government system. By calculating the weighted sum of these profiles, I estimate the curves for the total government transfers (Figure 10). The results confirm Lee's inference about the role of the public sector in Brazil (Lee, 1995a). As stated by the author, contrary to other developing countries, Brazil has strong social insurance programs, which makes the reallocations of resources to the elderlies as important as in developed countries. According to my estimations, excluding the non-age-related transfers, the average elderly person in Brazil (above age 60) received

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[8] Social Security Administration in Brazil

[9] Social Security of public employees was a US$22BN program in 1996. It comprises civil public workers, military, members of the Judiciary, members of the Legislative, and state and municipal public workers.

[10] Other studies use the income age profile as proxy (Lee and Cohen, 1988). In this paper the consumption age profile is preferred because it comprises some services such as transportation that are also included in the non-age related expenditures.

from the government US$4,046 in 1996, almost ten times as much as the average child (below age 10).

Assuming the stable equivalent population in 1995/2000, how would the direction of government transfers be in Brazil? The arrow diagrams in Figures 11 and 12 summarize the average ages of making and receiving transfers. As expected, social security (private workers and public employees), and health care programs allocate resources from young to old (positive flow). Conversely, public education reallocates resources from old to young (negative flow), as well as the other non-age-related transfers (not graphed). On average, total government transfer is positive - the average age of receiving transfers is 7 years higher than the average age of making them - confirming that social insurance programs are the main mechanisms of interage allocations in the public sector (see Figure 12).

Since I use the stable equivalent population this is a hypothetical scenario. However, the differences between the actual and stable age distributions in 1995/2000 do not change the main conclusions. Even if a younger stable age distribution were used, more similar to the actual one, the direction of the flows would remain the same. A reduction in the total flow's duration - the difference between the average ages of receiving and making transfers – would be the only probable change.

This fact is explained by the age patterns of the transfer systems. The largest age-related group - social insurance programs – is characterized by high benefits at the oldest ages, making the average age of receiving total transfers typically old, independent of the age distribution.

Economic Consequences of Demographic Changes

What are the consequences of the demographic changes on government transfers? To answer this question I present two sets of simulations. First, I apply Lee's accounting framework to the stable population scenario discussed in the previous sections. The objective is to measure exclusively the demographic effects - mortality (growth rate and survival schedule) and fertility (growth rate). By comparing only stable equivalent populations, I am not taking into account the effects of the differences in the age compositions (previous regime of rates), typically observed in the actual scenario.

In Tables 1 and 2, I compare the stable equivalent populations in 1995/2000 and 2015/2020. The results refer to the accumulated effects over 30 years. Table 1 shows the accumulated changes in the per capita flows (US$), by transfer system, and type of demographic effect. Table 2 shows these effects as a % of the 1995/2000 per capita flows.

As a consequence of fertility decline, the intrinsic growth rate will reduce 0.68 percentage points (from 0.44% in 1995/2000 to -0.26% in 2015/2020). Since taxpayers are younger than beneficiaries in Brazil, the decrease of the growth rate will make the first group relative smaller than before. Therefore, the expected 0.45 child decrease in the TFR will imply in US$145 additional costs[11] per year, which is equivalent to US$8,452 over the life cycle (Table 1). This result represents an increase of 6% in the per capita flow in 1995/2000. The consequences are especially important for the social security programs. The fertility decline will increase 17% the costs of the private workers' program and 15%

[11] Lower benefits and higher taxes can both offset the fertility effect. In this paper I use the term costs, to represent a negative difference between the weighted sum of outflow and inflow. Also, I use the term gains to represent a positive difference between the weighted sum of outflow and inflow.

the public employees' program. These results demonstrate that fertility control does not imply in positive externalities, and Brazil is an exception if compared to other developing countries like India and Arabia (Stecklov, 1996).

The mortality change will result in contradicting effects. First, the decline in the mortality levels will increase the number of persons exposed to the risk of childbearing, and, then, increase the intrinsic growth rates. Higher growth rates imply in larger number of taxpayers in Brazil. On the other hand, the mortality decline also changes the survival schedule. As shown before, the person-years lived will increase more at older ages, resulting in relative larger number of beneficiaries.

According to Table 1, the increase in the growth rate will offset only part of the survival schedule change. The latter effect is 4.7 times larger than the first, resulting in additional costs for the government. The net cost amounts US$92/year or US$5,373 over the life cycle (an increase of 4% in the per capita flow in 1995/2000). These findings demonstrate that the character of mortality changes in Brazil will be similar to those observed in developed countries, where the survival schedule effect dominates.

For the entire period 1995/2000 - 2015/2020, consequences of mortality change are less important than consequences of fertility decline (about 65% of the fertility effect). However, as the TFR reduces to the replacement level, the consequences of mortality changes become more relevant. Figure 13 compares the effects (US$) of mortality and fertility transitions at each five-year interval. In 2010/2015 the costs due to the survival schedule change become the largest effect. The difference increases in 2015/2020 revealing that mortality will play a crucial role for the government budgets in the next decades.

Besides estimating the demographic effects in the stable equivalent populations, it is necessary to ask if the age composition (previous regime of rates) will be also important to government transfers in Brazil. To answer this question I estimate the gains and costs due to changes in the actual/projected age structures, and compare them to fertility and mortality effects (stable equivalent populations). The government transfers are divided in two groups, according to the direction of their flows in the population. Group 1 includes the transfer systems characterized by negative flows, and Group 2 comprises all the transfer systems that reallocate resources from young to old (social security programs and health care). My simulations refer to the period 1995/2000 – 2045/2050.

Figures 14 and 15 compare the actual/projected scenarios for Groups 1 and 2. For Group 1 (negative transfers), the curves show that changes in the actual age structures will result in gains all over the period. The relative increase of the working age population (taxpayers) together with the sharp decrease in the proportion of children aged 0-15 (from 32% in 1995/2000 to less than 20% in 2045/2050) explains the results. It is important to note, however, that the gains decrease over time as the proportion of children – beneficiaries of public education – stop changing. Finally, the accumulated gains indicate that the per capita outflow in 1995/2000 could reduce 12.8% in 2045/2050 without affecting the average benefit.

In opposite, changes in the actual age structures will result in costs in the positive transfers. The results are consistent with the demographic changes discussed previously in this paper. Despite the relative increase in the number of taxpayers (persons aged 15-65), the dependent population will change its composition dramatically. Elderlies will stand for 43% of the dependent population in 2045/2050 inevitably increasing the costs of the transfer systems that allocate resources to the older cohorts. Figure 14 shows that the highest cost will happen in 2030/2035 (7% increase in the 1995/2000 flow). Afterwards, as the rate of population aging reduces, the trend of the costs reverts. Estimations also indicate that the per capita flow of the positive transfers (health and social security programs) needs to increase 52.71% up to 2045/2050 compared to 1995/2000 (accumulated) to maintain the balance.

Figures 16 and 17 compare the actual/projected and the stable scenarios discussed above. Due to the previous regime of rates, the difference between the stable and actual age distributions will buffer 20% of the additional costs in the positive transfers over the next 25 years. According to Figure 16, in 2020/2025 the accumulated per capita cost will be equal to US$233 in the projected population against US$280 in the stable equivalent population. As the fertility and mortality rates are fixed, the age distributions – actual/projected and stable - become similar, and the accumulated costs rapidly increase in the actual scenario. In 2045/2050 the accumulated per capita cost in the actual/projected population will be twice as large as the stable distribution. The same age composition effect is responsible for higher gains in the negative transfers (Group 1) in the actual/projected scenario compared to stable equivalent distribution (almost 3 times larger in 2015/2020).

When all government transfer systems are summed (Figure 17), accumulated gains prevail up to 2005/2010. In addition, the total costs of fertility effect (growth rate) and mortality effects (growth rate and survival schedule) are delayed for about 15 years, characterizing what Carvalho and Wong (1995) called the golden age of Brazilian demographic transition. These results demonstrate that there is an important window of opportunity in the short run caused by the previous regime of rates (high fertility and mortality rates). Nevertheless, as population “forget their part”, total costs will keep increasing and finally require an accumulated 17% increase in the per capita flow.

Discussion

As argued in this paper the economic consequences of population aging in Brazil are irrefutable. Economic gains due to demographic changes will last for 10 years, suggesting that the golden age of the demographic transition is short. In addition, in the next 50 years, the Brazilian government will have to adjust the per capita flow of social insurance programs (positive transfers) by 50% - increasing taxes or reducing benefits - to avoid cash flow shortfalls.

Are these results reliable? There is no doubt that demographic rates play an important role in the government transfers, and the main findings in this study are consistent with the future scenarios. However, there are many shortcomings that may affect the precision of the results. First, I assume the profiles are fixed in the next 50 years. Actually, deficits in the government budget may be balanced, for example, if wages grow.

