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CHANGING RETIREMENT AGES: THE WELFARE EFFECTS

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Abstract:

Nowadays, many countries are facing severe problems to finance their Social Security Systems.
Most systems are financed on a pay-as-you-go basis, where financial problems come from two main sources. On the one hand, most of them are now reaching maturity. This means that an important part of the retired population is now entitled to receive full pensions. On the other hand, the decline in birth rates, together with a higher life expectancy, increase the dependency rate, and, therefore, the active generations have to sustain a growing number of retired persons. A standard method to confront these two situations is to raise the retirement age. This increases the number of years individuals contribute to the system and decreases the number of years they receive benefits from it.
This paper evaluates the welfare impact of the change in retirement ages that took place in Chile in 1979. This evaluation also considers the reform in the system's financing method, from pay-as-you-go to full funding. We find that the negative impact on the welfare of older workers of an increase in retirement ages can be reduced or increased, depending on how the transition from a pay-as-you-go system to a fully funded one is financed.

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1. Introduction

Nowadays, many countries are confronting problems financing their Social Security Systems. This situation affects both industrialized and developing countries who run their systems on a pay-as-you-go (PAYG) basis.

On such a system, the problems come two main sources. First, the excessively permissive pension benefits that are usually legislated. Most systems in the world were created or suffered a big expansion after the Second World War, and although many of them were supposed to be funded, political intervention prevented them. The systems began to spend on other items the funds that were supposed to finance future pensions. This was possible financially because the systems were young (*i. e.*, few people were entitled to receive pension benefits).

Permissive policies in pension benefits can take different shape. One, is using the funds not currently needed to finance health programs (as in Chile, Mexico and Ecuador, among others) and housing. The other is to give generous pensions to the retired, reduce the requirements to be entitled for a pension (for example, fewer years of contribution or a lower retirement age), or both.

Second, the falling rate of population growth and an increase in life expectancy. This is particularly relevant for industrial countries. Even a country that has not been excessively liberal in the promised benefits at the beginning of the system, will have financing problems if the ratio between retired and active workers increases. The dependency ratio (the population over 65 as a percentage of the population aged 15-64) for the OECD as a whole, is predicted to rise from about 19% in 1990 to 28% by 2020, and to 37% by 2040. This means that the number of economically active persons per pensioner, will fall from the current 5.3, to 2.7 in the year 2040. If the system's coverage does not change, it will mean doubling contribution rates fifty years from now, for benefits to be mantained.

Whatever the source of the problem, the policies that can be used to manage them are similar. One policy is to raise contribution rates. This is difficult considering that total contribution rates are 30% or higher. For example, in Germany, total contribution rates including health and others have risen from 30% in 1975, to 40% in 1994. This imposes a big burden on the formal labour market, increasing the incentives to underdeclare wages or to evade contributions.

A second option is to decrease benefits for pensioners. This can be done by fixing pension levels in real terms, *i.e.*, adjusting their evolution to Consumer Price index instead of increasing in earnings. However, this will create a growing income gap between pensioners and active workers that could become politically unacceptable.

A third policy is to increase the age of retirement. This policy is particulary useful in countries with extremely liberal retirement conditions, such as 35 years of contribution or 55 years of age. These conditions are clearly the product of excessive funds in the system during the first years of operation. Other countries, with conditions which are not as liberal, such as retirement at the age of 60, are also changing the retirement age, to 65 –as Chile in 1979 and recently Germany, Italy and Japan, or to 67– as in USA, where this measure will come fully into effect over 30 years.

Increasing retirement age alleviates the deficit in a PAYG system by acting on two fronts. On the one hand, workers contribute to the system for more years, increasing total income in any given year. On the other hand, it reduces the years of retirement, thus reducing total expenditures of the system in any given year. From the individual point of view, these effects are very strong, because not only the pension is delayed, but also, the individual has to contribute during those extra years, and this extra contribution does not entitle him for any additional benefit. The loss for those affected by this change is even greater in countries where pension benefits are linked with earnings in the last active years, because after age 60, returns from work tend to diminish with age. Thus, not only they will receive a pension for fewer years, but also a lower level because it will be determined by a lower salary base.

This paper focuses on the welfare impact this measure had on different generations, in the Chilean pension reform of 1979.

In Chile before 1979, there were many different retirement programs. Some of them allowed retirement at the age of 55 (and 35 years of contribution), for male workers, and at the age of 50 (and 30 or 20 of contribution, depending on the number of children) for female workers. In 1979 the age of retirement was set uniformly at 65 years of age for male workers and at 60 for female workers. Two years later, the system was changed from a PAYG to a fully funded (FF) one. All new workers had to affiliate to the new system, while those in the PAYG could change to the FF if they decided to do so.

In the Chilean case, the new retirement conditions, together with higher expected returns (Piñera, 1991) allowed the FF system to charge a 10% contribution. This compared favorably with the 19.9% that the employees pension program was requiring in the PAYG system. This reduction was not shared by those who remained in the PAYG system. Depending of the relative rates of return in the two systems, it is posible that part of the contribution in the old system was a pure tax that helped to finance the transition to the new system. Arellano (1985) estimated that assuming a change in the retirement age from 55 to 65 years of age, the necessary contribution rate for a given pension would have fallen to between 9.2% and 7.6%, in the old system for discount rates of 2% and 5% respectively. Using a general equilibrium methodology, Arrau estimated that such a change in retirement ages would have allowed a reduction in contribution rates from 14.8% to 4.9% in the old system.

However, this would happen only if the PAYG system was left with a cash surplus after the increase in retirement ages, a point which has not been documented in the literature.

It is important to emphasize two additional points. First, both measurements tend to overestimate the reduction that could have been allowed by the change in retirement ages, because an extreme case was considered, in which all workers retire at 55. According to Arellano himself, in 1971 only one fifth of the pensioners of the private employees institution had retired at that age. Second, the reduction in contribution rates is only gradual in time, so the new level can be reached only when there are no pensioners younger than the new retirement age.

This paper simulates the change in retirement ages in a general equilibrium context, evaluating the impact of this reform on the welfare of the different generations involved. Then, we simulate the transition from PAYG to FF together with the change in retirement ages. This will allow us to compare the change in welfare of those who changed to the FF system with those who remained in the PAYG system.

This paper is organized as follows. Section 2 presents the model and the values chosen for its different parameters. Section 3 explains and discusses the changes in retirement ages in the context of a simultaneous reform in the financing method, and explores different ways in which this can be done. Section 4 presents the macroeconomics and welfare results of the simulations and section 5 summarizes the main results of this work.

