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Transitional Effects of a Pension System Change in Spain

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Abstract

This paper studies the output effects, transition costs, and the change in pension benefits derived from the substitution of the current unfunded pension system by a fully funded pension system financed through mandatory savings. We estimate these effects by using reduced versions of the neoclassical and endogenous growth frameworks. Because of the greater capital accumulation during the transition, final output increases by 23,6% (neoclassical framework); and a 24,5-31,5 % (endogenous growth framework). The initial revenue loss for the government would represent a 4,8% of the GDP, raising very slowly during the transition period. Given the new growth rates, rates of return of physical capital, and financial intermediation costs, we have that the new pension benefits obtained by all 30-contribution-year workers would be more than twice than those that guarantee the sustainability of the public pension system.

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1 Introduction

The reform of the Social Security system has become one of the main issues of the public debate in many countries. Under the current pay-as-you-go, unfunded system, old workers' pensions are financed through the contributions of active workers. Because of demographic tendencies, such as the continuous increase in life expectancy and the reduction in the birth rate, the financing of future pensions under the current system becomes particularly troublesome except if a drastic reform consisting basically of a reduction of future pension benefits (see Herce et al., 1995), is not adopted soon.

Recent studies (Arrau (1990); Arrau and Schmidt-Hebbel (1993) Feldstein (1995); Huang, Imrohoroglu and Sargent (1995), Kotlikoff (1995)) have shown the existence of very major welfare and output gains in the U.S. economy derived from the transition to a fully funded pension system[1]. These gains are fundamentally derived from the difference between the real rate of return of capital assets and the implicit return of a mature unfunded pensions system, given the rate of growth of total wage income. Whereas the before-tax real rate of return of capital assets has been around 7 percent in the American economy in the last 60 years, the average rate of growth of real wages has been less than 3 percent in the same period. Moreover, the persistent change in demographic tendencies -increases in life expectancy, reduction in the birth rate- has lowered the real rate of return of pension contribution to negative levels in the U.S. in recent years (see Feldstein (1995)).

This paper studies the effects on the level of GDP of a progressive change from the current Social Security system to an alternative privatized, fully funded system financed through mandatory savings. In addition, we analyze the viability of the reform, that is, we compute the cost for the government of the transition between the two pension systems. Finally, we compute the pension benefits derived from the implementation of the fully funded system and we compare them with the benefits derived from the current unfunded system under the proposed Pacto de Toledo reforms that guarantee the financial sustainability of the pension system.

Under the pension reform designed in this paper, all workers who initially are less than 40 years old would place the proportion of their contributions

[1] For instance, Kotlikoff (1995) finds that a transition between the two pension systems financed through different combinations of tax increases would rise the steady state U.S. output until a 17%.

to the current Social Security system allocated to the payment of their future pensions in privately managed pension schemes, whereas older workers would continue in the old unfunded public system. During the transition between the two pension systems, the reform generates a public Social Security system deficit because of the loss of the contributions of the younger workers. After a 25-30 years period in which the new capitalized pension system progressively replaces the old pay-as-you-go system, all workers would be in the private pension system. As usual in this pension scheme, future workers' pensions are financed by the returns of cumulative savings.

Different versions of the capitalized pension system have been already implemented in several countries. On one hand, some twenty countries, mostly former British colonies in Africa, Asia, and the Pacific islands have mandatory, publicly managed pension plans. These countries had no public pay-as-you-go pension system when they established their national funded plan. On the other hand, Chile, which is the only country whose capitalized pension system is privately and competitively managed (see World Bank, 1994). A common characteristic of these countries is the high savings rate generated by the capitalization system, which has been a key factor in explaining their relatively very high growth rates. In Singapore, for example, workers capitalize a 35 percent of their wages in the publicly managed Central Provident Fund, established in 1955. Since then, the gross domestic savings rate has been increased from 10 percent in 1955 to 39 percent in 1993. At the same time the growth rate, which oscillated around an average of 2 percent per year in the 50s, increased to an average of more than 8 percent in the last thirty years. This rate of growth means that the Singaporean GDP requires less than nine years to double.

Closer to the pension reform designed in this work is the Chilean reform.[2] In Chile, the new capitalization system was introduced in 1981. Under the Chilean system, all covered workers must place a 10 percent of their monthly earnings in privately managed savings accounts. The success of the Chilean reform is almost unanimously recognized: pension plans have yielded an average *real* rate of return of... 14,5%! during the last 12 years (Diamond, 1993). Moreover, as in Singapore, the reform has substantially increased the savings rate from 14 percent of the GDP in 1981 to 27 percent. As a consequence, the

[2]For a more detailed analysis of the Chilean experience, see Diamond (1993) and Diamond and Valdes-Prieto (1994).

Chilean economy, which grew at a lower rate than the average of the Latin American countries until 1980, grew at a substantially greater-than-average rate of seven percent per year during the last decade, making Chile the country with a greater per capita GDP (measured in purchasing power parity) of all Latin American countries in 1993, comparable with that of Greece (World Development Report, 1995). This process of sustained growth compares favorably with the crisis of other countries in the region which also adopted economic reforms during the eighties, like México. In México, the reforms only attracted short run, highly speculative capital, and they were unable to increase the gross savings rate (which, in fact, decreased from 18 to 15 percent of the GDP), making in this way impossible the financing of the necessary capital investments required for long run growth.[3]

In Spain, workers are bound by law to allocate a 24,8 percent of their gross wage earnings to the financing of their future pensions. This contribution is similar to the Singaporean workers' one, and substantially greater than that of Chilean workers. Yet the gross savings rate oscillates around a 20 percent of the GDP, and there is a slowdown in productivity growth which combinates with the highest unemployment rate of all OECD countries. The comparatively greater workers' earning sacrifice of the Spanish system has not been compensated by faster productivity growth but less, and there is no confidence that the current pension system will be able to finance workers' pensions in the future if drastic reforms are not taken soon (see, for instance, Herce et al., 1995 and Barea et al., 1995).