In the long run a rapid growth in the productivity of new generations could relieve the costs imposed by fertility and mortality declines. It is not clear, however, if labor productivity will solve the entire problem in Brazil, especially in the short run. According to Lee (2001), projections done in the US using high labor productivity growth showed that wage increases would not avoid adjustments in the government transfers. In addition, as stressed by the author, productivity increases are historically related to increases in health care costs, mitigating the benefits of higher wages.

Besides labor productivity and increases in health care prices, my estimations do not taken into account other important elements. One example is the recent changes in the social security policy in Brazil. In the public employees program, the adoption of the multi-pillar concept based on DC and DB plans will probably solve part of current and future shortfalls. In the private workers program, changes in the replacement rate formula will certainly buffer part of the future deficits.

In addition, the lack of data did not allow me to include the government debt in the intergenerational accounting, Assuming it presents a positive flow – young people buy debt bonds and sell them back to the government at older ages – population aging will probably impose market restrictions to the government.

Finally, I call the attention to the projection assumptions I use in this paper. The increasing importance of mortality decline as shown in the previous section, indicates that better forecasts are necessary in Brazil. Despite data limitation, methodological procedures based on stochastic projections should be used in order to get more precise long-term scenarios. Studies in the U.S. based on stochastic forecasts have shown that differences in mortality assumptions may be relevant to social insurance projections (Lee and Tuljapurkar, 1998).

Despite the methodological issues, the results of this paper have important implications. One question that it certainly brings into the debate is the relation between gains in household transfer systems due to population aging and government costs. To demonstrate the relevance of this issue I include Figure 18 in my results. The graph compares the actual/projected costs and gains in the household and government transfer systems. Since household transfers are negative in Brazil, population aging results in gains in the family, by reducing the relative number of children (fertility) and increasing the person-years lived by the parents (mortality) [12]. A simple analysis of these findings would lead to the conclusion that economic gains in the family could entirely offset the effects of population aging on government transfers. If per capita costs of raising children did not rose, families would have more resources to pay extra benefits for the elderly through the government transfers. However, one important aspect must be considered. Expenses with children have a different character than expenditures with elderly. The first comprises investments, while the latter only consumption costs. Therefore, the simple reallocation of resources between dependent groups may reduce the chances of higher economic growth rates in the future.

Actually, considering the discussion presented by Preston (1984) for the U.S., we may expect that at least part of the resources in Brazil will be directed to the elderlies, reducing the potential investment on children. The author shows that elderly have better conditions to compete for resources and maintain their economic status than children, especially in a scenario of population aging. This fact is probably also true for Brazil.

As shown in this paper, population dynamics is opening a window of opportunity in the next 10 or 20 years in Brazil. To neglect the enduring long-term effects of aging is to give up the immediate opportunities that this event brings to the Brazilian economy Massive investments in children now could make them more productive to support the additional costs in the following decades. It is time for society to discuss the most appropriate solutions and decide how the scarce resources should be allocated.

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[12] The age profiles are determined according to information provided by PPV, and include gifts, alimony, donations, bequests, and within-household transfers (child costs).

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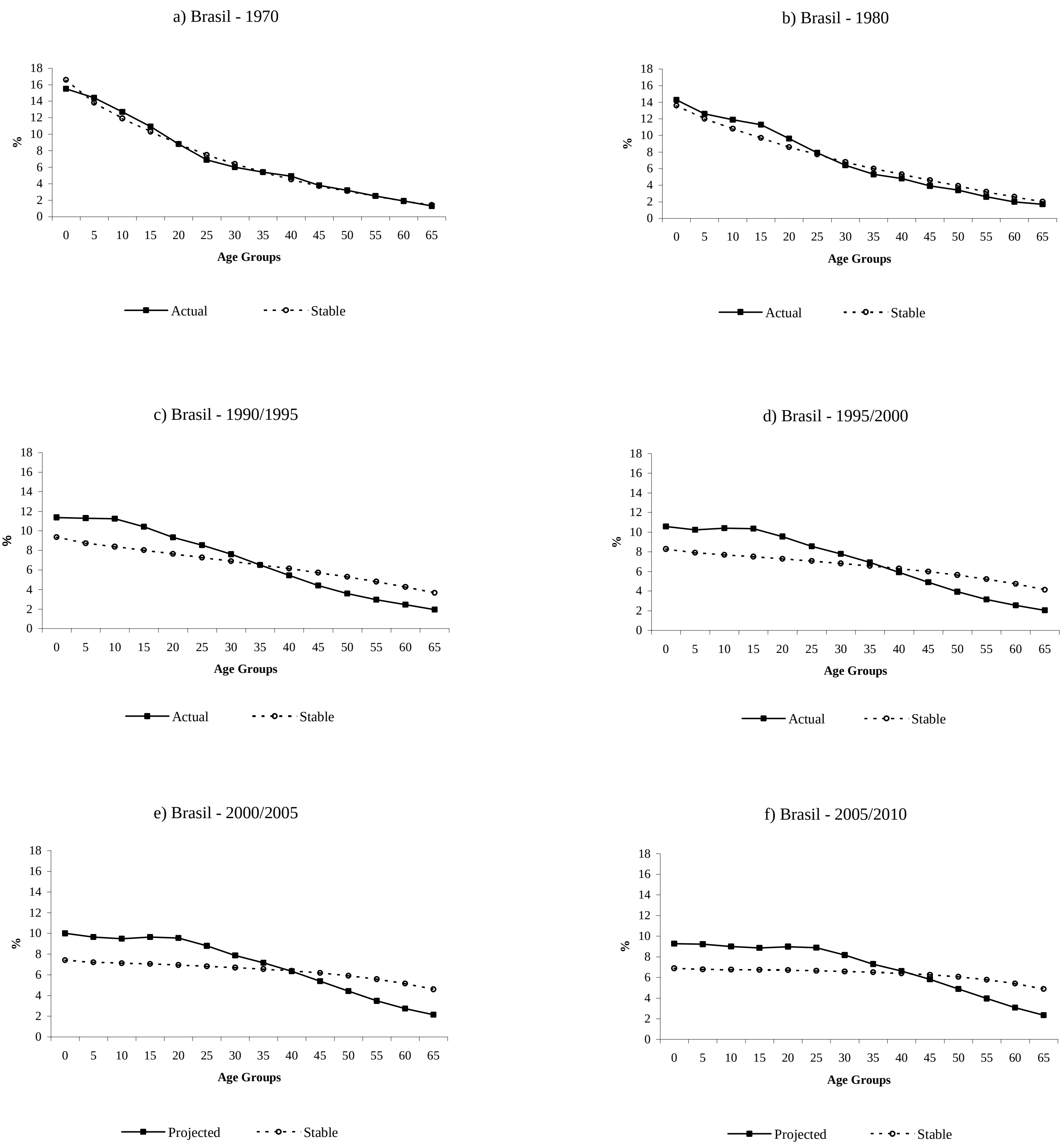
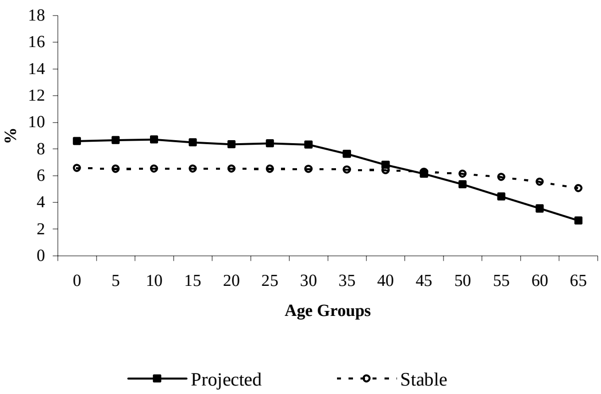
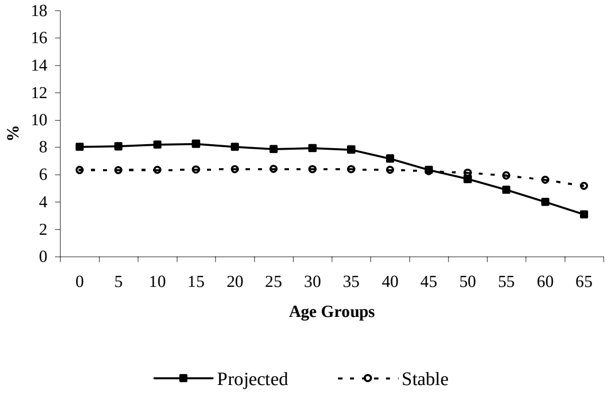
Figure 1 - Proportionate Age Distributions (%) - Both Sexes - Actual/Projected and Stable - Brazil