2. The Model

The model used for the simulations is based on Arrau (1991), which in turn is based on the dynamic simulation model of Auerbach and Kotlikoff (1987). This section will briefly discuss its main features. For a more in-depth discussion on the model and on the values chosen for some parameters, see Arrau (1991) and Cifuentes (1993). The model is one of overlapping generations, where there are 55 generations alive in every year.

Preferences

There is one representative agent in each generation, who maximizes the following utility function:

$$Y = 1/(1 - 1/\gamma) \sum_{t=1}^{55} (1 + \delta)^{-(t-1)} C_t^{(1-1/\gamma)}$$

where γ is the constant elasticity of intertemporal substitution in consumption, and δ is the rate of intertemporal preference. The individual lives for 55 years, where in the first 45 she is endowed with labor ability. This can be seen as the case of someone who works from age 21 until 65, and then retires for 10 years dying at age 75. The utility function used is additively separable across time periods and exhibits constant elasticity of intertemporal substitution in consumption.

The individual has income from her labour, that she supplies inelastically to wages, and from the pensions that she receives during her retirement. Her labour endowment is a function of experience and of technical progress. On the basis of experience alone, the labor endowment grows until age 60 and then declines slightly, according to an age-earnings profile derived by Arrau (1991) from chilean data. Arrau estimated this profile from a cross section of wages, assuming that labor productivity growth was 2% per year and that labor productivity increases are received only by the generations that start to work that year.

This model assumes rational expectations, in the sense that relevant future prices (wages, real interest rates and tax rates) are perfectly anticipated. The only restriction to consumption is life-cycle income. Therefore, the individual can acquire debts with the only restriction of having enough future income to pay it back, even if this implies giving human capital as collateral.

Firms

Firms hire labour and capital every period to produce output, with a Cobb-Douglas production function with depreciation. Output is consumed or invested to create capital, with no installation costs. The net production function is:

$$Y_t = K_t^{1-\beta} L_t^{\beta} - \alpha K_t$$

where β is the labour's share, that we assume to be 65%, and α is depreciation rate of the capital stock, which we set at 3.5%. Firms pay factors their marginal productivity.

The supply of labor is fixed, as it has been said, while the supply of capital is determined from the savings of the individuals minus the net debt issued by the government.

Government

There is a government sector that spends resources in consumption every period. Following Arrau (1991), we asume this expenditure to be 13% of GDP as representative of the chilean economy over the last thirty years.

The government collects income taxes and has a recorded net public debt of 25% percent of GDP. This debt is renewed every year paying market interest rates. Income taxes are used to pay for public consumption and the interest on debt that cannot be financed with the new debt that is issued as GDP grows.

At the same time, the government is responsible for the pension system. On the PAYG system it collects contribution charges on wages, that allows it to finance a pension equivalent to 70% of the last salary. At the moment of the reform, the system is financed charging a contribution rate of 9.6%. This rate may sound small compared with rates in real PAYG systems. First, it must be remembered that this rate only finances old age pensions. It does not cover other insurance, such as health, disability or unemployment. Second, all workers contribute every year since the age of 21 until pension age, fixed at 60.[1] So, there are 40 years of contributions to the PAYG, without interruptions due to temporary withdrawals from the labor force or to unemployment and no evasion.

When the pension system is changed to a FF one, the government imposes mandatory contributions to the pension funds, and takes the responsability for the pensions of the old system.

Note that the income tax distorts the saving decisions, because it is applied to the earnings of capital, as well as to the earnings of labor. Labor is inelastically supplied, so the income tax does not distort this decision, and neither do social security contributions, while savings supply reacts to changes in prices.

Market Equilibrium

The asset market equilibrium introduces an additional restriction, by equating savings demands by firms and the government with savings supply by individuals. This condition endogenously determines the real rate of return. The condition is:

$$K_t + B_t = \sum_{s=1}^{55} F(s) (1 + n)^{-(s-1)}$$

where K represents the stock demand for physical capital by firms, B the stock of government debt, F(s) the savings (stock) supplied by generation of age s, and n the rate of population growth, that we suppose equal to 2%.

The equilibrium in the labor market requires real wages to adjust until firms' demand for labour equals the supply of labour by households. The aggregate supply of labor is influenced by the age earnings profile, the rate of population growth and the rate of technical progress in labor productivity. The condition is:

$$L = \sum_{s=1}^{55} l(s)\,(1+n)^{-(s-1)}\,(1+\chi)^{-(s-1)}$$

where L is the demand for labor by firms, w the wage rate, l(s) the supply of effective labor units by the individual of age s, and χ the rate of labor productivity, exogenously fixed at 2% as was already stated. Workers supply labor until the age of 45 (65 in effective age) independently of the pension age. This means that if some system allows earlier retirement this will not affect labor supply to the economy.

3. A Change in Pension Ages with a Change in the Financing Method

3.1. *Changing retirement age: some alternatives*

Increasing pension age is an effective measure to improve the financial situation of a PAYG system, but a hard measure for the active workers that have to suffer it. This is specially true for those who are close to retirement and have less time to prepare a smooth accomodation to their new financial situation.

The impact on individual wealth is composed of two parts. One is the impact on pension benefits. They are not only delayed, but also reduced, because the lost benefits are not going to be received in the future in any form. As mentioned earlier, benefits are also reduced if the benefit formula relates pensions with the last salaries that were received, and usually wages are declining between the ages of 60 and 65.

The second part corresponds to the contribution for the wages earned in the extra years of work. This contribution is a pure tax because it does not change the pension the worker will receive, if she was alredy entitled to receive a pension when retiring at the previously set age.

One way to make this change less dramatic for the generations involved, is to increase retirement age gradually, acording to the years left until retirement. The next table shows the retirement age[2] according to age at the moment of the reform in the chilean case. These are the figures used for the simulations in this paper.

TABLE 1

PENSION AGES FOR THOSE WHO PREVIOUSLY PENSIONED AT 60

Current Age	New Pension Age
60 or more	–
59	61
58	62
57	63
56	64
55 or less	65

This transition reduced the costs for those who were very close to the old retirement age and had less time to adapt to the new situation.

This is not the only way to implement a change in retirement ages. In Japan the change in the retirement ages took the form of only a reduction in benefits received by pensioners. In this case, the worker receives "reduced benefit" between the ages of 60 and 64, and receives her full entitled pension only at 65.

3.2. *Changing the Retirement Ages Combined with a Change in Financing*

The problem here is how to recognize the contributions done to the PAYG system by a worker who is changing to the FF system. In the chilean case a "Recognition Bond" was calculated for these cases. A further question is: Does the formula used to calculate the recognition bond acknowledge the change in pension ages? Since the chilean formula did not consider the age of the worker, it is possible to anticipate that some generations will gain if they change to the FF system, while others will lose. To make this clear, we will separate the formula in two. One part refered to benefits and the other to the contributions to the PAYG system.