We design a change in the pension system which verifies three properties. First, no worker (retired or active) must suffer a pension benefit loss during the transition period or in the steady state of the new capitalization system. Second, workers' contribution costs must be the same under the two alternative systems. In fact, throughout our analysis we impose the condition that the wage percentage contribution to the fully funded system must equal the actual burden of the contributions to the pay-as-you-go system. Third, the transition costs generated by the financing of public pensions must be "bearable" for the government. This condition imposes a lower limit on the transition period between the two pension systems, because a very short

[3] Argentina, Colombia and Perú, and other Latinoamerican countries- are now replacing or supplementing their public pension systems with mandatory, privately managed pension schemes.

transition period raises the public pensions financing burden drastically.[4]

The success of the proposed pension system change depends crucially on the way in which the public pensions deficit is financed during the transition between the two pension systems. If the government chooses to finance the pension system deficit through a reduction in public consumption, we find that the net savings effect of the transition is maximized, and so will be capital accumulation and output growth. The faster economy's growth reduces the burden of public pensions in the long run and raises the overall benefits of the new pension system. However, if the government finances pensions through proportional public deficit increases, the output and physical capital gains are substantially smaller, but -even in this case- there exists the possibility of such gains under realistic assumptions (see Feldstein (1995)). These gains are derived from the fact that the rate of return of the current unfunded system -and thus the service of the debt to be paid by the government- is much smaller than the average rate of return of physical capital[5]. A third option is to finance public pensions through either tax increases or transferences reductions. In this case, the net effect of the pension system change depends on the effect of these measures on private, voluntary savings.

To compute the capital and output accumulation effects of the transition to a fully funded pension system, we use two alternative frameworks: neoclassical and endogenous growth. This approach allows a greater consistency of our results, which are largely independent on the macroconomic framework assumed. In the neoclassical framework (Solow, 1956), technical progress is neutral and exogenously given, there is perfect competition and the output technology presents constant to scale returns. In the alternative endogenous growth model (Romer, 1986), technological change increases with physical capital investments, and the assumptions of perfect competition and constant to scale returns do not necessarily hold.

Our main results can be summarized as follows. In both the neoclassical and endogenous growth frameworks, in the short run an immediate change in the current pension system would increase the gross rate savings and investment by more than 20 percent. Net investment grows at a substantially higher rate, 55 percent, and changes from 8,3% to 12,9% of the GDP. These

[4]For instance, the cost of immediately shifting all workers to the privatized system would represent a 9,3% of the GDP in Spain.

[5]For the U.S. economy, the historical long run real rate of return of public debt has been of 0,5%, whereas before-tax rate of return of capital has been around 7%

capital investment figures mean that, if we assume that the ratio capital-worker remains constant, the Spanish economy would be able to create more than 250.000 additional new jobs each year initially, reducing significantly the unemployment rate without reducing the productivity of new jobs.

If we consider that the economy follows closely the neoclassical growth framework, we have that the pension reform would raise GDP by 23,6% in 2025. Alternatively, if we consider the endogenous growth model as a more accurate description of the reality, the GDP growth is 31,5% in the case in which there is no significant substitution between mandatory, pension funds savings and the rest of savings. If we assume partial substitution between the two kinds of savings, the GDP growth is reduced to 24,5%. To obtain these results, we compare the projected evolution of the Spanish economy -assuming that GDP will grow at an average rate of 3%- with that obtained with the higher savings rate generated by the transition between the two pension systems. Our results imply that, *ceteris paribus*, our country will have approximately the same average per capita income of the European Union in 2025.

We obtain that the initial transition costs for the government of the pension reform here proposed are equivalent to 4,8% of the GDP. This cost is high, and implies a strong fiscal adjustment. However, empirical evidence (Alesina and Perotti, 1995) shows several recent similar fiscal adjustments in democratic Western countries. For instance, in Belgium public deficit fell by 4% of the GDP in only one year, 1987. In Ireland, a quantitatively similar adjustment based almost exclusively on reductions of public expenditures was carried out in 1987-1989. Very recently, the American Congress has approved spending cuts which are substantially stronger than those here proposed (but the cuts will be carried out over the next seven years).

Finally, from the income distribution perspective, it is obtained that all groups belonging to the "Régimen General" category are substantially benefitted by the new pension system. The gains are really huge (3,4 - 3,5 times the Pacto de Toledo pension) if we assume that the economy follows closely the endogenous growth framework. But even in the case in which the economy behaves as in the neoclassical model, we have that the median 30-contribution-year worker would receive a pension which is more than 2,7 times the obtained under the current public pension system. Workers' gains are enhanced by the fact that a greater output growth increases workers' wages and thus the contributions to the fully funded pension system.

The remainder of this paper is organized as follows. Section II describes the historical evolution of the Spanish public pension system and its perspectives. Section III finds the physical capital and output effects of the reform under a neoclassical growth theoretical framework; whereas Section IV obtains these effects under a simplified version of an endogenous growth model. Section V studies the initial cost and the evolution of the public pension system deficit generated by the transition to a fully funded pension system. Section VI calculates the pension benefits obtained under the new private pension system by every group of workers, and compares them with the pension benefits derived from the proposed Pacto de Toledo reforms. The Conclusion resumes the main results and considers some possible extensions of our approach.

2 Social Security in Spain: Historical Overview, Perspectives and Projected Reforms of the Public Pension System

As in other European countries, the first institutions of the Spanish social welfare system were established at the beginning of the present century. Since then, we can distinguish two clearly differentiated phases. During the first phase (which finishes in 1963), the government creates several social security institutions which work separately. The most important of these institutions is the SOVI (Seguro Obligatorio de Vejez e Invalidez), which was a sort of an embryonic pay-as-you-go pension system.