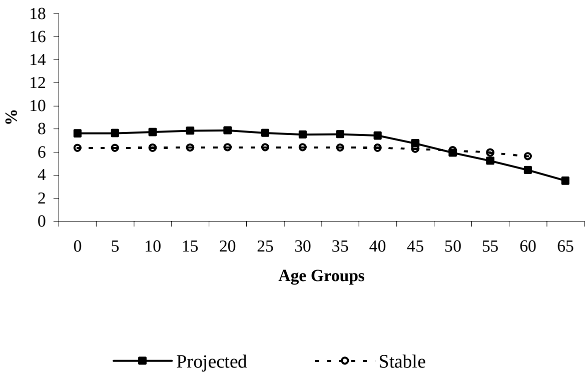
g) Brasil - 2010/2015



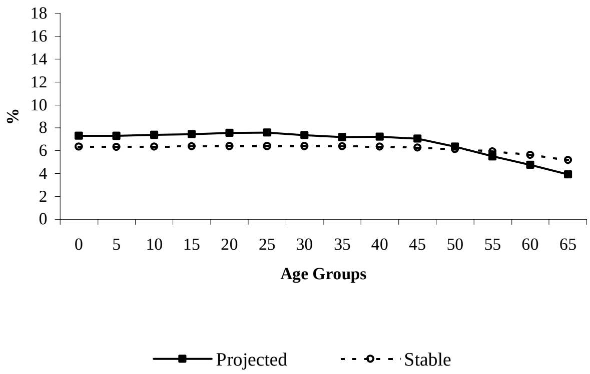
h) Brasil - 2015/2020



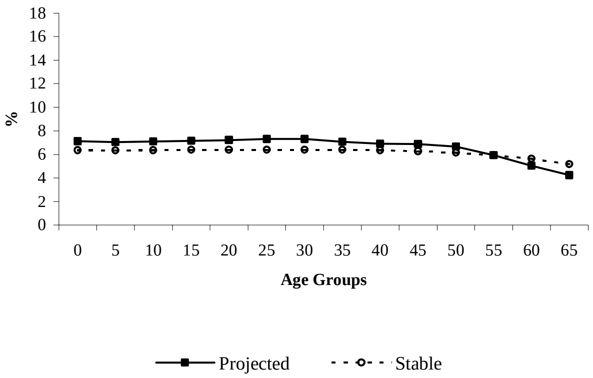
i) Brasil - 2020/2025



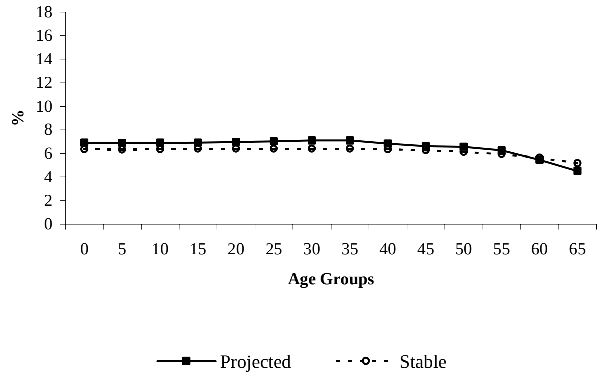
j) Brasil - 2025/2030



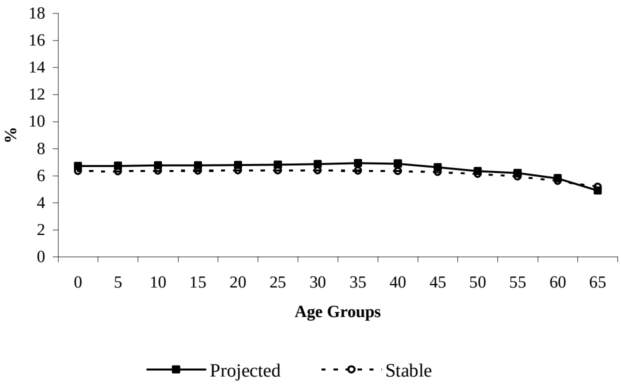
l) Brasil - 2030/2035



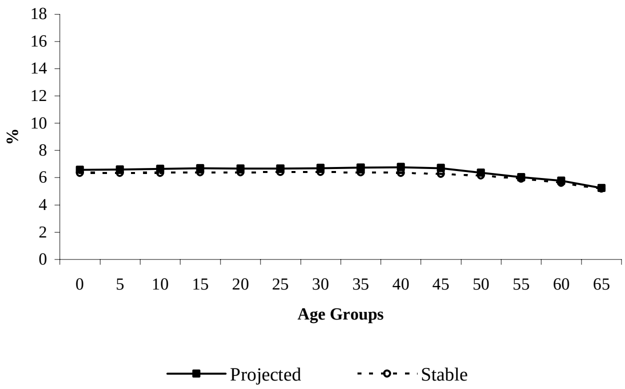
m) Brasil - 2035/2040



n) Brasil - 2040/2045

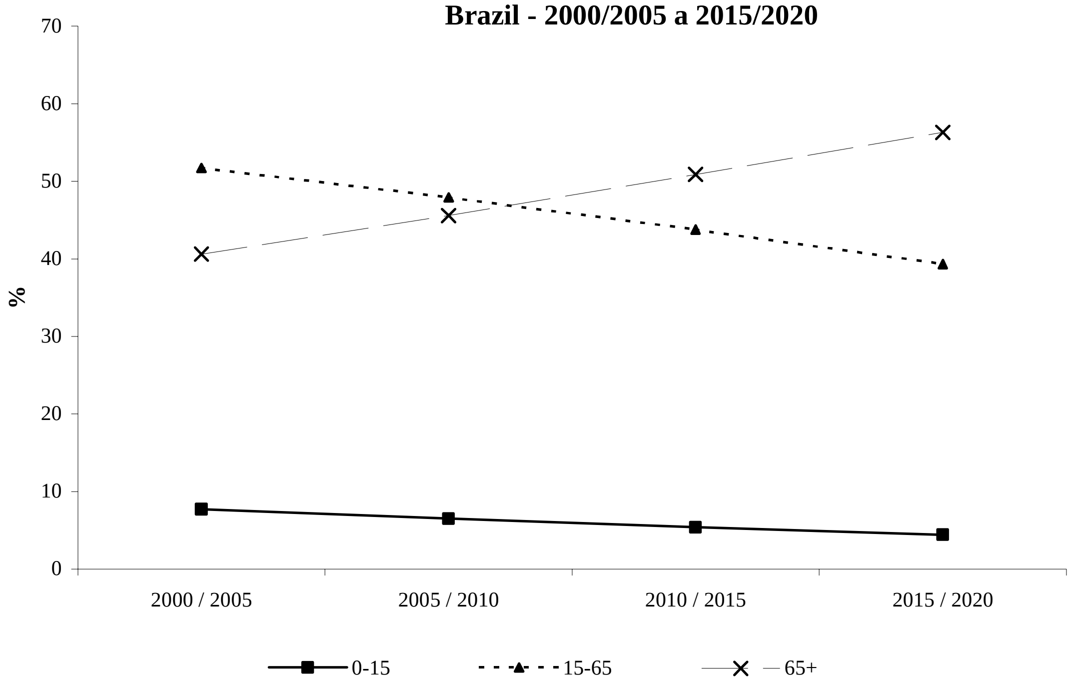


o) Brasil - 2045/2050



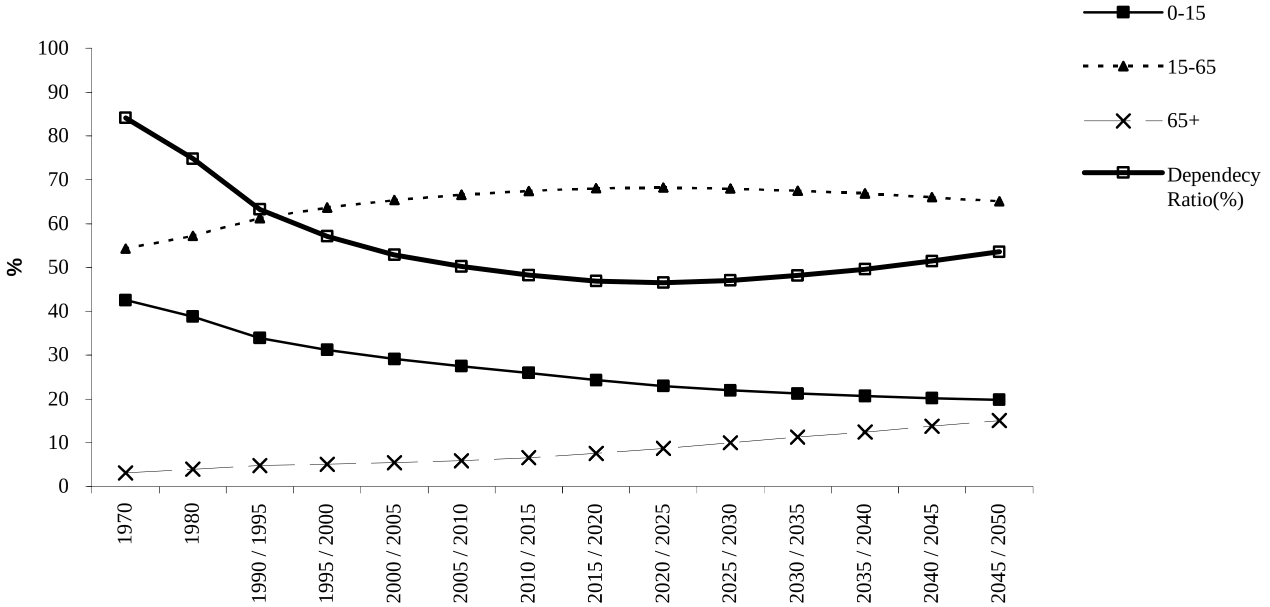