On the benefits side, chilean law calculates annualized earnings in the last 12 months,[3] and multiplies them by 0.8, which is the replacement rate.[4] The resulting number represents the pension that a worker will receive in a year (the annualized pension).

Let us suppose a worker contributed the number of years required by law to obtain full benefits; the question now is: During how many years will she receive this benefit? In the Chilean recognition bond calculation formula, the annualized pension is multiplied by 10.35. This number must be compared with the annual factors in the annuities market, to establish its adequacy.

Arrau (1991) presents some evidence for the chilean market in December 1990, where annual factors for a man of 65 ranged from 10.28 to 12.08, depending on marital status and the number of sons under 18. This supports the idea that the benefit formula of the recognition bond assumed the new pension age applied, as the annual factor used is similar to that in the annuities market for a man of 65. The problem with this comparison is that market data were obtained nine years after the law was put into practice, and changes in life expectancy and reductions in long term interest rates could increase that factor.

To determine what fraction of the total benefit a worker is actually entitled to receive, the recognition bond calculation formula takes her years of contribution and divides them by 35. Thus, workers with 35 years of contribution receive full benefit. However, this benchmark seems more adecuate for a system with retirement at 60. As a matter of fact, programs in the Chilean PAYG system that allowed retirement after 35 years, normally implied retirement between 55 and 60. On the contribution side, it can be said that the recognition bond did not change retirement age.

In terms of section 3.1, the recognition bond formula reduces benefits as if there is a change in retirement age without increasing the years of contribution. This can be an incentive to change to a FF system for those generations that otherwise will have to face the complete change in retirement age. Once the bond is calculated, it earns a fixed 4% interest rate until the new retirement age of 65. At that moment, the bond is redeemed and is transferred to the individual account and starts earning the pension fund's return.

3.3. *Modelling the Chilean Reform*

Some assumptions are useful in order to simplify the modelling of the transition. The first simplifying assumption is that the change in the retirement age and in the financing method ocurred together in 1981, while in reality the former ocurred in 1979 and the latter in 1981. The second assumption refers to the age composition of workers that stayed in the old system and of those who changed. In reality, the trend was that younger people changed to the FF in a larger proportion. Yet, some people over 60 changed system while some under thirty remained in the old one.[5] For the simulation, we assumed that every worker under fifty changed to the new system, while older ones remained in the PAYG. This roughly replicates real life effects.

4. Changing Retirement Ages: The Macroeconomic and Welfare Effects

In this section we show the macroeconomic and welfare effects of changing retirement ages. First we simulate this case without any other change in the pension system.

For the first case, we have assumed that the PAYG pension system is financially balanced. The alternative assumption of a deficit in the pension system does not make a qualitative difference. If we assume a previous deficit, then we have to assume some policy to finance this deficit. If it was financed with income taxes, then a change in retirement ages that balances the pensions system will bring benefits to the economy. This is so because a distortionary tax, the income tax, will be replaced with a non-distortionary tax, the social security contribution. This contribution is non-distortionary because labour supply is inelastic. The alternative of financing a previous deficit through debt is similar, in so far as increasing debt increases interest payments and this has to be financed through taxes.

This assumption take us closer to the Chilean case, where available information shows a situation closer to equilibrium in pension programs in the late '70s, after some adjustment in the previous years to the pension levels and in the control of evasion.[6] It can also be the case of a system that is financially balanced, but is facing changes in the age structure of population.

The next step is to define a policy for the public sector to adjust its new flows of income and expenditure. If the system was previously balanced, then the surplus in the pensions system has to be spent in some way. The alternative of increasing pensions is not interesting because we are trying to evaluate precisely the case of a change in retirement ages without any direct compensation. The natural alternative of increasing public expenditure is also forbidden, because public consumption is not an argument of the individual utility function in this model, so will be unable to account for the associated increase in welfare.

An alternative to increasing public expenditure, is to give income subsidies to the population through a reduction in income tax rates. In this case, results have to be carefully evaluated because, as income taxes are replaced by wage taxes, distortions in the economy will be reduced in the context of our model, as explained above. Another available policy is to use the funds to decrease public debt and, eventually, to accumulate public assets. In this paper we have tested various combinations of these two alternatives.

The second simulation considers a case where the change in retirement age occurs simultaneously with a reform from a PAYG to a FF pension system. Those who change to the FF system receive a recognition bond calculated on the assumption that retirement ages have changed. Thus, the benefit is supposed to cover from the age of 65 until death. On the contribution side, the worker is supposed to contribute until 65 (*i. e.*, 45 years of contributions). So, we are giving less generous bonds than in the chilean case, assuming that retirement age has changed for the calculation of the recognition bond.

We consider two financing methods for the transition deficit that the change from PAYG to FF generates, because of those retired in the PAYG system that will not be covered by the contributions of the workers that stayed in that system and by the recognition bonds issued.

The first financing method asumes that all the transition deficit will be financed with income taxes. The second method uses public debt to finance the deficit and as much debt as possible to finance interest payments on this debt. The limit to this is growth of GDP: because the market interest rate exceeds GDP's rate of growth, if all interest payments were financed through public debt, there would be an unbounded growth of debt in relation to the GDP. In this case, the tax rate will have to grow to cover the payment of interest on the public debt that cannot be covered with new debt.

The macroeconomic effects of financing a social security reform with these tools, have been discussed in Arrau (1991), Cifuentes (1993) and Arrau & Schmidt-Hebbel (1993). To understand the macroeconomic results, it is essential to note that in a PAYG system there is a stock of public debt not registered in the public sector's accounting, whose only difference with "official" public debt is that, while the latter pays market interest rates, the former pays a return given by the growth of the mass of wages that pay contributions. The growth of this mass depends on the growth of the labor force, productivity and the system's coverage. Thus, a reform in the method of financing Social Security can be seen as a change in the composition and/or level of public debt. Macroeconomic effects can be directly derived from this.

If the transition is financed with taxes, the implicit debt in the PAYG system will disappear. This means that in the long run the economy will have a bigger capital stock, because the stock of debt rebought by public sector "crowds in" capital formation. But this have costs, and the generations alive during the transition will have to pay higher taxes to finance the debt purchase.

When the transition is financed through debt, the only effect at the macroeconomic level is that now all the debt is being recognized explicitly and all of it pays market interest rates. This implies higher income tax rates to finance the higher cost of the debt. This will have a macroeconomic impact, specially because a distortionary tax is being increased. But this impact is lower than the one that would occur if all the debt issued to finance the social security deficit where effectively new debt issued and not only an adjusment in the interest rates paid.

