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RETIREMENT INCENTIVES: PENSION WEALTH, ACCRUAL AND IMPLICIT TAX

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Abstract

This paper estimates social security financial incentives for early retirement using contemporary techniques developed in economics, and compares these estimates to those estimated for developed countries. I find that implicit tax on continued work increases with age and amounts to over one-third of an individual potential earnings at age sixty-five. The pension replacement rate shows the degree of the generosity of the Brazilian pension system, on average pension benefits correspond to 60% of labor income. In general, I find that incentives inherent to the pension system situate Brazil in the bottom level of developed countries. The replacement rates, implicit tax on work and pension accrual rates in Brazil are similar to the levels observed in the US and Canada.

Key words: retirement incentives, pension accrual, Brazil, public pension systems.
Classification JEL: J14, J18, J26.

Introduction

There is widespread concern on how demographic changes, especially population aging, affect macroeconomic variables and public sector fiscal balance. A related question is how the provision of social security benefits affects retirement decisions of older workers (Wise 2004). The literature on this topic in developed countries is extensive (Costa 1998; Burtless and Quinn 2001; Gruber and Wise 1999). People know a great deal about retirement behavior in different developed countries around the world. There are two main explanations for early retirement in developed countries. First, the existence of generous public pension systems (Gruber and Wise 1999; Wise 2004), and second, higher income and expansion of the leisure class (Costa 1998). Population aging combined with early retirement has put social security systems across the

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industrialized world under pressure. Legislation changes have taken center stage in public policy debates in recent years (Diamond 2004; Wise 2004).

Despite unabated interest among researchers in issues pertaining to the impacts of social security provisions to retirement behavior, little is known about these issues in emerging economies. Brazil is one example of an important context for elaborating linkages between pension benefits provision and retirement behavior. The rapidly aging population presents one of the greatest public policy challenges in Brazil. Compared to other emerging countries economies, Brazil is distinct for combing a relatively large public sector with rapidly aging population and declining labor force participation at older ages. The percentage of individuals age 65 and over is estimated to be 18% in 2050, compared to 3% in 1970 (UN 2003). These changes in population age structure may impose severe pressures on the public sector (Bongaarts 2004). At the same time, the length of working life has fallen over time, which results from both increases in educational attainment (younger workers) and changes in retirement behavior (older workers). The fall in economic participation for older workers (65 and older) is striking: 30% of them were in the labor force in 2000 compared to 60% in 1970. In 2002, social security benefits and other forms of elderly support represented about 12% of the GDP (Ministério da Fazenda 2003) and are expected to be the fastest growing component of public spending (Giambiagi and Além 1997; Giambiagi and de Castro 2003).

Early research showed two striking features of the Brazilian labor force: 1) decline in the participation of older male workers, and 2) variations in the retirement hazard rates according to workers' characteristics (Queiroz 2005). The empirical evidence supports the hypothesis that public pension regulations create incentives for older workers to retire. In this paper, I use the methodology developed in Gruber and Wise (1999) to calculate pension benefits for male workers under the program rules to estimate the incentives of the social security program for retirement behavior.

The purpose of this paper is to show the relations between social security regulations and the labor force of older workers. I show that in some steps. First, I describe the main characteristics of the pension system in Brazil. Then, I document some facts about the labor force participation and retirement behavior of older workers. Next, I compute net social security wealth for representative individuals and assess their sensitivity to differences in mortality and interest rates. Finally, I present a summary of the key findings with emphasis on the relation between social security financial incentives and labor force participation of older workers. It is worth mentioning that I do not model worker behavior under current and alternative pension schemes[1]. Thus, although it is possible to obtain some ideas relating to labor market outcomes one should be careful when doing so.

1. Background

1.1 The social security system in Brazil

The pension system in Brazil consists of three main segments: the general system (workers in private sector), the civil servants system, and other general private funded systems. Most of

[1] An interesting discussion relating social security schemes and labor market outcomes can be found elsewhere (Gruber and Wise 2004).

pension system is based on the PAYGO scheme (Bonturi 2002). The country has also a large non-contributory system with means-tested eligibility that provides benefits for low-income elderly[2].

The Social Security system for workers in the private sector (general system) is an unfunded defined-benefit program. There is still debate regarding when it began. In 1888 some measures were taken to provide pension benefits for postal workers and employees of the national press. In the following years, retirement benefits were extended to railroad workers, employees of the Ministry of Finances, the Mint and the armed forces. In 1923, the Lei Eloi Chaves (legislation) was approved to regulate social security for both civil servants and private sector workers. This law decentralized the pension system, as each company became responsible for its own employees. The first reform happened in 1933 when the pension funds became structured by professional categories (Leite 1983). The general pension system was centralized only in 1996, when the House of Representatives approved the Social Security Ordinary Law. The National Social Security Administration, INPS, incorporated all the revenues and expenditures from sector-specific programs as well as its assets and liabilities. Another major change during this time was in the scheme of the program, which changed from a capitalization system to PAYGO (Leite 1983).

The last major reform occurred with the 1988 Constitution, which extended mandatory social security coverage to most of the previously excluded groups, including rural workers, without requiring equivalent increases in revenue from contributions. Other measures also made the system more generous than before: establishing the minimum wage as the lowest benefit paid by the system, indexing all pensions to the minimum wage, and reducing minimum retirement age (Stephanes 1998).

Until 1998, full pension benefits were granted to all workers who had contributed for a minimum of 10 years to the system, have reached normal retirement age through the Old-Age Pension Benefit (65 for men and 60 for women), or could prove that they have been working for a certain number of years with the Length of Service Pension Benefit (35 for men and 30 for women, but without requirement of contribution for the same period of time). In addition, special retirement schemes existed that granted proportional retirement benefits for individuals who had worked for 30 and 25 years, for men and women respectively. The benefits were computed based on the last 36 months of work (MPAS 2002). The level of benefits is relatively high, old-age benefits recipients receive, on average, 3 times the minimum wage, and the length of service benefits is 2.5 times higher than the old-age benefits[3].