The second stage starts in 1963 with the *Ley de Bases*. This law unified the different social protection institutions into a single pay-as-you-go Social Security system. Since the implementation of the new system, pension resources have grown at an astonishing average real rate of 10% per year, and its weight has changed from 1,23% of the GDP in 1967 to 9,03% in 1993. In the same period the resources obtained by the Social Security have grown at a much lower rate of 6%, increasing its GDP weight from 6,15% in 1967 to 10,6% in 1993. As a consequence of the greater expenditures' growth, the State transference to the Social Security system has grown from nearly zero to a level of 4,73% of the GDP in 1993. State resources have been basically oriented to the financing of the public health system.

The outstanding growth of public pensions expenditures has induced the government to adopt some measures oriented to the deceleration of pension expenditures. The most important measure is the *Ley de Medidas Urgentes para la Racionalización de la Estructura y de la Acción Protectora de la Seguridad Social,* promulgated in 1985. This law has raised the minimum contribution period required to receive a contributive pension from 10 to 15 years, from which two of them must be (at least) in the eight year period before the beginning of the pension payment. Other measures intended to curb the increase in pension expenditures -such as the rise of the minimum contribution period used to calculate the pension perceived- has been also implemented.

The 1985 law main achievement was a transitory, four year reduction of the percentage of public expenditure devoted to pension payments (see Table I). After this period, the underlying negative demographic tendencies lead to a new increase in public pension expenditures. This increase has motivated a recent agreement of the political parties and social groups (Pacto de Toledo) oriented to guarantee the viability of the public pension system. Since the burden of Social Security contributions in Spain is already very high -around 25% of total labor costs-, the adoption of measures is basically intended to curb future pension expenditure increases.

To achieve this objective, the government must consider that, because of the projected rise in the number of pensioners -around 50% in the next 30 years- and the much slower growth of the active population (between 0.5% and 1% per year) the financial equilibrium between contributions and pension expenditures can be only achieved through a 25 - 35% reduction in real future pensions. In the long run, this reduction *does not depend* on the rate of growth of the productivity of workers. Effectively, a higher productivity growth implies greater Social Security revenues, but also higher pensions because pension benefits are calculated as an average of the wages perceived in the last period of the working life.

The 30% reduction in future pension benefits can be achieved through two ways. A direct way, proposed by Barea and Herce et al. (1995) among others, consists in a negative growth of real pensions, which oscillates between -1% (Barea) and -0,5% (Herce et al.) per year during the next 30 years. Alternatively, an indirect way that seems preferred by the government, consists on the adoption of several measures oriented to reduce the future level of pensions. Within this way, the main proposals to reduce pension benefits

can be resumed as:

a) A gradual enlargement of the contribution period considered for the calculation of new pensions, from the average real wage of the last 8 years to the average real wage for the entire contribution period. This means an important reduction in the pension benefits received by future retired workers, because real wages of very past periods (which are, on average, lower than present wages) will weight the same as recent wages. For instance, if productivity -and real wages- grows at a 2 percent per year, a 35 contribution year worker with a real gross wage of 2,6 million ptas. receives a 2,36 million ptas. pension per year in real terms under the present system (or 90,8% of her last wage). Under the Pacto de Toledo reforms, the perceived pension will be of only 1,82 million ptas. per year (or 70% of her last wage). This represents a 23% reduction in the pension received by the worker.

b) A progressive reduction in the percentage of discounted wages received as a pension by retired workers. Currently, a 15 contribution years worker receives a 60% of the average real wage corresponding to her last eight contribution years. Under this proposal, the percentage received is $\frac{CY_i}{35}$, where CY_i are the contribution years of the worker i. This means that (for instance) a 15 contribution years worker will receive only $15/35 = 42,8\%$ of the calculated base, which is given by the average real wage of the last 15 years (which is lower than the average wage of the last 8 years). Under the same assumptions of the example given in a), a 15-year-contribution worker would perceive a 944 thousand ptas. pension, a 66 percent of the 1,418 million ptas. pension received under the present system. A limit on the effectiveness of this measure to curb pension spending is that, actually, in the *Régimen General*, 70% of workers contribute more than 35 years.

c) A gradual increase in the retirement age to 68 or 70 years. This measure is intended to raise the effective contribution period and to reduce the pension benefit period.

The overall effect of these proposed reforms is a substantial reduction in pension benefits. As Table II shows, pension cuts -which oscillate between 23% and 34%- are general and significant, and they are able to guarantee the financial equilibrium of the public pension system in the long run.

However, the effect of these pension benefit cuts is an additional reduction in the already low rate of return implicitly obtained from the contributions to the public Social Security system (see Gil, 1996). In fact, using Herce et al. (1995) projections, the future average rate of return of the contributions to

the pension system is a mere 0,9%. Effectively, the implicit rate of return of pension contributions in a pay-as-you-go system in the long run is $r = n + g$, where n is the net rate of growth of the ratio *active workers /pensioners* and g is the wages growth rate. Herce et al. (1995) assume n = -0,4%, because the projected rate of growth of pensioners is around 1,4% and the (optimistic) projection on the rate of growth of active population is 1%; and g = 1,3%. Hence, the implicit rate of return of the public pension system is r = *-0,4 + 1,3% = 0,9%*. This rate of return is clearly smaller than any reasonable projection of the potential rate of return of a private pension scheme.

Next Section starts the study of an alternative reform aimed to guarantee the future payment of reasonable pension benefits: the change to a fully funded pension system.

3 Output Effects of the Privatization of Pensions: the Neoclassical Framework

3.1 A. The Theoretical Framework

This Section estimates the physical capital and output effects of the pension system transition by using a modified version of the Solow's model (Solow, 1956) in which we include labor measured in efficiency terms. This approach is similar to that used by Mankiw, Romer, and Weil (1992).