Finally, we need to explain the method we use to measure welfare change. We use the so called Compensatory Variation. We take the value of the utility function of an individual in the year of the reform, which takes into account the consumption from that year onwards. Then we take the value of the utility function for this same period, but after the reform. After, we compare these two figures and change the wealth of the individual in the last situation, until she reaches the same utility level. If the change is positive, it means the individual is worse off after the reform, because she needs a positive change in wealth to reach an utility level similar to the previous one. The

figures presented below change the sign of the percentages, so a negative percentage means a loss and a positive one means a gain in welfare.

Note that the measured welfare refers to the wealth each individual has at the moment of the reform. This wealth will be different for different generations, because they are in different periods of their life-cycle and also because different generations have different labor productivity levels, meaning that effective payments to labor are different. It could be also different if individuals had different savings behaviors, *i. e.*, different time preferences. But this is not the case, as we are asuming the same time preferences for different generations. This means that the real resources involved in a change of, say, 1% for the generation of 65 years old at the reform are much lesser than the resources involved in a change of 1% of any other generations. In other words what we compare is the impact of the change as a proportion of the remaining wealth of each generation as of the reform date, not in real resources.

4.1. *Transition One: Change in Pension Ages*

In this case, workers under 60 years of age are gr. dually affected by a change in retirement ages and they do not receive anything from this. The simulations below assume that initially the surplus is used to reduce public debt or accumulate public assets until some desired level. After achieving that level, the surplus is used to reduce income tax rates, reducing the level of distortions in the economy from then onwards. The reduction in debt improves the macroeconomic environment, benefiting live generations and future ones. Reduction in taxes gives more inm diate benefits to population, through increases in disposable income.

The main result at a macroeconomic level is that this change increases private savings. This is so, because resources for retirement are reduced, and individuals adjust life-cycle consumption reducing consumption when young. Reductions in public debt by the government also help capital accumulation, "crowding in" physical capital. Finally, reducing income taxes reduces distortions against savings, increasing capital accumulation. This will benefit generations alive in the future, who will live in an economy with more capita and less distorted.

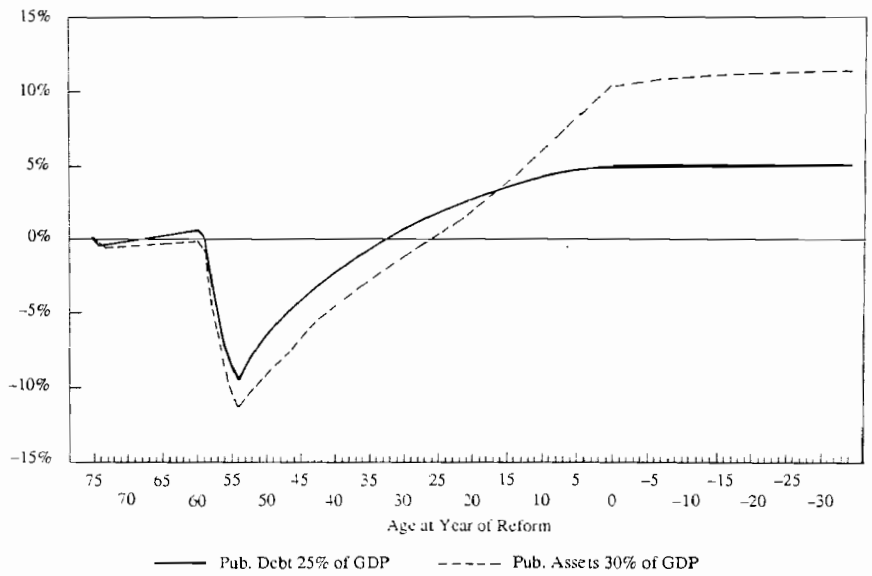
Figure 1 shows the welfare changes for different generations in two extreme cases. In the first case, we used the surplus to reduce taxes, leaving public debt untouched. In the second case, public debt was eliminated and public assets accumulated until a level of 30% of GDP. The horizontal axis shows the age at the year of the reform.

Generations retired at the reform year suffer a small loss in welfare. This is so because their wealth is mainly physical assets, whose return falls due to the increase in private savings described above. Yet, they can compensate this loss if taxes are reduced as in the first case mentioned. Generations under 60 have to face the change in retirement ages very close to their retirement and they suffer a big impact on wealth even if the income tax rate is reduced since the first year. The bigger impact is for those 55 years old, who have to face the full change. Their loss is a 9.4% of their wealth when taxes are reduced and 11.4% in the other case. Younger generations can gradually compensate these loses, because they live more time in an economy with more capital and lower income taxes.

The reform allows the government to increase fiscal earnings from social security contributions, from 5.8% to 6.2% of GDP, and reduce expenditures from 5.8% to 3.0% of GDP. This gives the government an improvement in the primary deficit of 3.2% of

FIGURE 1

INTERGENERATIONAL WELFARE CHANGES
Change in Retirement Ages



GDP for the long run. Table 2 compares long-run changes in GDP and welfare for different combinations of reduction of debt and income tax rates.

This shows that even in the case where public debt is not reduced, reduction in income taxes from 15.7% to 12.3%, enables the economy to reach a product which is 3.5% higher. We simulated a case where tax rates and public debt were held constant, so the surplus was used to increase public expenditure. In this case, GDP increases 1.7% due to the increase in savings for retirement. So, the difference between 3.5% and 1.7% is the effect on the product due to the reductions in distortions associated to the reduction in income taxes.

Tables 1 to 4 in the appendix show the evolution of some macroeconomic variables for the simulations presented here.

4.2. *Transition two: PAYG to FF with changes in pension ages*

In this section we simulate the case of a reform from PAYG to FF with simultaneous change in retirement ages.

Figure 2 shows the evolution of the deficit in the case where retirement ages are changed gradually from 60 to 65. The jump that can be seen at year 18 of the transition is due to the recognition bonds that begin to mature in that year. This a consequence of

TABLE 2

LONG-RUN CHANGE IN WELFARE, PRODUCT AND INCOME TAX RATES WITH CHANGES IN PUBLIC DEBT[a/]

Long-run Public Debt (% GDP)	Income Tax Rate (%)	Change in Product (%)	Change in Welfare (%)
25.0	12.3	3.5	5.1
10.7	11.5	4.6	6.8
0.5	11.0	5.4	8.0
-30.0	9.6	7.6	11.4

a/ In the year of reform, Public Debt was 25% and Income Tax Rate was 15.7% of GDP.

assuming that under fifty years of age everybody changed to the new system. If we had allowed in every generation some workers to change we would have not had the decline in the deficit that begins in year 12 and then the jump in year 18 of the transition. The deficit would have had a smoother evolution, but the real resources involved would have been the same.