Alongside the general pension system, civil servants have their own pension program, which is also an unfunded PAYGO defined benefit program. Although smaller in absolute numbers when compared to the general program, expenditures with the civil servants are large, reaching 4.7% of the GDP in 2002. The program is a complex chain of federal, state and local systems, including special programs to different civil servants categories. Benefits are more generous in the

[2] Public expenditures on social security benefits and other forms of elderly support amount to 12% of GDP (Ministério da Fazenda 2003).

[3] In recent years, the system has been facing budget shortfalls, which have gradually increased after new regulations were implemented in the early 1990s. In 1996, the deficit was equal to 0.1% but increased to 1.7% in 2004. The implicit debt, a long term measure of the system's financial adequacy, is also large and amounts to about 350% of the GDP (Bravo and Uthoff 1998).

civil servant program: replacement rates are higher and time of contribution to receive full benefits is shorter (Medici 2002).

1.2 Trends in labor force participation and retirement age

Figure 1 show the historical trends in labor force participation rates for males in Brazil. The data are taken from the Brazilian Population Census available, on-line, at the IPUMS project web-site (Ruggles, Sobek, Alexander, Fitch, Goeken, Hall, King, and Ronnander 2005). The data are available from 1960 to 2000. Labor force participation is defined by the International Labor Organization (ILO) as the proportion of the population of some specific age; normally population aged 16 to 65 years of age, who is either working or actively seeking work to the total population in the same age group.

The trend in labor force participation for Brazilian male workers shows significant changes in the last decades. It is clear that the length of working life shrank over time. Labor force participation rates of young individuals have declined because of the increase in educational attainment. Based on census data, I calculated that 95% of the population aged 10-14 years was in school in 2000, compared to 54% in 1960. The rates have also declined for older workers. In 1950, almost 90% of the population aged sixty to sixty-four was in the labor force, and this number declined to 65% in 2000. The same rate of declined is observed for younger old-workers. The fall in economic participation is even greater for older workers, those above sixty-five years of age: 30% of them were in the labor force in 2000 compared to over 60% in 1950.

The long-term information on labor force participation can be used to study trends in retirement. I estimate median retirement age for males from 1960 to 2000. The median retirement age is the youngest age at which fewer than 50% of the population is in the labor force (Burtless and Quinn 2001). The retirement age for Brazilian workers declined from 69 years of age in 1960 to 63 years in 2000, an average decline of 1.5 year per decade. The rate of decline is faster than what is observed for the USA between 1910 to 2000, from 74 to 63 years of age. In the same period covered by the Brazilian data, the decline in the median retirement age in the US has slowed down or even reversed. From 1960 to 2000, the median age declined 0.75 year per decade, from 66 years of age to 63 years in 2000.

I also estimated the Unused Productive Capacity, a summary measure of the labor force participation of older workers proposed by Gruber and Wise (1999). The measure is calculated by summing up the proportions of individuals out of the labor force between ages 50 and 69 and dividing it by the age range (in this case 19). The measure is interpreted as follows. Suppose the unused capacity measured between ages 50 and 69 in a particular year is 50%. It means that a cohort experiencing the labor force participation rates in that year for their whole life would work only 50% of their potential life time person-working years.

The unused capacity for the age group 55-65, in Brazil, increases from 28% in 1960 to 40% in 2000. This means that, in 2000, workers living under those labor force participation rates would work only 60% of the potential working years between ages 55 and 65. The increase in unused labor capacity occurs as the pension system reaches more population sub-groups and it becomes

more generous. I will consider later how this summary measure is related to the pension provisions in Brazil and how the country situates in relation to developed nations.

Figure 1
Labor Force Participation Rates, Males, Brazil, 1950-2000

Source: International Labor Organization Database.

2. Retirement Incentives

Two main features of the social security system affect the decision to retire. The first one is the age at which pension benefits become available. The second is the pattern of social security accrual, that is, how social security wealth will evolve with one more year of work.

In Brazil, as opposed to other developed and developing countries, the social security system does not have a minimum age requirement for the retirement of workers in the private sector. Workers can retire by length of service if able to prove 35 and 30 years of work for men and women, respectively. For those who cannot prove the minimum number of years of contribution, it is possible to retire at ages 65 and 60, for men and women respectively.

Social security wealth (SSW) is the present discounted value of the future benefits a person is entitled to receive upon retirement at a particular age. The future benefits are discounted by a time preference rate and by the individual's future survival probabilities. Social security wealth affects the worker's retirement decision based on how it evolves if the individual decides to continue working instead of retiring. For example, a worker aged 64 will consider how her SSW will change if she retires at age 65 rather than at age 64. The difference between SSW at 65 and SSW at 64 is called the pension accrual (Gruber and Wise 1999).

I follow Borsch-Supan (2000) and Gruber and Wise (1999) to formalize the calculation of the incentive measures. The social security wealth of a worker aged S and who is planning to retire at age R, is calculated as follows in equation 1:

$$SSW_S(R) = \sum_{t=R}^{\infty} YPEN_t(R) \cdot \alpha(s)_t \cdot \sigma^{t-s} - \sum_{t=s}^{R-1} c_t \cdot YLAB_t \cdot \alpha(s)_t \cdot \sigma^{t-s} \qquad (1)$$

where *SSW* = social security wealth, *S* = planning age, *R* = retirement age, $YLAB_t$ = labor income at age t, $YPEN_t(R)$ = pension income at age t for retirement at age *R*, c_t = contribution rate to pension at *age t*, $a_{(s)}t$ = probability of survival at least until age t given survival until age *S*, and σ = discount factor $(1/(1+r))$.