We depart from a closed economy in which markets are perfectly competitive and firms maximize profits. The assumption of closed economy means that the interest rate of capital is not exogenously given by the international capital markets and varies with the output-capital ratio. The perfect competition assumption implies the equality between the technical coefficients of the output production function and the income participation of different productive factors. Technological progress is assumed to be neutral and exogenously given. As usual, technological progress will be proxied by Total Factor Productivity (TFP), which measures the growth of output unexplained by capital or labor increases.

Even if the ideal theoretical framework to study Social Security issues is an overlapping generations model -as in Arrau (1990), Arrau and Schmidt-Hebbel (1993), Feldstein (1995), Huang et al. (1995) and Kotlikoff (1995)- the empirical evidence -Venti and Wise (1990)- shows that there is little or

not substitution of savings derived from the introduction of pension plans. For this reason, we compute the model under this assumption, and we focus in the effects of the transition between the two pension systems under different technological assumptions.

3.1.1 Savings Behavior Under the Transition

The key variable in the model is the evolution of the savings rate during the transition to the new system. The economy's savings rate s_t is given by the sum of both private and public voluntary savings, s_v, and net mandatory savings, s_m. Net mandatory savings are given by the sum of the contributions to the capitalization system minus the capitalized pensions payments. In the first stage of the transition between the two pension systems, nearly all contributions to the capitalized pension system (made by young workers) are net savings. This happens because there are almost no pension payments. When the younger workers retire, the rate of net mandatory savings declines and, in the long run, eventually becomes zero. However, since mandatory savings are positive during the transition, capital and output (but not growth) will be greater in the long run under the fully funded system if the rate of total net savings -voluntary plus mandatory savings- effectively augments.

Voluntary savings can be affected by the capitalization of pensions through two ways. First, the consumption-savings behavior of agents can be modified as a consequence of the introduction of the new pension system. Second, the way chosen by the government to finance the public pension deficit can modify the output effects of the pension system change because it can offset the positive savings effect of the transition between the two pension systems.

Since the decisions on the amount of individuals' resources allocated to pension plans are not taken by individuals but rather by the government, and since the reform here proposed assumes that the same fraction of wages is destinated to the privatized system as now, the only effect on individuals' savings decisions of the pension reform derives from the greater *expected* future pension under the fully funded system. There are two effects on voluntary savings of a greater expected pension. On one hand, the higher pension benefits has a negative income effect on voluntary savings. On the other hand, since the risk inherent to a private pension system is higher than the risk associated to the alternative public system, if individuals are sufficiently risk-averse, they can decide to save more. The combined effect of an expected

greater future pension and higher uncertainty can be either an increase or decrease in the rate of voluntary savings. Moreover, even in the case in which the total voluntary savings effect of the transition to a new pension system is negative, the existence of liquidity constraints in real economies that limit individuals' capacity to get indebted reduces the negative impact of the new pension system. Since empirical studies (see Venti and Wise (1990)) show a negligible savings substitution effect of pension plans -such as IRAs and 401Ks- in the U.S., we start our analysis by assuming that the total individuals' voluntary savings rate effect of the implementation of a fully funded pension system is zero[6]. But next Section (which considers a perhaps more sophisticated and realistic model) introduces the alternative assumption of a negative effect of mandatory savings on voluntary savings, and evaluates capital and output dynamics under this assumption.

There is a second way in which the rate of savings can be affected during the transition, which is the way chosen by the government to finance the public pensions deficit generated by the change between the two pension systems. The government can finance this deficit through three kinds of measures, or a combination of them: a reduction of public consumption, an increase in taxes or a reduction in transferences, and an increase in public deficit or a reduction of public investment. If the government chooses to finance the public pensions deficit through a proportional reduction in public consumption, there is no negative effect on aggregate savings. In this case, the capital accumulation and output growth effects of the transition are maximized. If the government raises taxes or reduces transferences, in general there is a negative effect on voluntary savings which depends on which tax or which type of transference is chosen by the government. Finally, if the government runs an additional national debt of equal value to the public pension deficit, the increase in saving and output growth is drastically reduced due to the payment of the debt service, and the transition costs would be substantially greater in the long run.

For our estimation purposes, we consider the case in which the govern-

[6]In fact, evidence from U.S. indicates that each dollar of occupational pension savings reduces individual savings by 60 cents, so total private savings increase by 40 cents (see Munnell and Yohn (1992) and Pesando (1991)). In Australia, the government projections assumed that half the contributions to the mandatory occupational escheme would be offset by declines in voluntary savings, so net national saving would increase by 16 percent (Bateman and Piggott (1993)).

ment adopts the behavior which maximizes the capital and output effects, and finances the transition's pension deficit through a proportional reduction in public consumption expenditures. It is possible, of course, to assume that the pension system deficit is financed through other measures, such as a tax increase, but the computation of the economy's dynamics becomes more troublesome because we need to compute the negative induced savings effects of the tax increase. We thus estimate the capital and output effects of the pension system change in the neoclassical economy under the assumption that the savings rate is given by $s_t = s_v + s_m$.

It is important to remark that the economy's savings rate is only increased during the transition between the two systems (which lasts between 30 and 50 years, approximately). Thus, output only grows at a higher rate during the transition period, in which capital accumulation is faster because of the greater savings rate. The steady-state ratio between physical capital and output, equal to $\frac{K}{Y} = \frac{s}{\delta+g}$, does not change[7], because this ratio is only affected by the long run rate of savings (which we assume that is the same under the two pension systems) as well as by the exogenous rate of depreciation of physical capital and the exogenously given rate of technological change.