Figure 3 shows the welfare situation of the different generations, and can be seen the big impact that the change in pension ages cause over the generations alive during the transition, specially those in the PAYG.

Figure 4 shows in more detail the welfare change for those alive at the moment of the reform. In the case of tax financing, almost every active generation loses. Only generations under 35 have a positive change in wealth. This is due to the increase in the income tax rates that are needed to finance a much higher explicit public debt. The generations retired at reform have to pay higher taxes on the returns of their savings. The active generations over 55 are gradually affected by the change in retirement ages. The bigger impact is on the individuals of 55 years of age, who face the full change in retirement ages. With these financing method all generations between 50 and 59 years suffer losses of more than 10% of their remaining wealth, in some cases reaching 15%. These losses are bigger than those obtained when as of the reform date the only change was on retirement ages. But the most important difference now, is with those who change to the FF system. They can reduce their losses because they receive a higher rate of return on their contributions, *i.e.* they can evade the tax levied on the contributions of those who remained in the PAYG. This is so because the return on their contributions to the new system will be fair, at a higher rate of return. The change in retirement ages affects them, but only in the past contributions that are the basis to calculate the recognition bond.

With time, new generations are also being benefited with the lower income tax rates, and by the increase in the wages due to a higher capital per-capita. Table 4 at the appendix, shows how capital is increasing as debt hidden in the PAYG system is being retired. In the long run, the bigger capital stock of the economy generates an increase in welfare valued in more than 10% of life-cycle wealth before the reform.

In the case of debt financing, most generations retired at the moment of reform have gains. In this case the tax rate increase slowly through time while interest rates

FIGURE 2

SOCIAL SECURITY DEFICIT
(% of GDP)

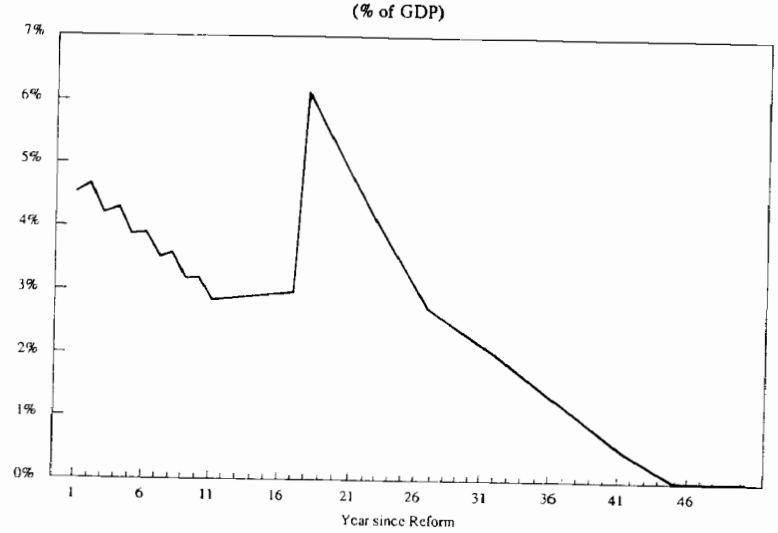


FIGURE 3

INTERGENERATIONAL WELFARE CHANGES
From PAYG to FF

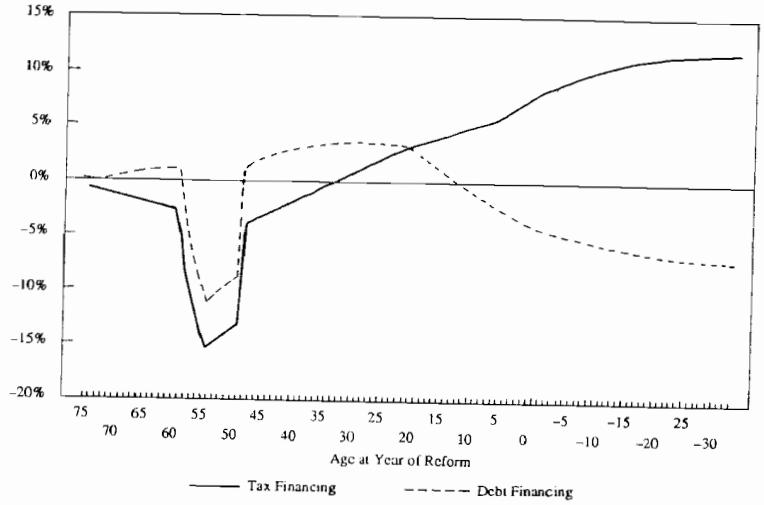
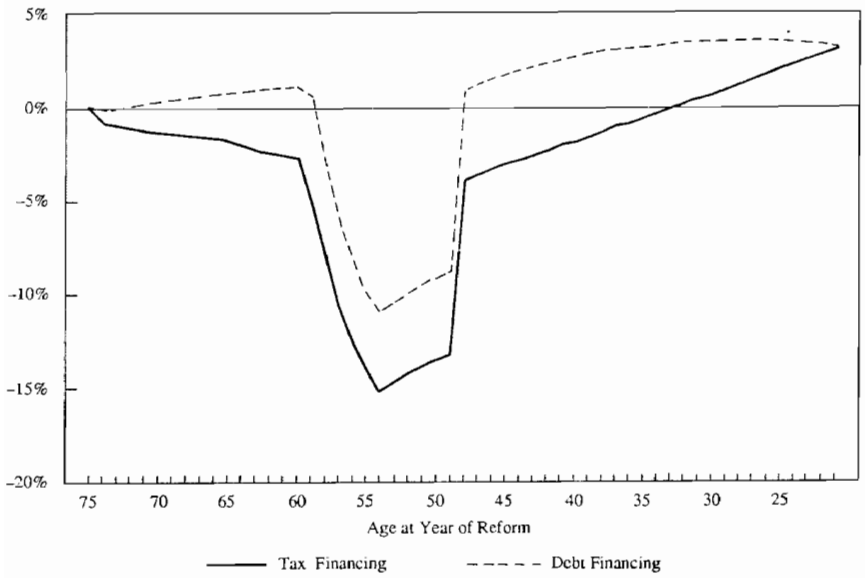