Source: UFMG/CEDEPLAR/PRONEX

Figure 2 - Proportional Changes in the Survival Schedule (As % of total change in the life expectancy at birth) Brazil - 2000/2005 a 2015/2020



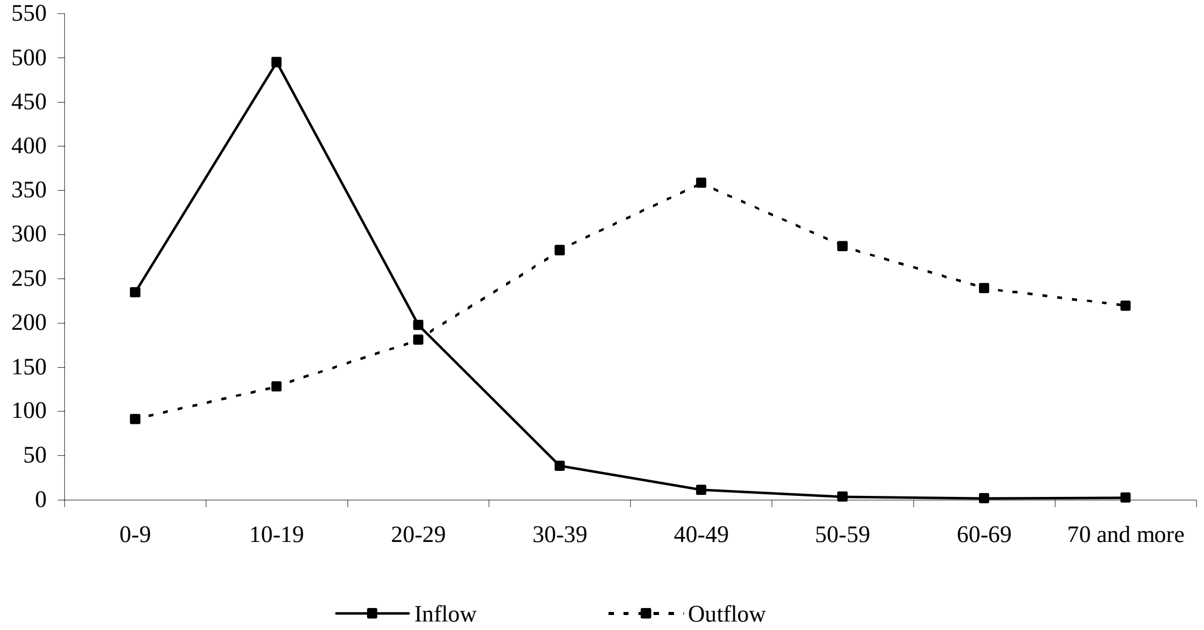
Source: UFMG/CEDEPLAR/PRONEX

Figure 3 - Age Groups and TDR (%)
Actual and Projected Populations - Brazil



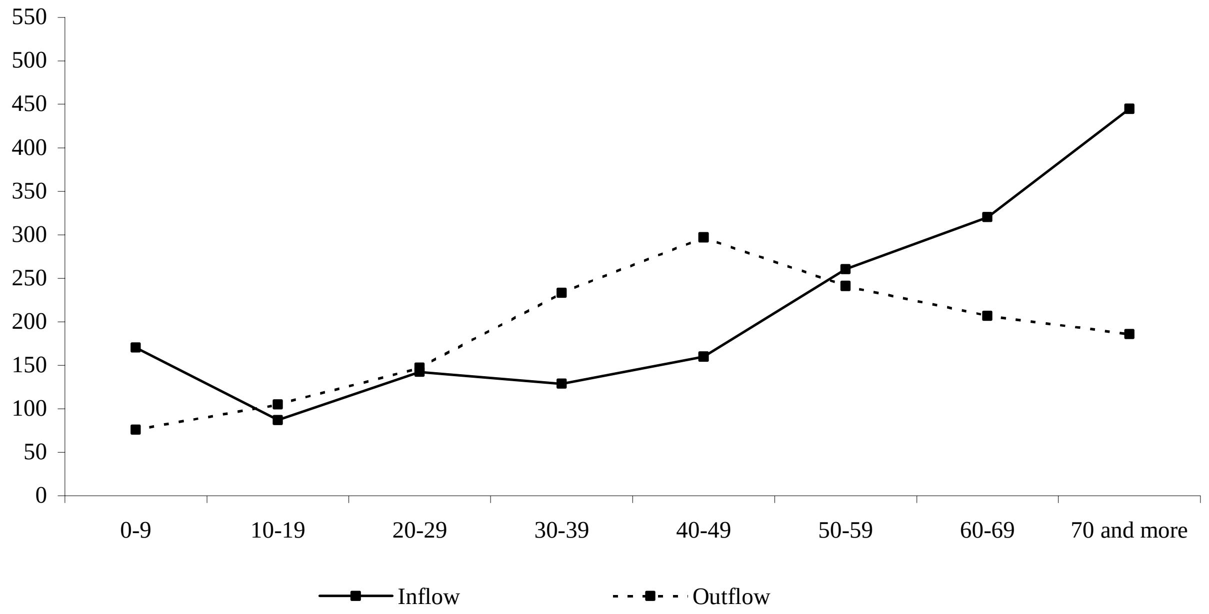
Soruce: UFMG/CEDEPLAR/PRONEX

Figure 4 -Public Education
Annual Values - Per Capita - US$(dez96)



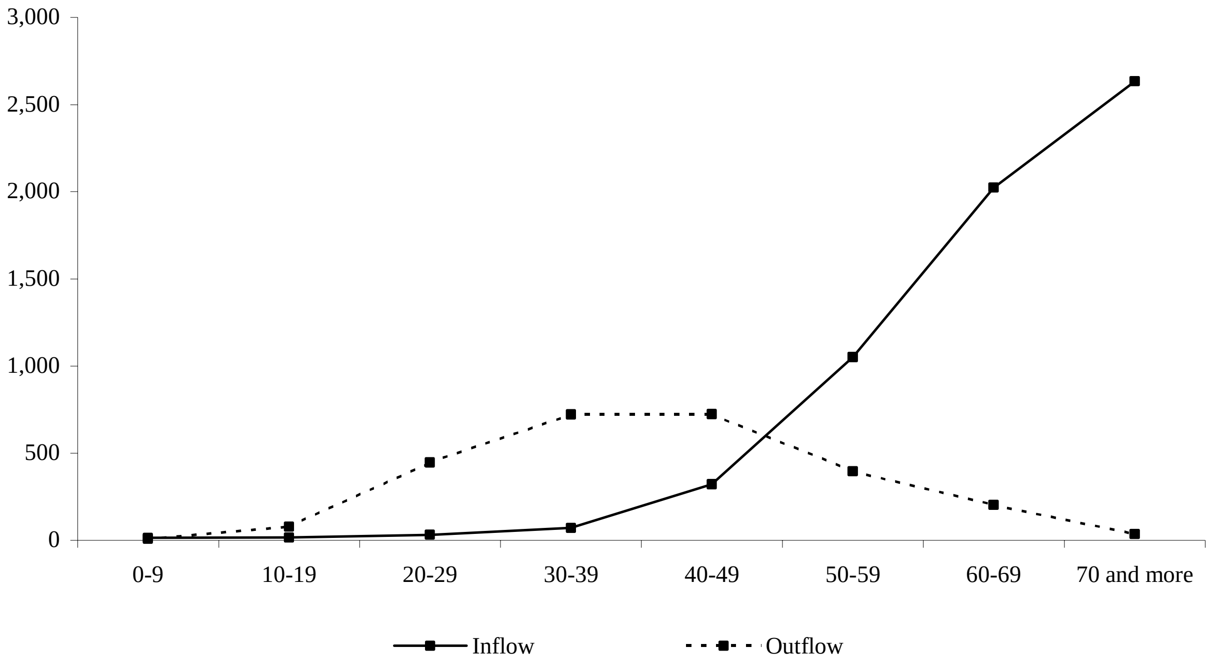
Fonte: Turra (2000)