3.1.2 The Dynamics

The dynamics of the physical capital stock is given by the equation

$$K_t = (1 - \delta)K_{t-1} + s_t Y_t \tag{1}$$

where δ is the physical capital depreciation rate, s_t is the savings rate and Y_t represents final output. Output is produced according to the constant-to-scale production function

$$Y_t = A_t {K_{t-1}}^{\alpha} {H_t}^{1-\alpha}. \tag{2}$$

Using the perfect competition assumption, α equals the participation of physical capital income with respect to total income. The Spanish national accounting suggests $\alpha = 0,5$, and this value is used by some economists in their estimations. However, many other economists consider this value too high,

[7]This does not mean that the *levels* of both physical capital and output are also the same, because the transition raises the level of these two variables.

because the accounting of capital income includes a part of autonomous workers' labor income. They take $\alpha = 0,4$. We will take the most conservative approach in our estimation, that is, $\alpha = 0,4$ (and hence $1 - \alpha = 0,6$).

On the other hand, as it is standard, technical progress A_t evolves over time following the dynamic equation

$$A_t = A_{t-1}(1 + g_A) \tag{3}$$

where g_A is the exogenously given rate of growth of technological progress.

3.2 Estimation Results

To compare the physical capital and output evolution under the two alternative pension systems, we depart from the benchmark economy -an economy without any change in the Social Security system- in which output and physical capital grows at the same constant rate, 3% per year. This means that the capital-output ratio remains constant over time in the benchmark economy, and so does the interest rate. The savings rate compatible with the capital and output growth, and the depreciation rate, is equal to 21%.

Using the data provided by the MOISEES' model (see Baiges, Molinas, and Sebastian, 1987), we estimate the output effects of the transition between the public and private pension systems by estimating the parameter values of the dynamic equations (1)-(3). The MOISEES database provides historical data about real GDP Y_t, the capital stock K_t, the number of occupied workers L_t, and the depreciation rate of the capital stock, δ. We consider the depreciation rate $\delta = 0,062$ as a central value derived from the MOISEES database. We compute the amount of labor in efficiency units, H_t, the growth rate of technical progress g_A, and the net mandatory savings rate generated in the transition between the two pension systems.

To estimate human capital -or labor in efficiency units, in this model- we consider that the relative efficiency of different types of labor is measured by the difference in relative wages. For instance, if a worker with only primary education earns a gross wage of 2 million ptas. per year, and a worker with higher education earns 5 million ptas., this means that the higher education worker is 2,5 more productive than the primary education worker. Using this assumption, we use the data of the I.N.E (Instituto Nacional de Estadística) and the Social Security wage scale to obtain the evolution of the structure of

the working population measured by their educational achievement and the relative wages. Table III shows the data.

We obtain that, in the period 1963-1984, human capital grew at an average rate of 1,1 percent per year. In the period 1985-1994, the growth rate was 2,3 percent per year. This faster growth reflects the outstanding increase in higher education enrollment rates since the recession years. We take an intermediate value, 1,86 percent, as the projected average growth rate for human capital between 1996 and 2025.

The growth rate of technological progress, g_A, is immediately derived from our assumptions about the evolution of output, physical and human capital. Effectively, given the technology represented by (2) and $\alpha = 0,4$, the rate of growth of TFP is $g_A = g_Y - 0,4g_K - 0,6g_H$. Using our projections, we obtain $g_A \approx 0,7\%$.

To estimate the alternative evolution of the economy under the transition between the two pension systems, we depart from the same initial values for physical capital (K_t), GDP (Y_t), and technical progress, (A_t). The new savings rate is given by $0,21 + s_m$, where s_m is the mandatory savings rate generated by the pension reform. Using the previous values for all parameters, we have that the dynamics of the economy is given by the equations

$$K_t = (1 - 0,062)K_{t-1} + (0,21 + s_m)A_t K_{t-1}^{0,4}[H_{t_0}(1,0186)^t]^{0,6} \qquad (4)$$

and

$$A_t = A_{t-1}[1 + 0,007] \qquad (5)$$

Table IV and V shows the results. Table IV shows the actual evolution of savings, physical capital and output; assuming a GDP growth of 3%, whereas Table V shows the alternative evolution under the transition to a privatized pension system.

We can appreciate that, as a consequence of the greater savings rate generated during the transition between the two pension systems, physical capital increases a 68,7%, and output rises a 23,6% with respect to the actual evolution under the current public pension system. These figures imply that the average growth rate of physical capital changes from 3% (in the benchmark economy) to 4,7%, and that the average growth rate of the GDP rises from 3% to 3,7% in the period 1996-2025.

4 Output Effects of the Privatization of Pensions: the Endogenous Growth Framework

The framework used in the previous Section has been widely criticized because of the lack of realism of their assumptions. Moreover, some empirical work (Boskin and Lau, 1992) has rejected the most important hypothesis underlying the neoclassical framework: exogenous technological change, perfect competition, and constant to scale returns production function.

For this reason, with the objective of increasing the realism of our results, we alternatively estimate the effect of the privatization of pensions on aggregate savings, capital accumulation and output growth by using a simplified version of the Romer's model (Romer, 1986). In this model, physical capital investment generates a public capital good which increases the productivity of the economy. However, as in the neoclassical framework, in his paper Romer maintained the assumptions of perfect competition and constant-returns-to-scale in privately appropriable inputs which, according to Boskin and Lau, have been rejected by the empirical evidence. We relax these assumptions and, in addition, we introduce the different performance for investment and final output goods prices that has been observed in almost every economy[8], so we are implicitly considering a two-sector model in which capital and final goods are produced through different technologies.

We depart from the national accounting identity between gross investment and savings

$$\frac{P_{K_t}[K_t - (1-\delta)K_{t-1}]}{P_{Y_t}Y_t} = s_t \tag{6}$$

where K_t, K_{t-1} are the stocks of physical capital at t and *t-1* respectively, δ is the depreciation rate of physical capital, Y_t is the gross domestic product, P_{K_t} and P_{Y_t} are the physical capital investment and GDP deflactors respectively, and s_t is the economy's savings rate.