FIGURE 4

INTERGENERATIONAL WELFARE CHANGES
From PAYG to FF



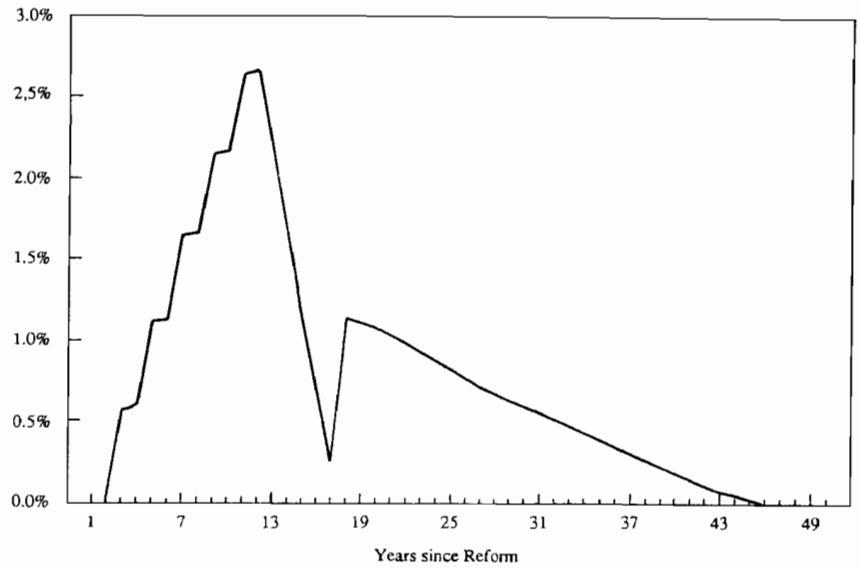
also increase. Pensioners benefit from this as long as they have positive savings. The loss for the generations on their fifties at the reform, reaches the level of 10% of their remaining wealth as of the reform date in almost every case. Generations that changed to the new system will have a much higher return on their pension contributions, and this gains will compensate the losses of the higher income tax rates. In the longer run, the economy will have less capital, which means less wages and product, and higher taxes to finance the higher interest rates that pays the public debt. Note that the amount of debt as percentage of GDP is the same as before the reform, because in that case the PAYG debt was not recognized. The difference now is only the higher return that this debt pays.

Figure 5 shows the reduction in the transition deficit due to the change in retirement ages when compared with a case where the reform to FF is held without a change in retirement ages. This saving is due to more years of contributions, less years of pensions and lower levels of recognition bonds.

It has to be noted that the loss of the generations on their fifties is larger than that of the other generations (retired and younger) measured as a fraction of remaining wealth as of the reform date. It also has to be noted that the representative agent in this model has a low time preference (2%), which means that she saves voluntary for her retirement. This means in turn that voluntary savings at her fifties is reasonably high. If we think about an individual that saves less or does not save at all voluntarilly for old

FIGURE 5

REDUCTION IN TRANSITION DEFICIT
(% of GDP)



age and relies completely on pensions from maintenance, the loss as a percentage of her wealth will be very much higher.

Tables 5 and 6 in the appendix show the evolution of the macroeconomic variables for the simulations reported in this point.

5. Conclusions

This paper evaluates the option of changing retirement ages as a way to deal with the financial problems in a PAYG system. This measure has good results in terms of the financial situation of the system, but is a hard measure from the point of view of the individuals affected by it. This is specially true for active workers close to the previous retirement ages.

This paper intented to give a measure to that loss in welfare in terms of individual remaining wealth as of the reform date. We find that this loss could be valuated in about 10 to 15% of the wealth of the most affected generations. But it is important to note that this value assumes that the individual saves voluntarily for retirement, so she has a reasonable financial savings her fifties. But if we think about somebody who does not save voluntarity for retirement, the loss in terms of her current wealth will be much higher.

Appendix

TABLE 1

CHANGE IN RETIREMENT AGES
Debt Fixed at 25%, Income Taxes Adjust

	Real Interest Rate (%)	Income Growth (%)	Investment Rate (% GDP)	Private Consumption (% GDP)	Capital Output Ratio (%)	Public Debt (% GDP)	Income Tax (%)	Social Security Income (% GDP)	Social Security Payments (% GDP)	Soc. Sec. Oper. Deficit (% GDP)
0	11.20	3.99	17.65	69.35	2.38	25.00	15.67	5.85	5.85	0.00
1	11.21	4.00	18.59	68.39	2.38	25.00	15.67	5.85	5.85	-0.01
2	11.18	4.14	18.68	68.38	2.38	25.00	15.63	5.85	5.85	0.00
3	11.16	4.14	18.71	68.28	2.39	25.00	14.99	5.94	5.34	0.60
4	11.13	4.14	18.78	68.22	2.39	25.00	14.97	5.94	5.32	0.61
5	11.10	4.15	18.80	68.18	2.40	25.00	14.36	6.02	4.84	1.19
6	11.07	4.15	18.87	68.13	2.40	25.00	14.34	6.02	4.82	1.20
7	11.05	4.15	18.89	68.09	2.41	25.00	13.75	6.10	4.35	1.75
8	11.02	4.15	18.95	68.04	2.41	25.00	13.73	6.10	4.33	1.77
9	10.99	4.15	18.97	68.01	2.42	25.00	13.17	6.18	3.88	2.30
10	10.36	4.15	19.02	67.97	2.42	25.00	13.13	6.18	3.18	2.32
11	10.83	4.15	19.04	67.94	2.43	25.00	12.60	6.25	3.42	2.82
12	10.90	4.15	19.08	67.91	2.43	25.00	12.55	6.25	3.38	2.66
13	10.88	4.15	19.13	67.87	2.43	25.00	12.51	6.25	3.35	2.90
14	10.85	4.15	19.18	67.81	2.44	25.00	12.47	6.25	3.31	2.93
15	10.82	4.15	19.25	67.75	2.44	25.00	12.42	6.25	3.28	2.97
30	10.49	4.08	19.09	67.93	2.50	25.00	12.28	6.25	3.17	3.07
45	10.44	4.04	18.96	68.03	2.51	25.00	12.29	6.25	3.18	3.07
60	10.43	4.04	18.94	68.06	2.51	25.00	12.29	6.25	3.18	3.07
75	10.43	4.04	18.95	68.06	2.51	25.00	12.29	6.25	3.18	3.07
New St-St	10.43	4.04	18.94	68.06	2.51	25.00	12.29	6.25	3.18	3.07

TABLE 2

CHANGE IN RETIREMENT AGES
Debt Fixed at 10.7% since year 9, Income Taxes Adjust there on