The pension accrual is the difference between the SSW of retiring today and the SSW of working one more year. The most important consideration for a worker is how this wealth will evolve with continued work. An individual aged sixty will ask the question of what is the change in SSW if she retires at age sixty instead of sixty-one. If the Accrual is positive it is interesting for the worker to stay in the labor force for an additional year. That is, a positive accrual encourages labor force participation and a negative accrual encourages retirement. The accrual can be represented as follows, in equation 2:

$$ACC = SSW_S(R) - SSW_S(R-1) \qquad (2)$$

The social security wealth, and accrual, is affected by the probability of survival, earnings curve and tax structure, and characteristics of the pension system. The most important factor is the last one, in other words, how the pension system adjusts pension benefits for an extra year of work. The extra year of work means that the individual is foregoing one year of pension benefit. In actuarially fair systems, the adjustment in the pension benefit would at least offset the fact that pensions are being received for one less year. It is observed, for several countries, that such adjustment does not occur. The degree of the adjustment will create more or less incentives to remain in the labor force, a positive accrual rate indicates incentives to remain in the labor force whereas a negative rate an incentive to retirement (Gruber and Wise 1999; Borsch-Supan 2000).

The pension benefit depends on the worker's earnings profiles. If it is expected that earnings later in life will be higher than earnings in the beginning of the career, this may rise the social security wealth. However, labor earnings are often taxed, for both income and social security taxes, which lowers SSW. These two factors act in opposite directions. On one side a longer earnings history creates incentives to remain in the labor force. On the other side tax schedule creates incentives to retire. Last, probability of survival declines as individuals age, and delaying receiving pension benefits increases the chances that a worker might die before collecting his benefit (Gruber and Wise 1999).

I calculate three different measures derived from the social security wealth and pension accrual. First, I calculate the pension replacement rate, shown in equation 3, which is the rate at which social security benefits replace net earnings of the worker if he/she decides to stay in the labor force that year (Gruber and Wise 1999).

$$REPL_t = Y\ PEN_t\ (t)/\ Y\ LAB_t^{net} \quad (3)$$

The benefit replacement rate is calculated in relation to the net income, that is, income received after-tax. It is important to do this calculation after-tax because the tax schedule for social security benefits is not the same as the one observed for labor earnings. The replacement rate indicates the degree of generosity of the system, Gruber and Wise (1999) show that at early retirement ages the replace rate ranges from 20% in Canada to 91% in France and the Netherlands[4].

The second concept is the accrual rate. Gruber and Wise (1999) define it as the percentage change in social security wealth from the previous year (Equation 4). The third is a tax/subsidy rate which measures the absolute change in SSW over the potential earnings for working during that year (Equation 5).

$$ACCRATE\ =\ [\ SSW_S\ (R) - SSW_S\ (R\text{-}1)]/\ SSW_S\ (R\text{-}1) \quad (4)$$

The pension accrual rate, equation 4, shows how well social security system adjusted SSW for an additional year of work. For the countries studied by Gruber and Wise (1999) all, but the US and Spain, have negative accrual rates indicating a incentive to leave the labor force and start receiving pension benefits at the early retirement age.

$$TAXR_R =\ -\ [\ SSW_S\ (R) - SSW_S\ (R\text{-}1)]/\ Y\ LAB_t^{net} \quad (5)$$

The last measure, tax/subsidy rate, is the absolute change in social security wealth over the potential earnings from working an extra year (Gruber and Wise 1999). This measure represents the implicit tax or subsidy to continued work in terms of the change in SSW. A positive number indicates that the social security system creates incentives to retire, and a negative number (subsidy) indicates that the system generates incentives to remain in the labor force. The implicit tax /subsidy ranges from -23 to 141 in the cross-country study by Gruber and Wise (1999).

3. Individual Earnings History

There are three basic pieces of information necessary to estimate retirement incentives in Brazil. The first one is the structure of the social security system. The structure of the system is important to define how benefits were calculated and what the social security tax profile was at each year. The second one is an individual history of wage earnings, which is used to calculate the social security benefits. The last one is the public pension tax structure.

In Brazil there are no official data on the worker's earnings history and social security tax payments over time. However, there are two options to deal with this problem. The first option is

[4] The early retirement age is the first age at which pension benefits are available. For the three countries cited a worker can first claim pension benefits when she turns 60 years old.

to follow a synthetic cohort of workers using available data. The best data source for this option would be the PNAD, Brazilian Household Survey, which collects labor market information and is available from 1976 to 2006. Using this long series of cross-sections I can evaluate the median wage of male workers and estimate their social security tax based on the regulations of the time. A major short-coming of this approach is that during this period inflation rates were extremely high and currency was changed a few times. These two factors make construction of the measures and the interpretation of the results extremely difficult.

The second best is to project the age-earnings profile based on cross-sectional data. I am aware of the limitations of this approach and the problems of using a cross-sectional dataset to infer longitudinal information. However, in the absence of better data I opt for this alternative. The cross-sectional data does not represent the actual dynamic of a group of workers during a period of time, but it is a representation of the wage structure in a period of time and how it differs across workers with different characteristics. This is not an uncommon procedure; Gruber and Wise (1999) and Gruber and Wise (2004) use a similar approach in some countries investigated in their cross-national study (e.g. Italy and Japan).