We consider different prices for capital goods and final output because the Spanish data for the period 1963-1995 show a different behavior for the two prices. In particular, the GDP deflactor grew by 0,8 percent per year more than the investment one. The implication of this empirical result is

[8]Gordon (1990) shows that, on average, the relative price of equipment has fallen at a rate of more than 3% per year in the U.S.

that cost reduction (and thus technological progress) is faster in the sector which produces capital goods than in the final output sector.

4.1 The Production Function

We assume that output Y_t is generated through an aggregate production function that can be written in the form

$$Y_t = F[A_t K_{t-1}, H_t] \tag{7}$$

where A_t is technical progress and H_t is human capital, or labor measured in efficiency terms.

The above specification of the production function means the existence of capital-augmenting technical progress. This is consistent with empirical evidence from a sample of OECD countries, as Boskin and Lau (1992) show. These authors estimate an aggregate meta-production function without the conventional and restrictive assumptions of neutrality of technical progress, constant-returns-to-scale, and profit maximization with competitive output and factors markets implicit in the standard neoclassical Cobb-Douglas production function $Y_t = A_t F[K_{t-1}, H_t] = A_t {K_{t-1}}^{\alpha} {H_t}^{1-\alpha}$. They obtain that technical progress is strongly complementary of capital formation, that technological progress can be represented by a single set of augmentation rates for capital, and that the elasticities of output with respect to physical capital and labor are $\alpha \in [0,21; 0,29]$ and $\beta \in [0,5; 0,55]$ respectively. Following their empirical findings, we assume that the aggregate production function (7) takes the form

$$Y_t = (A_t K_{t-1})^{\alpha} {H_t}^{\beta} \tag{8}$$

with $\alpha = 0,25$, $\beta = 0,5$.

4.2 The Dynamics

According to the empirical findings of Boskin and Lau (1992), we consider that technical progress evolves over time following the linear equation

$$\frac{A_t - A_{t-1}}{A_{t-1}} = \gamma g_{K_t} \tag{9}$$

where γ is a parameter that measures the influence of the growth rate of the physical capital stock, g_{K_t}, on technological innovation. The value of γ will be estimated through ordinary least squares.

Using the production function (8) and the equality between investment and savings given by (6), we have that the stock of physical capital follows the dynamic equation

$$K_t = (1-\delta)K_{t-1} + \frac{s_t}{P^*{}_t}(A_t K_{t-1})^{\alpha}(H_t)^{\beta} \tag{10}$$

where $P^*{}_t = \frac{P_{K_t}}{P_{Y_t}}$ is the ratio between the prices of capital goods and final output. The economy's dynamics is given by equations (9)-(10).

The dynamics generated by the two dynamic equations (9) and (10) is studied in Appendix I. This Appendix shows that the model presented here converges to a balanced growth path in which $P_{K_t}[K_t - (1-\delta)K_{t-1}]/P_{Y_t}Y_t$ is constant over time. The ratio K_t/H_t does not remain constant in the balanced growth path however, but this does not represent any problem for the model dynamics because human capital is labor measured in efficiency units in this model. In particular, given the parameter values here considered, it is obtained that physical capital grows at a higher rate than labor in efficiency units in the balanced growth path. This result is consistent with empirical evidence.

4.3 Estimation Results: No Substitution Between Voluntary and Mandatory Savings

As it was explained above, we take the empirically verified values of $\alpha = 0,25$ and $\beta = 0,5$. As in the previous Section, we consider the depreciation rate $\delta = 0,062$ as a central value derived from the MOISEES database, and $g_H = 1,86\%$ per year as the estimated growth rate of human capital. The MOISEES database shows that the relative capital-output prices P_{K_t}/P_{Y_t} decreased, on average, by 0,8% per year during the period 1963 - 1995. We assume that the decrease will be the same in the period 1996 - 2025 as it was during the period 1963-1995.

Using the OLS estimation method, we estimate equation (9): $g_A = \eta + \gamma g_K + \epsilon$, where $\epsilon \approx i.i.d(0, \sigma^2)$. To do this, we differentiate logarithmically the production function (8) and we substitute the dynamic equation for technical

progress (9). We obtain

$$g_Y - \beta g_H = a + \alpha[(1+\gamma)g_K] \equiv a + bg_K \tag{11}$$

where $b \equiv \alpha(1+\gamma)$. Table VI shows the estimation results. We can appreciate in this Table that a is not significant, so we neglect this parameter for the rest of our estimations. From $\alpha(1+\gamma) = 0,544$, we obtain $\gamma = 1,176$.

The previous results (a no significant, b greater than one) mean that, as in Boskin and Lau (1992), exogenous technical progress is almost irrelevant, and that an increase in the growth rate of physical capital raises the rate of technological progress more than proportionally. These results are consistent with a production function which exhibits increasing returns once we have considered the effect of capital increase on technological change (as in Romer, 1986).

As in the previous Section, the benchmark economy grows at a 3% per year. We consider that the benchmark economy is on a balanced growth path, that is, K_t/Y_t does not change in the period considered. The reader can easily check that both the savings rate $s = 21\%$ and the human capital growth rate $g_H = 1,86\%$ are consistent with the steady state of this model. Using the previous values for all parameters, we have that the dynamics of the economy follows the equations

$$K_t = (1-0,062)K_{t-1} + \frac{0,21+s_m}{P^*_{t_0}(0,992)^t}[A_t K_{t-1}]^{0,25}[H_{t_0}(1,0186)^t]^{0,5} \tag{12}$$

and

$$A_t = A_{t-1}[1+1,176g_{K_t}] \tag{13}$$

Table IV and VII shows the results. Table IV shows the actual evolution of savings, physical capital and output; assuming a GDP growth of 3%, whereas Table VII shows the alternative evolution under the transition to a privatized pension system.