	Real Interest Rate (%)	Income Growth (%)	Investment Rate (% GDP)	Private Consumption (% GDP)	Capital Output Ratio (%)	Public Debt (% GDP)	Income Tax (%)	Social Security Income (% GDP)	Social Security Payments (% GDP)	Soc. Sec. Oper. Deficit (% GDP)
0	11.20	3.99	17.65	69.35	2.38	25.00	15.67	5.85	5.85	0.00
1	11.21	4.00	18.55	68.42	2.88	25.00	15.67	5.85	5.85	-0.01
2	11.19	4.13	18.63	68.38	2.38	25.00	15.67	5.85	5.85	0.00
3	11.16	4.14	18.70	68.31	2.39	24.96	15.67	5.94	5.34	0.60
4	11.13	4.14	18.78	68.24	2.39	24.34	15.67	5.94	5.32	0.62
5	11.11	4.15	18.87	68.15	2.40	23.67	15.67	6.02	4.83	1.19
6	11.08	4.16	18.98	68.04	2.40	22.40	15.67	6.02	4.81	1.21
7	11.04	4.17	19.11	67.92	2.41	21.05	15.67	6.10	4.34	1.76
8	11.01	4.18	19.25	67.78	2.41	19.10	15.68	6.10	4.31	1.80
9	10.97	4.19	19.31	67.68	2.42	17.01	14.39	6.18	3.86	2.32
10	10.93	4.19	19.38	67.59	2.43	15.47	13.79	6.18	3.82	2.36
11	10.89	4.20	19.41	67.54	2.43	14.35	12.87	6.25	3.39	2.86
12	10.85	4.19	19.46	64.48	2.44	13.52	12.55	6.25	3.35	2.89
13	10.81	4.18	19.52	67.43	2.45	12.89	12.30	6.25	3.32	2.93
14	10.77	4.19	19.59	67.37	2.45	12.41	12.11	6.25	3.28	2.96
15	10.73	4.20	19.66	67.31	2.46	12.05	11.96	6.25	3.25	3.00
30	10.29	4.10	19.51	67.52	2.54	10.74	11.52	6.25	3.20	3.05
45	10.19	4.05	19.38	67.61	2.56	10.69	11.52	6.25	3.21	3.04
60	10.16	4.04	18.31	67.69	2.56	10.69	11.53	6.25	3.21	3.03
75	10.16	4.04	19.31	67.69	2.56	10.69	11.53	6.25	3.21	3.03
New St-St	10.16	4.04	19.31	67.69	2.56	10.69	11.53	6.25	3.21	3.03

TABLE 3

CHANGE IN RETIREMENT AGES
Debt Fixed at 0.5% since year 13, Income Taxes Adjust there on

	Real Interest Rate (%)	Income Growth (%)	Investment Rate (% GDP)	Private Consumption (% GDP)	Capital Output Ratio (%)	Public Debt (% GDP)	Income Tax (%)	Social Security Income (% GDP)	Social Security Payments (% GDP)	Soc. Sec. Oper. Deficit (% GDP)
0	11.20	3.99	17.65	69.35	2.38	25.00	15.67	5.85	5.85	0.00
1	11.21	4.00	18.55	68.42	2.38	25.00	15.67	5.85	5.85	-0.01
2	11.19	4.13	18.62	68.38	2.38	25.00	15.67	5.85	5.85	0.00
3	11.16	4.14	18.68	68.32	2.39	24.96	15.67	5.94	5.34	0.60
4	11.14	4.14	18.75	66.26	2.39	24.34	15.67	5.94	5.32	0.62
5	11.11	4.14	18.83	68.18	2.40	23.67	15.67	6.02	4.83	1.19
6	11.08	4.15	18.93	68.09	2.40	22.41	15.67	6.02	4.81	1.21
7	11.05	4.16	19.04	67.98	2.41	21.06	15.67	6.10	4.34	1.76
8	11.01	4.17	19.16	67.86	2.41	19.11	15.68	6.10	4.31	1.79
9	10.98	4.18	19.30	67.72	2.42	17.02	15.68	6.18	3.86	2.32
10	10.94	4.19	19.46	67.57	2.42	14.33	15.68	6.18	3.82	2.36
11	10.89	4.21	19.64	67.39	2.43	11.46	15.68	6.25	3.38	2.86
12	10.85	4.23	19.84	67.19	2.44	7.97	15.68	6.25	3.33	2.91
13	10.79	4.25	19.87	67.08	2.45	4.27	13.02	6.25	3.28	2.97
14	10.74	4.24	19.93	67.01	2.46	2.68	12.00	6.25	3.24	3.00
15	10.69	4.24	20.00	66.94	2.47	1.88	11.52	6.25	3.21	3.04
30	10.16	4.11	19.80	67.23	2.56	0.55	10.99	6.25	3.22	3.03
45	10.02	4.06	19.68	67.31	2.59	0.52	11.01	6.25	3.23	3.02
60	9.98	4.04	19.58	67.42	2.60	0.52	11.01	6.25	3.23	3.01
75	9.98	4.04	19.57	67.43	2.60	0.52	11.01	6.25	3.23	3.01
New St-St	9.98	4.04	19.58	67.43	2.60	0.52	11.01	6.25	3.23	3.01

TABLE 4

CHANGE IN RETIREMENT AGES
Debt Fixed at -30% since year 19, Income Taxes Adjust there on

	Real Interest Rate (%)	Income Growth (%)	Investment Rate (% GDP)	Private Consumption (% GDP)	Capital Output Ratio (%)	Public Debt (% GDP)	Income Tax (%)	Social Security Income (% GDP)	Social Security Payments (% GDP)	Soc. Sec. Oper. Deficit (% GDP)
0	11.20	3.99	17.65	69.35	2.38	25.00	15.67	5.85	5.85	0.00
1	11.21	4.00	18.59	68.37	2.38	25.00	15.67	5.85	5.85	-0.01
2	11.18	4.13	18.65	68.33	2.38	25.00	15.67	5.85	5.85	0.00
3	11.16	4.14	18.71	68.28	2.39	24.96	15.67	5.94	5.34	0.60
4	11.13	4.14	18.77	68.23	2.39	24.34	15.67	5.94	5.32	0.62
5	11.10	4.15	18.84	68.16	2.40	23.67	15.67	6.02	4.83	1.19
6	11.07	4.15	18.93	68.08	2.40	22.40	15.67	6.02	4.81	1.21
7	11.04	4.16	19.02	67.99	2.41	21.05	15.67	6.10	4.34	1.76
8	11.01	4.17	19.12	67.89	2.41	19.10	15.68	6.10	4.31	1.79
9	10.98	4.18	19.24	67.78	2.42	17.01	15.68	6.18	3.86	2.32
10	10.94	4.19	19.37	67.65	2.42	14.32	15.68	6.18	3.82	2.36
11	10.90	4.20	19.51	67.51	2.43	11.45	15.68	6.25	3.39	2.86
12	10.85	4.21	19.67	67.35	2.44	7.97	15.68	6.25	3.33	2.91
13	10.81	4.22	19.85	67.17	2.45	4.26	15.68	6.25	3.28	2.97
14	10.76	4.24	20.05	66.97	2.46	0.34	15.68	6.25	3.28	3.02
15	10.70	4.26	20.27	66.75	2.46	-3.82	15.68	6.25	3.16	3.06
30	9.87	4.18	20.68	66.34	2.62	-29.90	9.46	6.25	3.26	2.99
45	9.58	4.09	20.56	66.43	2.68	-29.91	9.57	6.25	3.26	2.96
60	9.46	4.04	20.36	66.64	2.70	-29.91	9.60	6.25	3.29	2.96
75	9.47	4.04	20.32	66.68	2.70	-29.91	9.60	6.25	3.29	2.95
New St-St	9.47	4.04	20.35	66.65	2.70	-29.91	9.60	6.25	3.29	2.95