3.1 Data and methods

3.1.1 Data

Data for my study come from the *Pesquisa Nacional por Amostra de Domicilios*, 2002 (PNAD). The PNAD is a nationally representative stratified random sample of the Brazilian population comprised of about 90,000 households. The survey consists of cross-sections collected annually since 1976, except in 1994 and during censuses years (1980, 1991 and 2000). The PNAD contains a comprehensive and comparable set of demographic and economic variables, including detailed information on economic activities.

I selected male workers, between the ages of 20 and 70, living in the urban areas who reported working or having a job during the week of reference, held a job in the formal sector and declared making contribution to the social security system. Among these workers, I only considered those who worked between 40 and 50 hours during the week of reference. I do that in order to eliminate older workers who might have moved to a part-time job later in their career. I also did not consider civil servants because they are under a different social security system. From the initial sample I also eliminated workers who were already receiving pension benefits because they might have a different labor supply behavior. The final sample has 25,263 observations. Descriptive statistics are presented in Table 1.

In my sample, men are, on average, 34.8 years old. Educational levels in Brazil are very low, especially for older cohorts. Male workers analyzed in this paper have completed, on average, less than 8 years of education which is two more years than the average of the whole adult male population. The higher level of school attainment is directly related to the type of workers I selected to estimate age-earnings profiles: formal labor market, contributes to social security, lives in urban areas and works at least forty hours per week. The average wage is 764.66, in Brazilians currency (R$) of 2002, which is about four times the minimum wage at the time.

Table 1
Summary Statistics, Male Workers, Brazil, 2002

Variable	Mean	Std. Dev.	Min.	Max
Age	34.89	10.32	20	70
Hours	44.17	3.54	40	50
Education	7.78	4.12	0	15
Wage	764.66	1024.88	100	25000

Source: Pesquisa Nacional por Amostra Domiciliar (PNAD), 2002.

3.1.2 Method

The construction of age-earnings profile is based on a regression model for different categories of workers, constructed using educational attainment. I divide the workers in four educational groups depending on the number of years of education[5]. The educational categories, which are related to the worker's qualification level, are: less than 4 years of schooling (elementary education), between 5 and 8 years of schooling (junior high-school), between 9 and 12 years of education (high-school) and more than 13 years of education (some college or more). By using this approach, I obtain four different age-earnings profiles, and each one of them should represent best the reality of each particular group of workers.

The estimation of the profiles follows the methodology proposed by Murphy and Welch (1990), Creedy (1992) and Andrade (2001). The model assumes: a) only age and time explain differences between cohorts, b) time is measured in years, and c) age effect is a polynomial of fourth order and time effect is linear, which implies that earnings grow at a constant rate.

The model, proposed by Creedy (1992), is shown in equation 6. The model allows estimation of the cross-sectional age-earnings profiles for each educational category defined previously. A similar procedure was used in Gruber and Wise (1999) to estimate lifetime earnings of Japanese and Italian workers, and to backcast earnings for Canadian workers.

$$Y_{t,d} = \alpha_0 + (\alpha_1 + \beta_0)\cdot t + \alpha_2 \cdot t^2 + \alpha_3 \cdot t^3 + \alpha_4 \cdot t^4 + \varepsilon_1 \qquad (6)$$

where $Y_{t,d}$ is the log of the wage observed by the age group t and category d; α_0, α_1, α_2, α_3, and α_4 are the parameters estimated in the model; and β_0 is the productivity growth rate obtained from an external source[6].

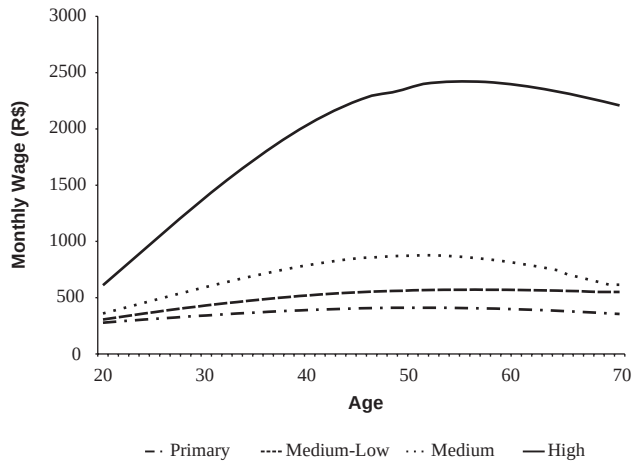
[5] I construct years of education using the information about the last grade completed with success.
[6] Murphy and Welch (1990) criticize the use of only a quadratic form because it provides a poor approximation of the actual relationship observed in longitudinal data. They proposed the use alternative forms, concluding that the quartic form provides a good approximation of what would be observed if one had the worker's lifetime earnings history. I estimate the model in equation 6 using different specifications and also found that the polynomial with four degrees (quartic form) provides the best fit to the model.

I then apply the estimates of α_0 and α_i to 'un-age' a 60 years old worker in the 2002 survey to 1962 (when he was 20) and deflate his profile by the average productivity growth in the country during the period. In this paper, for simplicity I assume a constant productivity growth rate of 3%. However, I observe a decline in the cross-section age profile after age 60 for all educational categories which might be indicating a selection bias of who stays in the labor force after that age, and since I am assuming that the cross-sectional data reflect the cohort reality I opt not to consider the period profile after age 60. Thus, for ages 60 and above I assume that earnings only increase by the productivity growth rate after that age.

3.2 Age-Earnings Profile: results

The age-earnings profiles use the estimate lifetime earnings presented in Figure 2. I present the four estimated profiles in the same graph in order to compare the differences in wage level and the profile of the curves of each group of worker.

Figure 2
Age-Earnings Profile, Male Workers, Brazil, 2002



Source: Pesquisa Nacional por Amostra Domiciliar (PNAD), 2002.