Figure 5 -Public Health
Annual Values - Per Capita - US$(dez96)



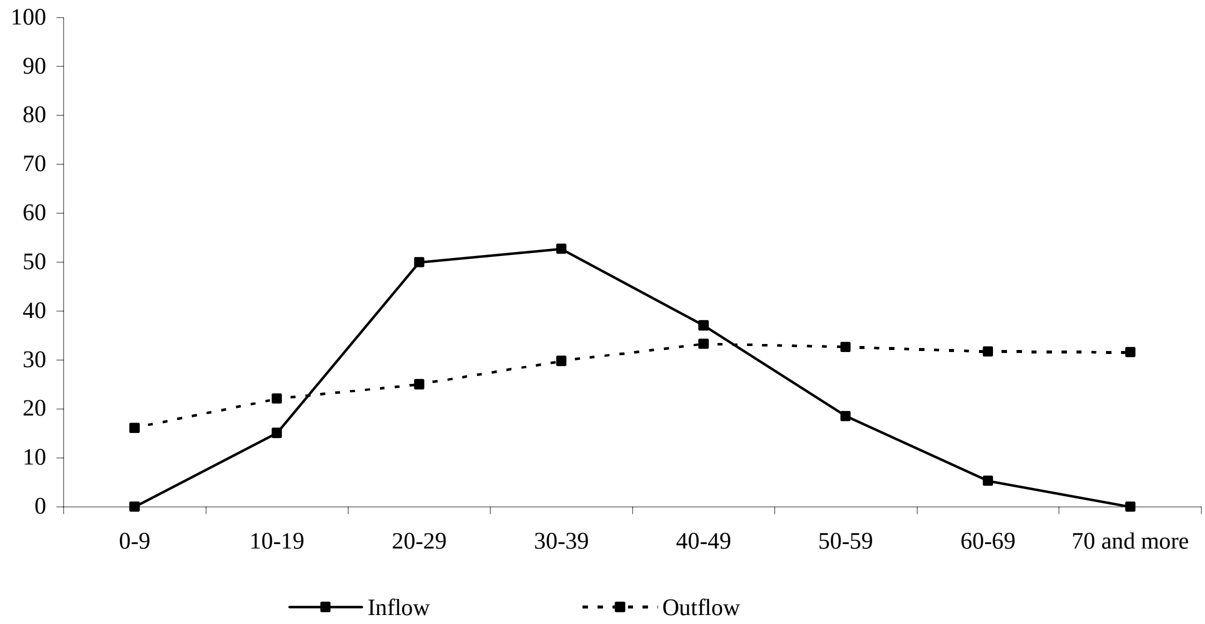
Source: Turra (2000)

Figure 6- Social Security - Private Workers
Annual Values - Per Capita - US$(dez96)



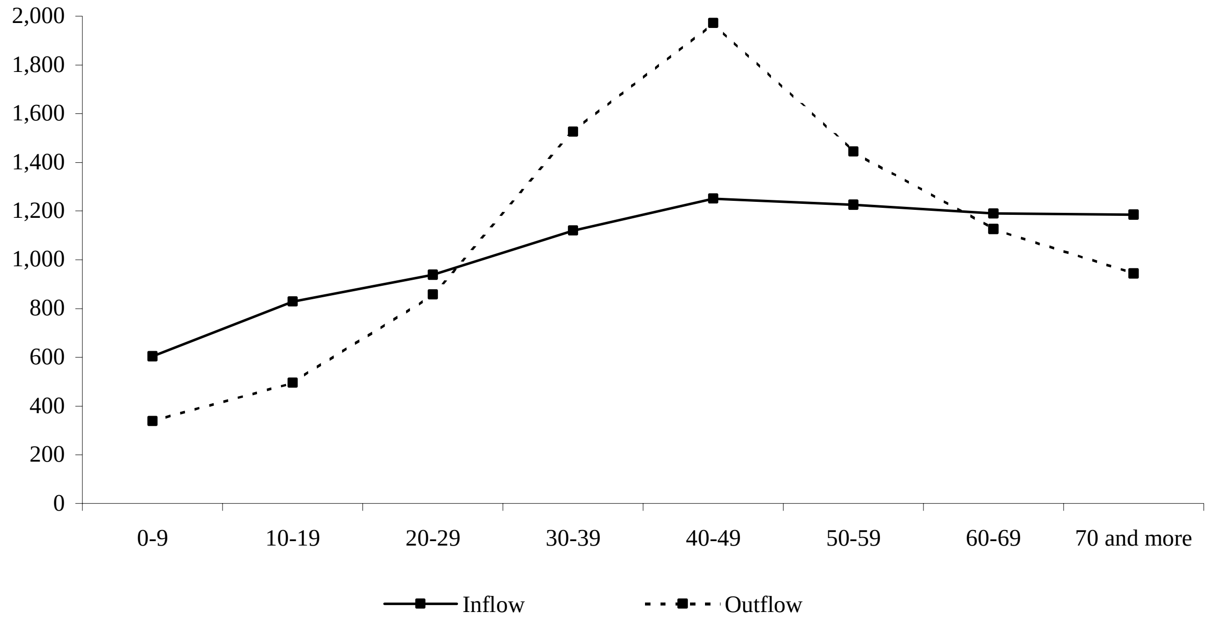
Source: Turra(2000)

Figure 7- Unemployment Insurance
Annual Values - Per Capita - US$(dez96)



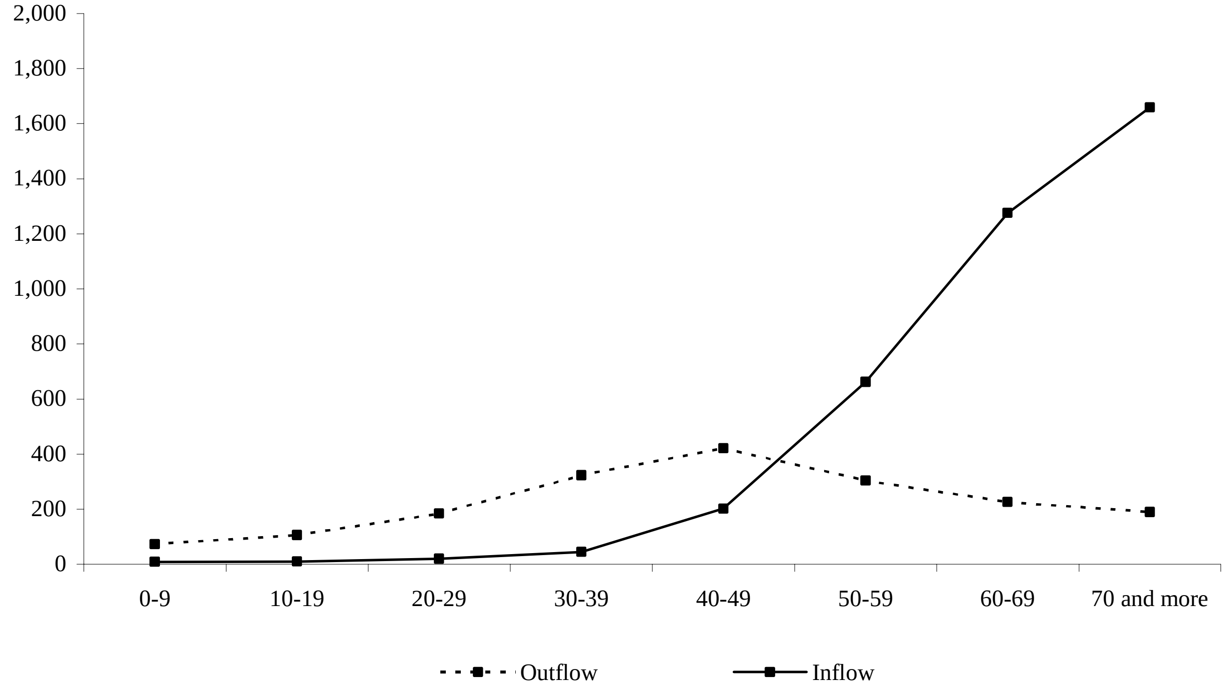
Source: Turra (2000)