TABLE 5

CHANGE FROM PAYG TO FF
Tax Financing

	Real Interest Rate (%)	Income Growth (%)	Investment Rate (% GDP)	Private Consumption (% GDP)	Capital Output Ratio (%)	Public Debt (% GDP)	Income Tax (%)	Social Security Income (% GDP)	Social Security Payments (% GDP)	Soc. Sec. Oper. Deficit (% GDP)	Issue of Recogn. Bonds (% GDP)
0	11.20	3.99	17.65	69.35	2.38	25.00	15.67	5.85	5.85	0.00	0.00
1	11.21	4.00	17.03	70.04	2.39	25.00	20.48	1.33	5.85	4.52	0.00
2	11.25	3.91	17.07	69.97	2.37	25.00	20.60	1.18	5.83	4.64	0.00
3	11.28	3.92	17.13	69.91	2.37	25.00	20.72	1.04	5.80	4.75	0.00
4	11.31	3.93	17.19	69.84	2.36	25.00	20.83	0.91	5.77	4.86	0.00
5	11.33	3.95	17.25	69.76	2.36	25.00	20.94	0.78	5.74	4.96	0.00
6	11.35	3.96	17.32	69.68	2.36	25.00	21.04	0.65	5.71	5.05	0.00
7	11.37	3.97	17.39	69.60	2.35	25.00	21.13	0.53	5.68	5.14	0.00
8	11.38	3.99	17.47	69.52	2.35	25.00	21.22	0.42	5.64	5.23	0.00
9	11.39	4.00	17.56	69.49	2.35	25.00	21.30	0.30	5.61	5.31	0.00
10	11.40	4.02	17.65	69.33	2.35	25.00	21.37	0.20	5.58	5.38	0.00
11	11.40	4.03	17.75	69.29	2.35	25.00	21.44	0.10	5.54	5.45	0.00
12	11.40	4.05	17.86	69.12	2.35	25.00	21.50	0.00	5.51	5.51	0.00
13	11.39	4.06	17.92	69.04	2.35	25.00	20.87	0.00	5.01	5.01	0.00
14	11.39	4.07	17.96	68.99	2.35	25.00	20.46	0.00	4.53	4.53	0.00
15	11.38	4.07	17.97	68.96	2.35	25.00	19.97	0.00	4.07	4.07	0.00
30	10.85	4.20	19.52	67.58	2.44	25.00	18.44	0.00	0.00	0.00	2.89
45	10.28	4.16	19.99	67.01	2.54	25.00	15.51	0.00	0.00	0.00	0.11
60	9.98	4.09	19.95	67.05	2.60	25.00	15.49	0.00	0.00	0.00	0.00
110	9.88	4.04	19.73	67.27	2.62	25.00	15.50	0.00	0.00	0.00	0.00

TABLE 6

CHANGE FROM PAYG TO FF
Debt Financing

	Real Interest Rate (%)	Income Growth (%)	Investment Rate (% GDP)	Private Consumption (% GDP)	Capital Output Ratio (%)	Public Debt (% GDP)	Income Tax (%)	Social Security Income (% GDP)	Social Security Payments (% GDP)	Soc. Sec. Oper. Deficit (% GDP)	Issue of Recogn. Bonds (% GDP)
0	11.20	3.99	17.65	69.35	2.38	25.00	15.67	5.85	5.85	0.00	0.00
1	11.44	3.15	16.78	70.16	234.34	30.90	14.43	1.33	5.90	4.57	0.00
2	11.47	3.91	16.61	70.35	233.79	36.81	14.96	1.18	5.91	4.73	0.00
3	11.51	3.89	16.45	70.52	233.15	42.73	15.49	1.04	5.92	4.87	0.00
4	11.56	3.87	16.30	70.68	232.45	48.65	16.01	0.91	5.92	5.01	0.00
5	11.61	3.85	16.15	70.83	231.68	54.57	16.53	0.78	5.92	5.14	0.00
6	11.66	3.84	16.02	70.97	230.86	60.48	17.04	0.65	5.91	5.26	0.00
7	11.72	3.83	15.88	71.11	229.89	66.39	17.55	0.53	5.91	5.38	0.00
8	11.78	3.82	15.77	71.23	229.08	72.28	18.05	0.42	5.90	5.48	0.00
9	11.84	3.81	15.65	71.35	228.14	78.17	18.54	0.30	5.88	5.58	0.00
10	11.91	3.80	15.54	71.46	227.17	84.03	19.03	0.20	5.86	5.67	0.00
11	11.97	3.79	15.44	71.56	226.17	89.88	19.51	0.10	5.84	5.75	0.00
12	12.04	3.79	15.38	71.63	225.16	95.69	20.45	0.00	5.82	5.82	0.00
13	12.11	3.79	15.31	71.70	224.16	101.01	20.80	0.00	5.32	5.82	0.00
14	12.18	3.79	15.24	71.76	223.16	105.84	21.11	0.00	4.83	4.83	0.00
15	12.25	3.79	15.18	71.83	222.17	110.20	21.41	0.00	4.36	4.36	0.00
30	13.28	3.80	14.35	72.76	208.62	183.90	25.87	0.00	0.00	0.00	3.14
45	14.16	3.89	14.11	72.89	198.17	206.14	27.95	0.00	0.00	0.00	0.13
60	14.65	3.99	14.30	72.70	192.85	206.14	28.32	0.00	0.00	0.00	0.00
110	14.78	4.04	14.44	72.56	191.50	206.14	28.38	0.00	0.00	0.00	0.00

Notes

[1] As will be explained later, this is not the retirement age. Individuals retire at 65, but the PAYG system allows them to receive pensions since 61.
[2] Decreto Ley Nº 2448, December 26, 1978.
[3] Annualized because if in the last 12 months there were no contributions in one or more of them (for example, because of unemployment), missing values are replaced with the average monthly contribution of the remaining months.
[4] For the simulation we used 70%, which is our estimation of the effective replacement rate in the Chilean system.
[5] Cifuentes (1993), page 145, estimates the age distribution of workers in both systems by the last quarter of 1982.
[6] See Cifuentes (1993), page 106.

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