We can appreciate that, as a consequence of the greater savings rate generated during the transition between the two pension systems, physical capital increases a 61,6%, and output rises a 31,5% with respect to the actual evolution under the current public pension system. These figures imply that the average growth rate of physical capital changes from 3,8% (in the benchmark economy) to 5,6%, and that the average growth rate of the GDP rises from 3% to 3,9% in the period 1996-2025.

4.4 Estimation Results: Partial Substitution Between Voluntary and Mandatory Savings

We relax the assumption of non-substitution between voluntary and mandatory savings to consider that the implementation of a private pension scheme has a final negative effect on voluntary savings. Since a total substitution between the two kinds of savings is not compatible with a welfare-maximizing behavior (because workers give a positive value to their consumption when they retire), and empirical (see Venti and Wise (1990)) studies show a negligible substitution effect of private pension plans, we compute the dynamics of the model under the assumption that one percent of pension plan savings substitute 0,2 percent of voluntary savings, that is, we estimate

$$K_t = (1 - 0,062)K_{t-1} + \frac{(0,21 - 0,2s_m) + s_m}{P^*_{t_0}(0,992)^t}[A_t K_{t-1}]^{0,25}[H_{t_0}(1,0186)^t]^{0,5} \tag{14}$$

jointly with the dynamic equation (13).

Table VIII shows the evolution of savings, physical capital and output under the transition to a fully funded pension system. Comparing with the predicted of these variables (see table IV) we have that, under a 20% substitution parameter of voluntary by mandatory savings, physical capital increases under the transition between the two systems by 46,3% with respect to the benchmark economy; whereas output grows by a 24,5%.

5 Transition Costs

Once the capital and output effects of the pension system change has been computed under alternative approaches, an interesting exercise is the study of the cost for the government of the transition here designed. These costs are derived from the deficit in the public pension system imposed by the loss of the contributions of younger workers, and by the condition that no individual who receives (or will receive) a public pension must be harmed by the pension change.

The estimation of the government transition costs is thus done as follows. The total amount of pension expenditures represents a 9,3% of the GDP. Using the data described by the *Anuario de Estadísticas Laborales (1995)* and

Castillo et al. (1991) about the age composition of Social Security workers and workers' wages, we estimate that the proportion of Social Security contributions made by workers with less than 40 years old will be 52% of overall contributions in 1996. From these figures, we have that the initial revenues loss for the government is (0,52)(9,3%) = 4,8% of the GDP.

How do the GDP proportion of transition costs evolve over time? In a theoretical framework, there are two opposite effects. On one hand, the proportion of workers in the fully funded system increases over time, as workers' generations with less than 40 years in 1996 get older and generations with more than this age become retired. Thus, the revenue loss for the government becomes greater, because less people contribute to the old public system. On the other hand, the faster economic growth implies that the fraction of the GDP which covers the cost of the already existing public system is lower. Under the reform here designed, the overall effect of these two effects is negative, and -as Table IX shows- the GDP proportion destinated to the financing of public pension rises from 4,8% to 7,4% in 2025, that is, 2,6% in 30 years in the endogenous growth model with partial savings substitution; to 7% of the GDP in the model without savings substitution; and to 7,5% in the neoclassical framework.

Hence, the further fiscal adjustment originated by the over time increase in transition costs (2,2% - 2,7% in 30 years) is not relevant relative to the 4,8% of the GDP initial fiscal adjustment. Moreover, we do not introduce in our analysis other important side effects of the transition between the two systems for the public finances. For instance, the greater investment and GDP growth is able to create a number of 250.000 new jobs equipped with the same capital as old jobs during the first year of the transition. Even if this job increase is reduced during the following years (because of the depreciation of the new capital stock), the new job creation growth means a long run reduction in unemployment to nearly zero, and hence a reduction in unemployment subsidies, which nowadays represent a 3,5% of the GDP. In addition, the larger amount of active workers raises the tax base and implies greater government revenues even if tax rates are not increased.

6 A Comparison of Pension Benefits under the Two Systems

A decisive variable in the political decision on the implementation of the new fully funded system must be the pension benefits of workers under the new system. As it was shown in Section 2, the deep Social Security reform needed to guarantee the viability of the public pension system in the long run implies an average reduction in pension benefits of around a 30%. If the government adopts the indirect way to balance the pension system (and this seems to be the case), the future pension benefits cuts mean that workers will receive a pension which is about a 23 percent lower than the current real pensions, in the best case.

To compare with these pensions, we estimate the pensions corresponding to the rate of returns and wage increases implicit in our analysis. Table X shows the average rate of return of physical capital and the rate of growth of wages, whereas Table XI shows the corresponding pension benefits for several groups of workers. We consider capital intermediation costs of about 10% of the yearly contributions[9]. We can appreciate that the corresponding pension benefits under the fully funded system are more than twice the pension obtained under the Pacto de Toledo reforms for all workers' groups. Notice also (see Appendix) that these pensions are calculated assuming that widows receive a 100% of their consorts' pensions (in contrast with the 45% received under the public system) that the same percentage of incapacity pensions are paid under the new system (25%) and a 5% capitalization rate of total wealth in pension funds.

7 Conclusion

The objective of this paper is to show the fallacy of the two main objections to the introduction of new privatized pension system, which are: a) the

[9]In Chile (see Diamond (1993)) the intermediation costs represented about 30% of the 10% mandatory savings rate. We consider smaller financial costs for Spain because of, first, the greater degree of development of the Spanish financial market and, second, because the regulation of the Chilean reform implied measures such as the prohibition of collective pension funds, avoiding the obtention of potential economies of scale that arise when the amount of pension funds managed by the financial intermediaries is greater.

transition costs between the two system are so high that the implementation of the new system is impossible in practice, b) only the richer individuals would benefit from the fully funded pension system. In contrast, we obtain that the financing of transition costs requires a fiscal adjustment which is not substantially greater than other fiscal adjustments experienced by democratic OECD countries. Moreover, because the future average real rate of return of the current public pension system is a mere 0,9% per year (using the projections of Herce et al. (1995)), we show that the new private system imply substantially greater pension benefits for all workers than the current public pension system.