Figure 8 - Non-age-related transfers
Annual Values - Per Capita - US$(dez96)



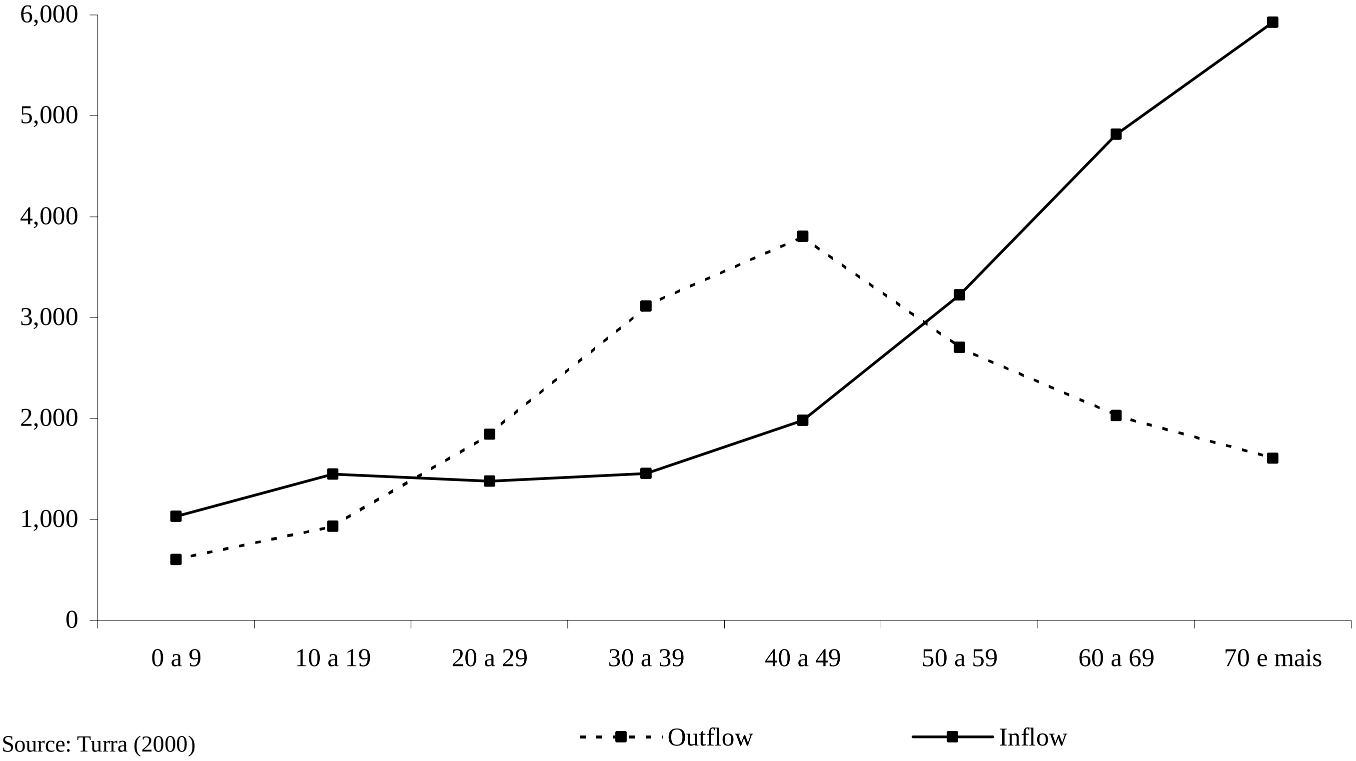
Source: Turra(2000)

Figure 9 - Social Security - Public Employees
Annual Values - Per Capita - US$(dez96)



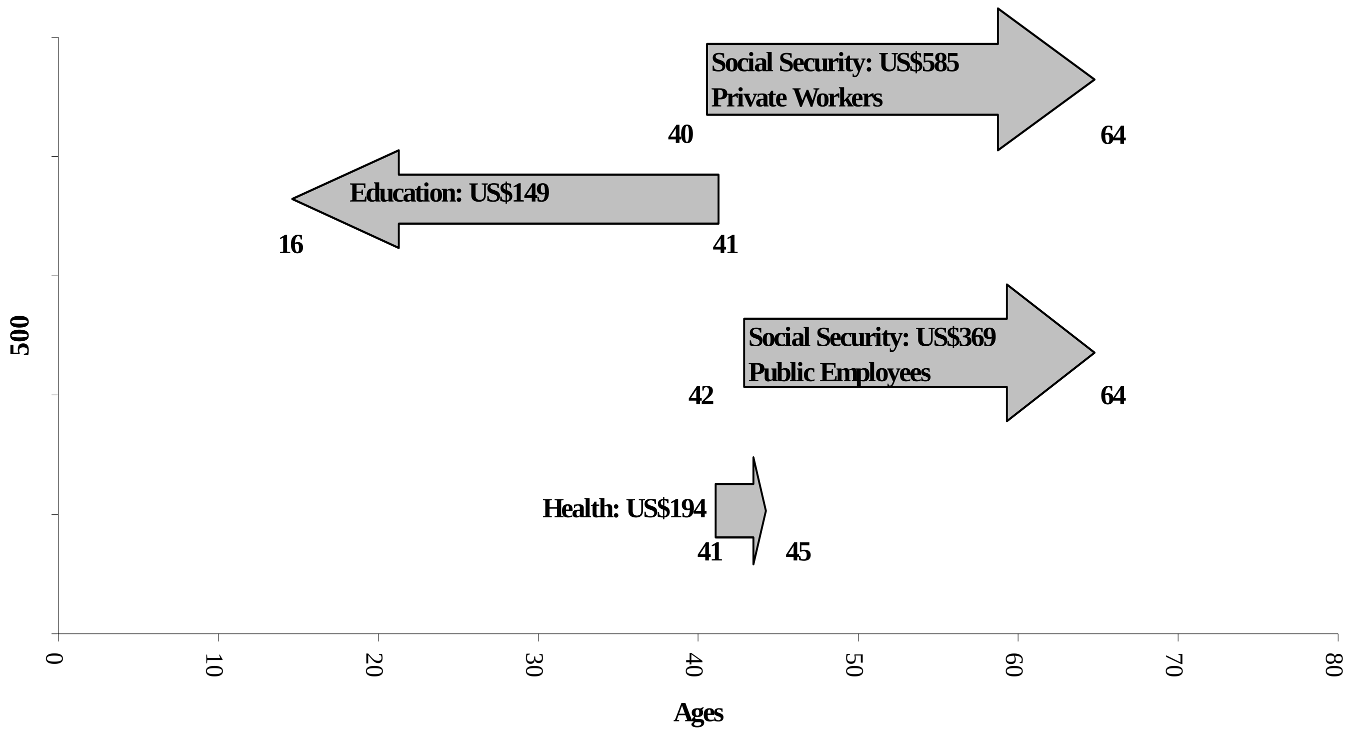
Source: Turra (2000)

Figure 10 - Total Government Transfers
Annual Values - Per Capita - US$(dez96)



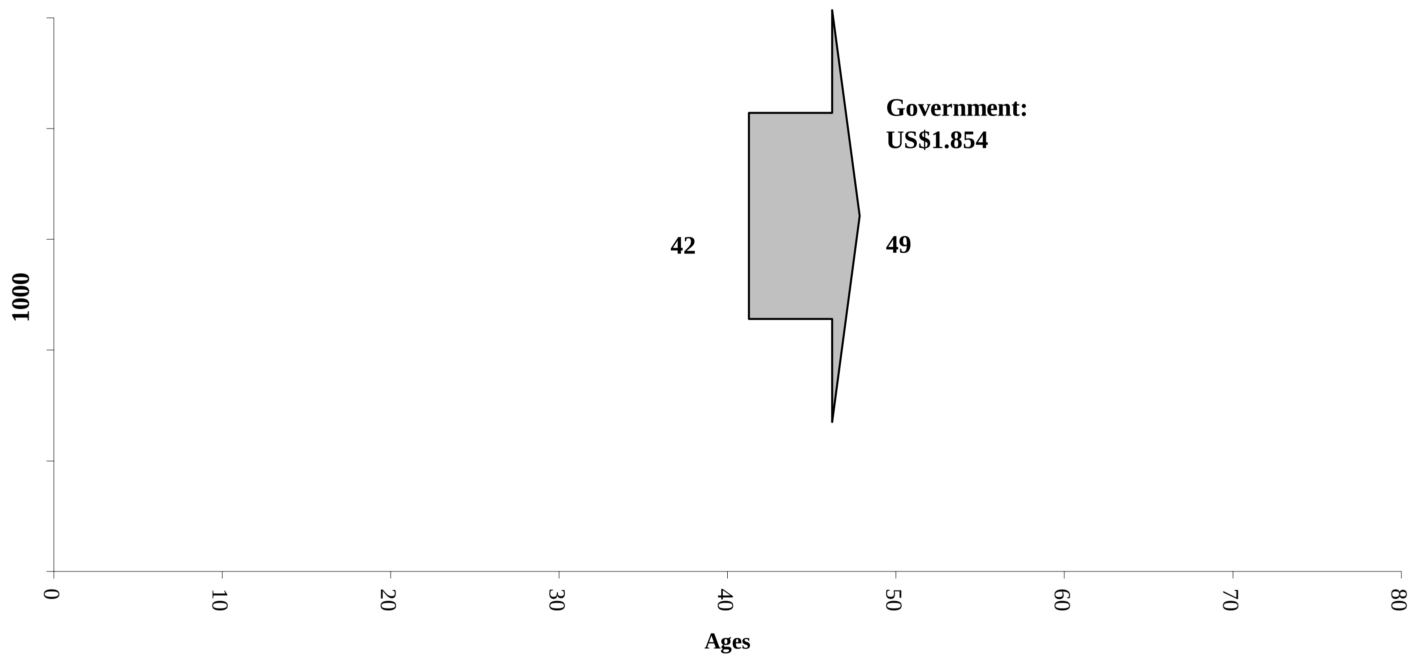
Source: Turra (2000)