The results presented above are not surprising and are similar to what was observed by others (Birdsall and Sabot 1996; Legrand 1995). The earnings profiles increase rapidly early in the career, but the growth rate is much higher for highly educated workers than the others. The growth rates slows down and even decline as workers approach retirement age. Less educated and medium-low workers have a flat earnings profile over age, which might be indicating the type of job they

perform, that is, more menial and or physically demanding that does not give returns to experience and tenure.

The profiles show another feature of the income inequality and the differences in returns to education in Brazil. It is estimated that an additional year of schooling increases income by 15%, and this value has not changed much over time. Empirical work also has shown that an individual with college degree can earn 12 times more than a worker with primary education (Menezes-Filho 2001; Birdsall and Sabot 1996; Lam and Levison 1992).

4. Results

4.1 Base-case

In this section, I estimate the incentives to retire the Brazilian social security system create. The basis to my analysis is the worker's earnings history estimated in the previous section. I use equation 7 to estimate pension benefits.

$$Benefit = M \cdot \frac{(Tc \cdot \alpha)}{\mathrm{Es}} \cdot \left(1 + \frac{R + Tc \cdot \alpha}{100}\right) \qquad (7)$$

, where M is the average of the 80% best wages, c is the contribution rate, Tc is the period of contribution, Es is the life expectancy at retirement, and R is the retirement age. Benefits start only after worker retires, although pensioners can re-enter the labor force without loss of benefits. Those who opt to work after starting to collect pension benefits have to pay social security taxes. This arrangement increases informality in the labor market for older workers.

Most of the countries in the international study by Gruber and Wise (1999), retirement is not granted before a specific age. In Brazil this is not the case, with a minimum number of years for retirement eligibility. Although the adjustment factor showed in Equation 7 creates some disincentives to early retirement, the penalties are not very steep. For example, a male worker who entered the labor force at age 20 and decides to retire at age 55 will have his benefit adjusted by 0.74, that is, he will receive a smaller benefit. If the same worker decides to stay longer the adjustment factor goes up to 1.04 at age 60 and 1.46 at age 65. In other words, entering the labor force at age 20 and leaving at age 65 means that the pension benefit will receive a 46% subsidy to the average of contribution wage.

Table 2 shows the base-case results. The simulation uses a worker who turned age sixty in 2002, not married, started working at the age of twenty, and receives the median wage in 2002. This worker has a complete earnings history and he has been registered in the social security system since the beginning of his working life. My base-case is similar to what was done for a series of countries in Gruber and Wise (1999). The same calculations can be made for a married worker with some changes in the formulas described earlier (See Gruber and Wise (1999) for details).

The retirement incentives measures, social security wealth and derivatives, are discounted back to age fifty-five by time preference rates and probability of survival. In the base-case, I use a 3% interest rate, but I perform a sensitivity analysis using 1% and 6% interest rates. I obtain the

probabilities of survival from the Brazilian National Statistics Office (IBGE). Following Gruber and Wise (1999), I use the probability of surviving to a certain age given that the individual survived to age fifty-five. This approach assumes a forward-looking individual, that is, a worker who at age fifty-four is considering retirement incentives at all future ages. I also perform a sensitivity analysis with the probabilities of mortality by using lower and higher mortality rates using a standard adjustment factor of 10% in either direction.

In my analysis, I follow the structure proposed by Gruber and Wise (1999). In the table, each row represents the last age he works, that is, in the first row I have represented a worker aged fifty-five who is considering to retire at age fifty-six.

The first column shows the replacement rate by age [7]. In the case of Brazil, since there is not a regulatory minimum age of retirement, individuals can start receiving benefits as soon as they fulfill the requirements. At the first age in which it is possible to claim benefits, replacement is about 32% of net labor income. The rate increases as the worker raises his pension benefit by delaying claiming. The social security benefit increases because workers replace lower wages received early in their careers with higher wages received later in life. The benefit formula also rises pension income for those who stay longer in the labor force[8]. The replacement rate increases monotonically with age. I do not observe any jump at a particular age such as the case of the United States when there is a clear jump in the replacement rate when the worker turns sixty-five (Gruber and Wise 1999). If my representative worker stays in the labor force until his sixty-fifth birthday, his social security benefits will replace 59% of his earnings.

Table 2 shows that my representative worker has a social security wealth of R$ 35 thousand by age 55, declining to R$ 29 thousand by age 65. The SSW ranges, approximately, from three to six times the labor earnings in a particular age. The wealth declines steadily with age and, as before, there is not a clear jump in the decline at any particular age. The examination of the pension accrual and accrual rate corroborates the previous findings. For a worker, with these specific characteristics, there is no incentive in delaying retirement to any particular age after he is eligible to claim benefits. Gruber and Wise (1999) show that for some countries there is a jump on the accrual rates at the first age in which pension benefits are available. For example, in the United States the accrual rate, for the median worker, jumps from -0.10 to 0.04 in his sixty-second birthday (Gruber andWise 1999).

The last column in Table 2 shows the implicit tax. The implicit tax is very high and increases monotonically with age, the tax ranges from 2.7 to 25.3 percent of net income for each particular age (year). There are two reasons that explain this results. The first one is the pattern of the social security replacement rate which increases rapidly with age. The second reason is due to the calculation of the pension benefit. The new formula introduced in 1999 penalizes workers who leave the labor force at younger ages. However, for those with long contribution history, the penalties decrease fast and after certain age the adjustment factor is equal to 100% or even higher (Ornelas and Vieira 1999).