Figure 11 - Age Related Governement Transfers - Flows and Directions



Source: Turra (2000)

Figure 12 - Total Transfers- Flows and Directions



Source: Turra (2000)

Table 1 - Fertility and Mortality Effects - Stable Scenarios US$
Brazil 1995/2000 vs. Brazil 2015/2020

Transfer Channel	Growth Rate (Fertility)		Growth Rate (Mortality)		p(x) (Mortality)		Total	
	Pop	LC	Pop	LC	Pop	LC	Pop	LC
Public Health	(6)	(327)	1	60	(6)	(357)	**(11)**	**(625)**
Social Security: Private Workers	(117)	(6,829)	21	1,246	(77)	(4,521)	**(173)**	**(10,103)**
Social Security: Public Employees	(64)	(3,759)	12	686	(41)	(2,398)	**(94)**	**(5,471)**
Public Education	26	1,523	(5)	(278)	8	488	**30**	**1,733**
Unemployment Insurance	1	66	(0)	(12)	1	50	**2**	**103**
Non-Age-Related Items	14	811	(3)	(148)	(3)	(177)	**8**	**486**
Total Public Transfers (a)	(145)	(8,452)	26	1,542	(118)	(6,915)	**(237)**	**(13,824)**

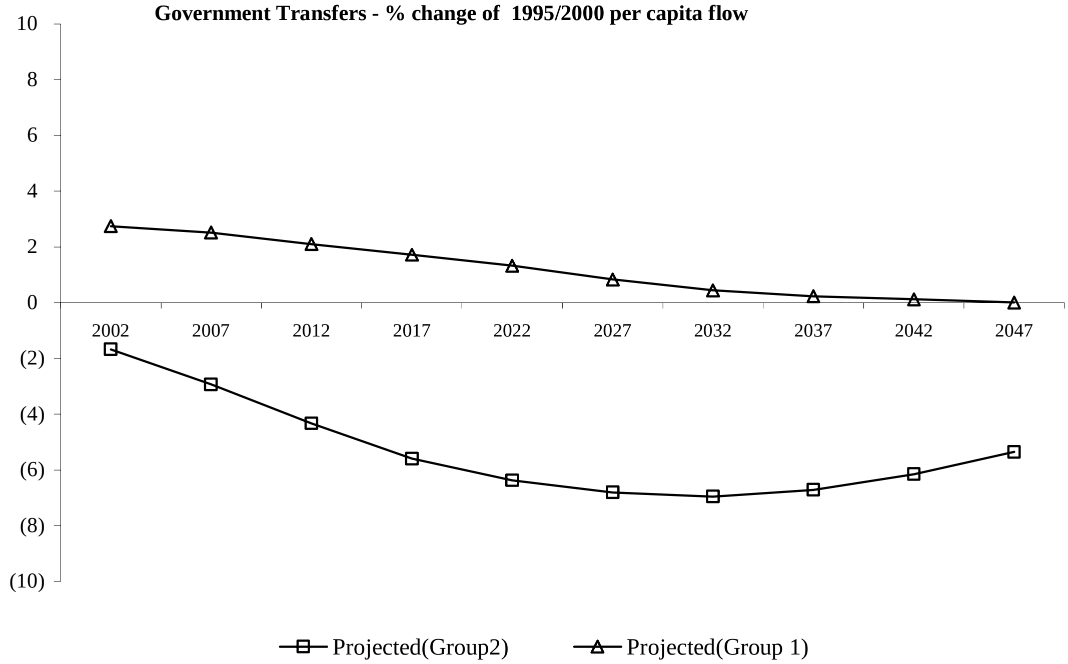
Source: Turra (2000)
a) Pop = Annual Per Capita - Population
b) LC = Net Present Value at Birth - Life Cycle
c) Results in parentesis = costs

Table 2 - Fertility and Mortality Effects: % of the per capita flow in 1995/2000
Brazil 1995/2000 vs. Brazil 2015/2020

Transfer Channel	G. Rate (Fertility)	G. Rate (Mortality)	p(x) (Mort.)	Total
Public Health	(3)	1	(3)	**(5)**
Social Security: Private Workers	(17)	3	(12)	**(26)**
Social Security: Public Employees	(15)	3	(10)	**(22)**
Public Education	19	(3)	6	**22**
Unemployment Insurance	5	(1)	4	**8**
Non-Age-Related Items	1	(0)	(0)	**1**
Total Public Transfers (a)	(6)	1	(5)	**(10)**

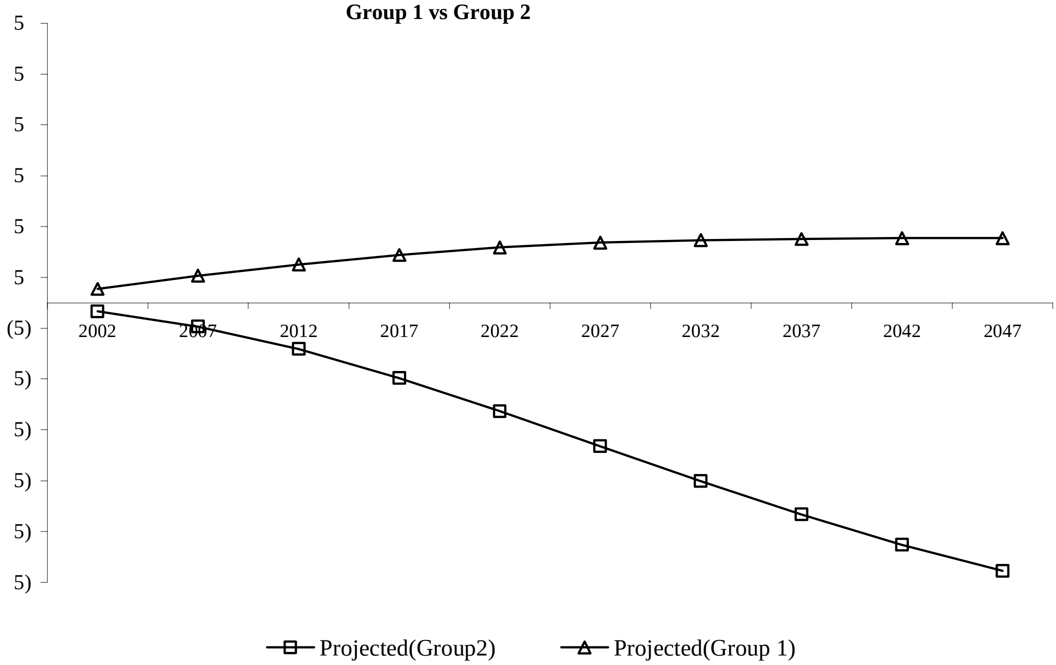
Source: Turra (2000)

Figure 14 -Population Aging Effects -Results by Five-Year Interval-
From 1995/2000 to 2045/50 - Group 1 vs Group 2
Government Transfers - % change of 1995/2000 per capita flow