The implicit tax, although lower than what is observed in some European countries, is much higher than what is observed in the United States. The representative worker during his sixtieth

[7] The Organization for Economic Co-operation and Development (OECD) estimates the average replacement rates in Brazil to be around 60% of worker's wage (Bonturi 2002).
[8] The benefit formula is explained and discussed in detail elsewhere (MPAS 2002).

birthday is forgoing R$ 1100,00 which amounts to 6.6% of his potential annual labor income. This happens because the system is not actuarially fair and does not compensate for individuals who remain in the labor force. The implicit tax increases more with age to the point that at age sixty-nine the worker would forgo over one-fourth of his potential yearly income.

The pattern of withdraw from the labor force is closely related to the incentives to retire intrinsic to the Brazilian pension system. For urban male workers there is not a clear peak in retirement age, and the probability of leaving the labor force increase steadily with age. Also, workers with the median level of education have higher probability of retirement than either more educated and less educated ones.

Table 2
Retirement Incentive Measures, Brazil, Base-Case Scenario, Brazil, 2002

Age	Replacement Rate %	SSW R$ (2002)	Accrual R$ (2002)	Accrual Rate %	Implicit Tax %
55	0.32	34589.45			
56	0.33	34466.86	-122.60	-0.004	0.031
57	0.34	34279.62	-187.24	-0.005	0.044
58	0.36	34031.60	.248.02	-0.007	0.053
59	0.36	33714.41	-317.19	-0.009	0.062
60	0.37	33332.92	-381.50	-0.011	0.067
61	0.41	32885.35	-447.56	-0.013	0.076
62	0.45	32369.59	-515.76	-0.016	0.085
63	0.49	31661.10	-708.49	-0.022	0.113
64	0.54	30763.10	-898.00	-0.028	0.139
65	0.59	29654.70	-1108.40	-0.036	0.167

Source: PNAD 2002, MPAS 2002.

4.1.1 Sensitivity analysis

The computation of the social security wealth (SSW) and other incentive measures are very dependent on the discount rate and mortality profile. It is reasonable to expect that the results are very sensitive to the rates and mortality schedule used. I simulate social security incentives under different assumptions to check the robustness of my results.

Table 3 shows the results of the sensitivity analysis performed on my base-case worker, 3% discount rate and 2002 life-table estimated by the IBGE, using 1% and 6% discount rates and a higher and lower mortality risks. The results are shown for a worker who worked until he was sixty years old. Figure 3 displays the implicit tax age-profile for the base-case and the alternative assumptions.

I use the same discount rates used in the economic literature and in Gruber and Wise (1999). I use a 10% mortality differential to estimate the base-case for high and low mortality scenarios. The baseline mortality is $\sigma_{(X)}$, the high mortality simulation is $1.1^{*}\sigma_{(X)}$ and the low mortality is $.9^{*}\sigma_{(X)}$. I chose this variation for convenience and to test the application of the model. It was not my objective to represent the reality observed in the country or to estimate different gain or losses across social groups.

The effects of differential mortality on the returns to social security are very important and relevant to the discussion of social security policy[9]. Afonso and Fernandes (2005) estimate social security rates of return in Brazil but do not take into account regional and/or social mortality differentials, which can affect the results they obtained. Rofman (1993) developed a methodology to assess the effects mortality differentials have on social security systems and found that they affect the redistributive feature of the pension plans in the United States.

Table 3
Incentive Measures - Sensitivity Analysis, worker aged 60

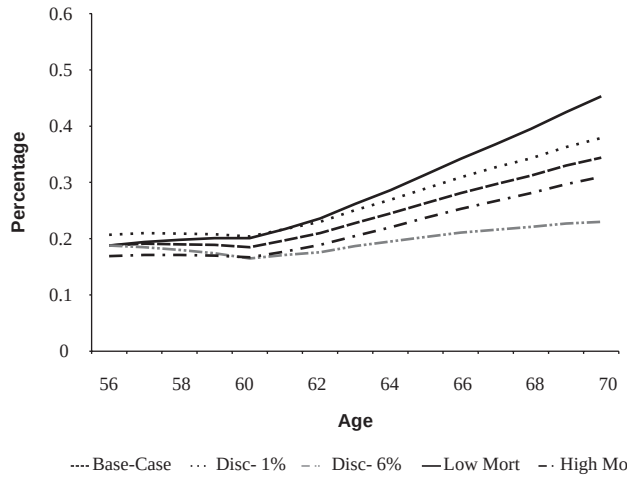
Parameter	Replacement Rate %	SSW R$ (2002)	Accrual R$ (2002)	Accrual Rate %	Implicit Tax %
Base-Case	0.37	33332.92	-381.50	-0.011	0.058
Discount = 1%	0.37	45839.79	-412.62	-0.009	0.063
Discount = 6%	0.37	21253.42	-340.11	-0.016	0.052
High Mortality	0.37	29999.62	-343.35	-0.011	0.065
Low Mortality	0.37	36666.21	-419.65	-0.011	0.052

Source: PNAD 2002, MPAS 2002.

The summary results in Table 3 and Figure 3 are not surprising. The computation using alternative assumptions result in expected differences in social security wealth and implicit tax. For example, higher discount rates and higher mortality risks result in lower social security wealth and lower implicit tax to work. On the other side lower mortality and lower discount rates increase social security wealth and the implicit tax on continued work. The age-profile of the implicit tax is pretty steady for all the scenarios studied, and despite variations in the levels by age the shape of the profiles is very similar.

[9] Although I do not estimate these returns in this dissertation they are part of my research interests. My results indicate the importance of taking mortality differentials into account when estimating social security rates of return as one can see by the differences observed using alternative levels of mortality.

Figure 3
Implicit Tax Age for different cases, Male Workers, Brazil, 2002



4.2 Other cases

Table 4 analyzes the same problem for a more educated worker. In this case, my representative worker has the same characteristics as the base-case worker except his earnings profile. I use the profile of a worker with more than 13 years of education. For this worker there is financial incentives to stay in the labor force longer when higher earnings later in the career substitute lower earnings early in the working life. An educated worker who retires at age 55 has R$ 97129.90 in social security wealth. There is then a increase in the wealth for working until age 62. This is because the worker will be able to replace lower earnings early in his working life for higher earnings later on. After this point, additional working years to do compensate for the higher chances the worker has to die and social security wealth declines.

The last column shows tax/subsidy to work. There is a small incentive to work until age 62. For example, in the fifth-six year there is a small subsidy of 4.2%. From age 62 on, the tax to work increases rapidly reaching 27.4% by age 69. This means that by age 69 the worker would be foregoing about one third of his potential labor income by staying in the labor force.

In comparison to the base-case scenario, a more educated worker has more incentives to stay in the labor force until certain age to replace low earnings early in life. After that point, implicit tax on work increases rapidly and by age 65 they are as high as the ones faced by the median worker.

Table 5 considers the old rules of retirement. The benefit is the mean monthly labor earnings during the past three years (MPAS 2002). I use the same lifetime earnings as before, but use a different formula to calculate benefits. Benefit replacement rates seem to be very high (around 85%). This finding is consistent with other work (MPAS 2002) and has one main reason. More

educated workers have a steeper earnings profile, and since calculation of benefits consider only past three years of earnings, the benefits are calculated when wages are at their peak and do not take into consideration lower earnings early in the career.

Table 4
Retirement Incentive Measures, Brazil, High Education Worker, 2002

Age	Replacement Rate %	SSW R$ (2002)	Accrual R$ (2002)	Accrual Rate %	Implicit Tax %
55	0.24	97126.90			
56	0.25	97593.42	466.52	0.005	-0.042
57	0.25	97992.22	398.81	0.004	-0.031
58	0.25	98261.38	269.16	0.003	-0.019
59	0.26	95521.31	259.93	0.003	-0.016
60	0.26	98703.74	182.59	0.002	-0.009
61	0.3	98798.64	94.74	0.001	-0.005
62	0.34	98791.84	-6.78	0.000	0.000
63	0.39	98009.39	-782.45	-0.008	0.037
64	0.44	96446.81	-1562.58	-0.016	0.072
65	0.49	94028.42	-2418.40	-0.025	0.108

Source: PNAD 2002, MPAS 2002.

Simulations also show that the old scheme produces strong effects on retirement decision of workers covered by the program. There seems to be a strong incentive to retire when benefits are first available under the old scheme. According to the calculation, at age 60 a worker's social security wealth amounts to six times the value of his annual earnings at age 60. The final column shows the implicit tax on work. This is a very high number, very close to the more generous countries studied by (Gruber and Wise 1999). The tax on working one additional year is about 50% of earnings in that year. The main reason for such high number is the large replacement rate implied by the old pension scheme.

The implicit tax age-profile corroborates the trends in labor force participation by SES group that shows low SES with higher participation than high SES groups. In addition to that, observed differences in replacement rates are congruent with recent empirical evidence showing that individuals receiving the lowest benefits have higher probability of returning to the labor market to increase their income (Liberato 2003).

The simulations show that the reform of 1998 has an important impact in reducing incentives to retirement, especially for the more educated and productive worker. For simplicity, the simulations shown here assumed that the new rules were operating throughout worker's life-cycle. This is not the case, since there is a transitional period from the old to the new regime and only younger generations of workers will have their benefits calculated following the regulations showed before. The simulations, however, provide evidence that the new system might have its expected impact in the near future by reducing incentives to retire and keeping older workers in the labor force.

Table 5
Retirement Incentive Measures under system old rules, Brazil, Highly Educated Worker, 2002

Age	Replacement Rate %	SSW R$ (2002)	Accrual R$ (2002)	Accrual Rate %	Implicit Tax %
55	0.81	225205.33			
56	0.82	218832.58	-6372.76	-0.028	0.578
57	0.78	212047.99	-6784.58	-0.031	0.533
58	0.77	204793.87	-7254.12	-0.034	0.500
59	0.76	197060.84	-7733.03	-0.038	0.463
60	0.76	188682.27	-8378.56	-0.043	0.433
61	0.85	179476.41	-9205.87	-0.049	0.462
62	0.91	169383.37	-10093.04	-0.056	0.491
63	0.94	158294.75	-11088.62	-0.065	0.524
64	0.94	146783.95	-11510.80	-0.073	0.528
65	0.94	135483.85	-11300.11	-0.077	0.503

Source: PNAD 2002, MPAS 2002.

5. International Comparison

It is important to compare the results from my study about Brazil to other countries presented in Gruber and Wise (1999). The authors coordinated an international research project to investigate the impacts of social security rules and regulations on retirement behavior. Although it is not possible to compare the levels of social security wealth across countries because of differences in currencies and standards of living, some of the estimated measures are comparable across different scenarios and are important to show the relation between social security financial incentives and retirement.

Table 6 presents a summary of the results for the eleven countries included in the first phase of the project (Gruber and Wise 1999). The table presents the main results of the study and contains information on labor force participation, replacement rate, pension accrual, and implicit tax. The social security replacement rate for sixty-year old in Brazil is about 40%. Brazil replacement rates situates in the bottom level of the countries studied by Gruber and Wise (1999) yet is more generous than the Canadian, American and British systems and as generous as the Swedish and Japanese ones. The accrual rate and implicit tax on work are also similar to the bottom distribution of the developed countries.