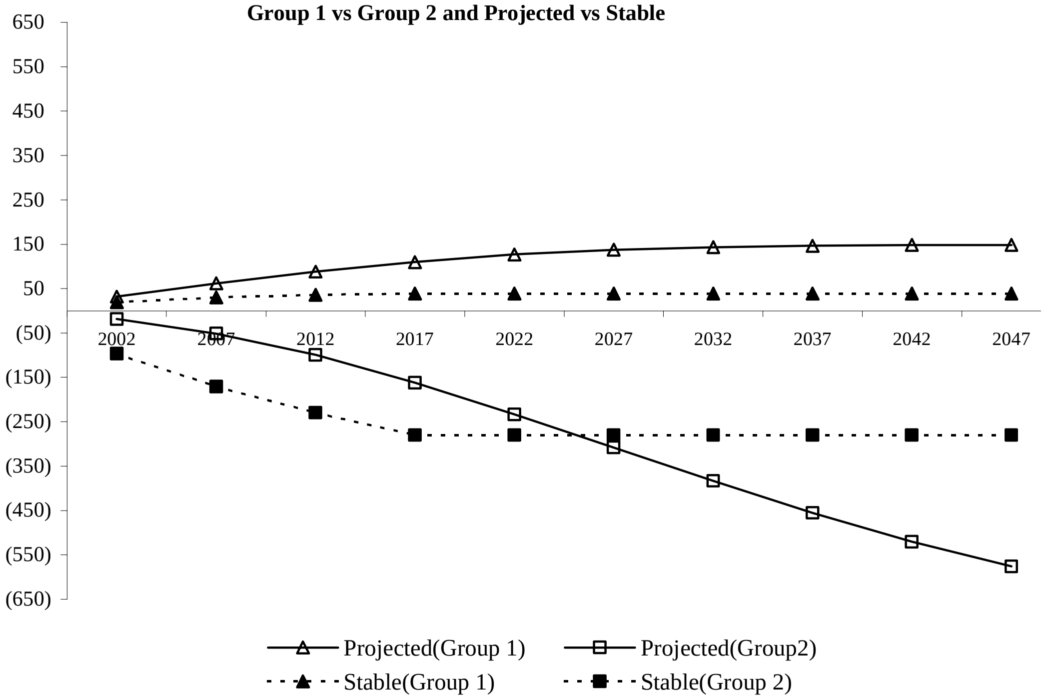
a) Group 1 = Education + Unemployment Insurance + non-age-related items
b) Group 2 = Social Security (private workers) + Social Security (public employees) + Heatlh
Source: Turra (2000)

Figure 15 - Population Aging - Accumulated Effects - From 1995/2000 to 2045/50
Government Transfers - % change of 1995/2000 per capita flow
Group 1 vs Group 2



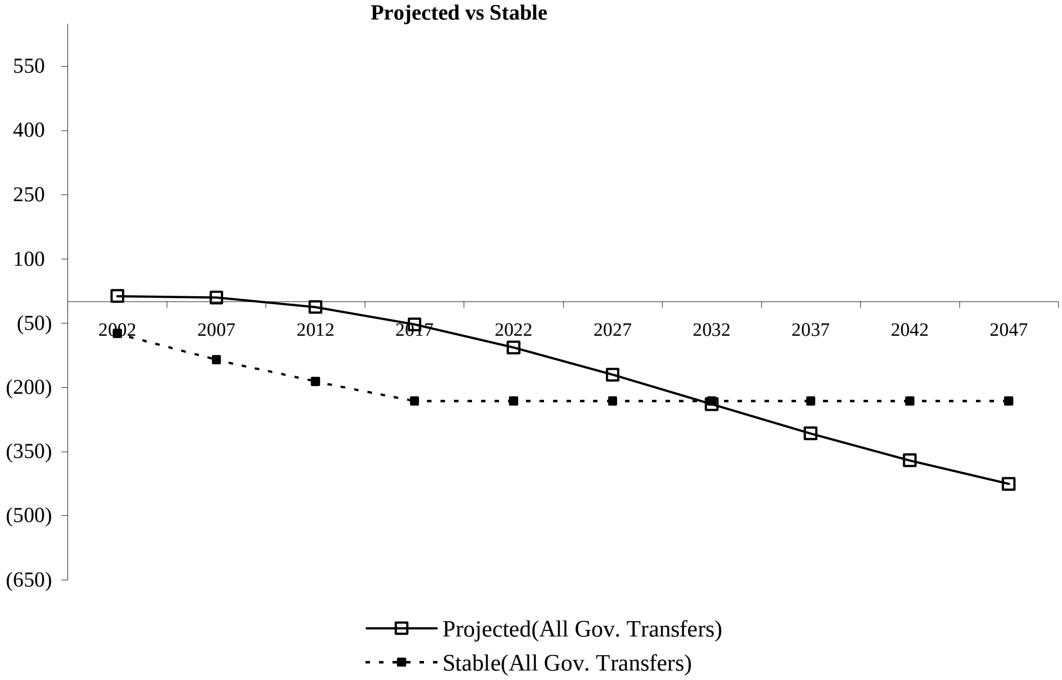
a) Group 1 = Education + Unemployment Insurance + non-age-related items
b) Group 2 = Social Security (private workers) + Social Security (public employees) + Heatlh
Source: Turra (2000)

Figure 16 - <u>Accumulated</u> Demographic Effects - From 1995/2000 to 2045/50
Government Transfers - US$ - Changes of 1995/2000 per capita flow
Group 1 vs Group 2 and Projected vs Stable



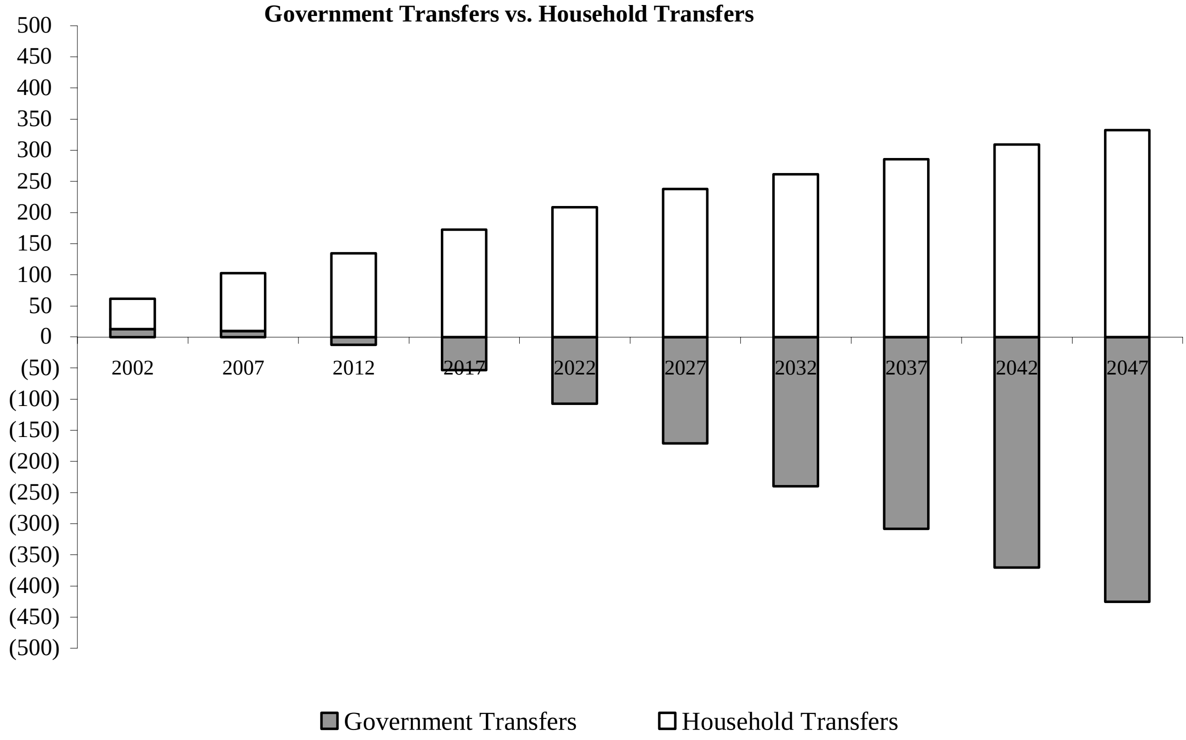
a) Group 1 = Education + Unemployment Insurance + non-age-related items
b) Group 2 = Social Security (private workers) + Social Security (public employees) + Heatlh
Source: Turra (2000)

Figure 17 - <u>Accumulated</u> Demographic Effects - From 1995/2000 to 2045/50
<u>All Government Transfers</u> - US$ - Changes of 1995/2000 per capita flow
Projected vs Stable



Source: Turra (2000)

Figure 18 - Accumulated Demographic Effects - From 1995/2000 to 2045/50
Changes in the 1995/2000 per capita flow - Projected Populations
Government Transfers vs. Household Transfers



Source: Turra (2000)