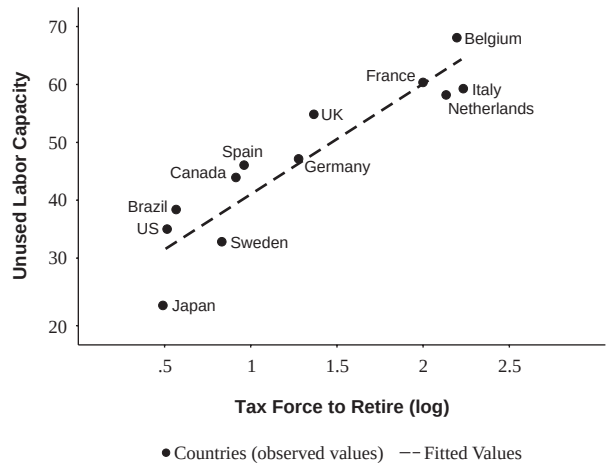
The comparison shows that the social security system is as generous as pension systems from countries with much greater levels of income. The replacement rate measures the generosity of the pension systems in the developed world. The rate at which pension benefits replace net earnings can be as high as 91%, the case of France and the Netherlands, at early retirement ages. On average, the eleven countries studied by Gruber and Wise (1999) have a replacement rate of 61.45%. A high replacement rate has significant impacts on the individual's decision whether to

remain in the labor force. The more dramatic point, however, is that most of the countries have a statutory minimum retirement age that does not exist in the Brazilian case.

In general, the study shows that pension accrual is negative for most of the countries. That is, an additional year of work reduces pension benefits to be received over the retirement years. The negative accrual implies an implicit tax on work, which creates incentives to retire. It is important to provide an example to clarify the meaning of the implicit tax. For instance, for a worker in France who decides to work during his sixtieth year, the early retirement age, it means forgoing 80% of what he would earn during that year. A more dramatic example is the Netherlands. If the worker decides to stay in the labor force when she reaches the early retirement age he would be forgoing 141% of the potential earnings for that year. The system, for most countries, is not actuarially fair regarding adjustment of pension benefits therefore creating incentives to early retirement.

Figure 4 shows the relation between unused labor capacity and the tax force to retire, based on the results presented by Gruber and Wise (1999) and my previous estimates for the median worker in Brazil (Base-Case). This relation indicates that more generous pension systems create incentives to worker's retirement when benefits are available. Unused labor capacity is the sum of the proportion of individuals out of the labor force in some age group, and tax force to retire is the sum of the implied tax on continued work. I plot the relation between unused labor capacity between ages 55 and 65 and the logarithm of the tax force to retire from ages 60 and 69. The relation is clear, there is strong correlation between unused capacity and incentives to leave the labor force. The dashed line shows the fitted values. Retirement incentives explain 80% of the variation in unused capacity.

Figure 4
Unused Labor Capacity vs Tax Force to Retire



Source: Gruber and Wise (1999) & Queiroz (2005) for Brazil.

Table 6
Unused labor capacity, incentive measures, retirement rate at early retirement age, by country

Country	Unused LF 55-65	Men not in LF at age 59	Early Ret. Age	Replacement Rate ER	Accrual Rate %	Implicit Tax %	Tax Force	Hazard Rate ER %
Belgium	67	58	60	77	-5.6	82	8.87	33
France	60	53	60	91	-7.0	80	7.25	65
Italy	59	53	55	75	-5.8	81	9.2	10
Netherlands	58	47	60	91	-12.8	141	8.32	70
United Kingdom	55	38	60	48	-10.0	75	3.77	22
Germany	48	34	60	62	-4.1	35	3.45	55
Spain	47	36	60	63	4.2	-23	2.49	20
Canada	45	37	60	20	-1.0	8	2.37	32
United States	37	26	62	41	0.2	-1	1.57	25
Sweden	35	26	60	54	-4.1	28	2.18	5
Japan	22	13	60	54	-3.9	47	1.65	12
Brazil	40	36	"60"	37	-1.1	5.8	1.62	10

Source: Gruber and Wise (1999) and Author's Calculations For Brazilian Median Education Worker.

6. Conclusions

The social security program, more specifically the incentives inherent to the system, is an important element considered by the worker when deciding whether or not to stay in the labor force. Although the system is not yet universal there is evidence from the simulations performed in this paper, and the trends in labor force participation that the Brazilian pension system creates incentives to retirement and affects the age of retirement.

In this paper, I showed the implicit tax on continued work to an individual with certain characteristics. I found that for an educated male resident in the urban areas, the implicit tax on working increases steady with age and amounts to over one-third of his potential earnings by the age of sixty-nine. The system creates heterogeneous incentives according to worker's characteristics such as the case of mortality differentials. The system's heterogeneity is also observed for workers with different periods of contribution to the system and earnings histories.

I conclude that the social security system in Brazil plays an important role in reducing the labor force participation of older workers and affecting, negatively, the potential working capacity of the population. Since the relative generosity of the system, shown by the increase in implicit tax on work by age, the social security reform should focus on creating incentives for older workers to remain in the labor force. The reform should create mechanism to compensate longer careers with higher pension benefits. It is clear that changes in the benefits scheme will play an important role in reversing the trend towards early retirement. Reversing this trend will act as a cushion to the impacts demographic changes will have on the pension systems in Brazil and around the world.

The results show the importance of continued research in this area. The results could be improved with better data on labor earnings histories and social security taxes paid, instead of

relying on a cross-section to construct these profiles. Unfortunately, there is a lack of high-quality data of this sort in Brazil. Also, the construction of a long-series of longitudinal data focused on the elderly, covering information on retirement and health will be fundamental to future research. As the Brazilian population ages, public welfare programs and public policies will play a major role in the well-being of the population and it relevant to understand how individuals respond to policies before elaborating a new one.

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