In addition, this work shows that, whatever the theoretical framework considered, there are important output gains of the transition between the two pension systems. This result is not surprising after the work of Huang et al. (1995) or Kotlikoff (1995), among others. Using a Auerbach-Kotlikoff dynamic life-cycle model, Kotlikoff (1995) show that, depending on the fiscal instruments adopted by the government during the transition, physical capital would be 52 percent higher and output 17% higher in the U.S. after the transition between the two pension systems. Furthermore, these authors measure the walfare gains of the pension system change and they obtain that these gains are important. In Spain, the welfare gains of our proposed pension change are thus susceptible to be very significant, and the first and most important extension of our approach will be the estimation of these gains by calibrating a dynamic general equilibrium model.

Some important questions arise in the practical implementation of the pension change. The first question is when this change must start. If the government wants to maximize the likelihood of a successful reform, the answer is easy: as soon as possible. The Spanish economy has recently started an expansion period that is usually decisive for a successful financing of fiscal adjustments. As empirical evidence shows, successful fiscal adjustment (Belgium, 1987; Ireland, 1987-1989) are normally carried out in expansive periods. Moreover, the dynamics of pension costs becomes costlier a future reform of the pension system.

A last issue is a political one, and has to do with the political incentives to implement a pension reform such as the one proposed here. If the median voter approach were empirically valid, the results of this paper show that a potential government would have a very strong incentive to start the transition as soon as possible. However, information is incomplete and costly,

electoral periods only last four years, and whereas almost the entire transition costs are beared during the first transition years, the benefits spread over a longer period. A practical implementation of the pension reform here defended is thus only possible through a process of becoming aware most of the population about the real and substantial gains derived from the pension system change.

References

Alesina, Alberto; and Perotti, Roberto (1995): "Fiscal Adjustments", *Economic Policy*, no. 21.

Arrau, Patricio (1990): "Social Security Reform: the Capital Accumulation and Intergenerational Distribution Effect", *World Bank*, Washington D.C.

Arrau, Patricio; and Schmidt-Hebbel, Klaus (1993): "Macroeconomic and Intergenerational Welfare Effects of a Transition from Pay-As-You-Go to Fully Funded Pensions", *World Bank*, Washington D.C.

Baiges, Josep; Molinas, Cesar; and Sebastian, Miguel (1987): "La Economía Española 1964 - 1985: Datos, Fuentes y Análisis", Instituto de Estudios Fiscales, Ministerio de Economía y Hacienda.

Barea, José (director) et al. (1995): "El Sistema de Pensiones en España: Análisis y Propuestas para su Viabilidad", *Monografía*, Círculo de Empresarios.

Bateman, Hazel; and Piggott, John (1993): "Australia's Mandated Private Retirement Income Scheme: An Economic Perspective", *Research Paper Series*, num. 7, University of New South Wales, Australia.

Boskin, Michael J.; and Lau, Lawrence J. (1992): "Capital, Technology, and Economic Growth", in *Technology and the Wealth of Nations*, in N. Rosenberg, R. Landau, and D. C. Mowery (eds.), Stanford: Stanford University Press.

Castillo, Sonsoles; and Toharia, Luis (1991): "Las Desigualdades en el Trabajo", *Mercado de Trabajo y Desigualdad*, vol. 4, Fundación Argentaria.

Diamond, Peter A. (1993): "Privatization of Social Security: Lessons from Chile", *NBER Working Paper 4510*, Cambridge, Massachusetts.

Diamond, Peter A., and Valdes-Prieto, Salvador (1994): Social Security

Reforms, in B. Bosworth (ed.), *Chilean Economy: Policy Lessons and Challenges*, Washington: Brookings Institutions.

Feldstein, Martin (1995): "Would Privatizing Social Security Raise Economic Welfare?", *NBER Working Paper 5281*, Cambridge, Massachusetts.

Gil, Joan (1996): "Tasas de Rendimiento, Efectos Redistributivos del Sistema Público de Pensiones y Pacto de Toledo", *mimeo*, Universitat de Barcelona.

Gordon, R. (1990): "The Measurement of Durable Goods Prices", *NBER Working Paper*, Cambridge, Massachusetts.

Herce, José A., and Pérez Díaz, José V. (directores) et al. (1995): "La Reforma del Sistema Público de Pensiones en España", *Colección de Estudios e Informes*, no. 4, Caja de Ahorros y Pensiones de Barcelona.

Huang, He; Imrohoroglu, Selahattin; and Sargent, Thomas J. (1995): "Two Computational Experiments to Fund Social Security", *mimeo*, Department of Economics, University of Chicago.

Kotlikoff, Laurence J. (1995): "Privatization of Social Security: How it Works and Why it Matters", *NBER Working Paper 5330*, Cambridge, Massachusetts.

Mankiw, Gregory N.; Romer, David; and Weil, David N. (1992): "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, 107, 2 (May), pp:407 - 437.

Ministerio de Trabajo y Seguridad Social (1995): "Anuario de Estadísticas Laborales", *Ministerio de Trabajo y Seguridad Social*, 1995.

Munnell, Alicia; and Frederick Yohn (1992): "What is the Impact of Pensions on Savings?", in Pensions and the Economy: Sources, Uses, and Limitations of Data, in Bodie, Zvi and Munnell, Alicia, 1992.

Pesando, James (1991): "The Multiple Roles of Private Pensions: Effect

on Savigs, Capital Markets, and Labour Market Decisions", Presented at the *OECD Conference on Private Pensions and Public Policy*, Paris.

Romer, Paul M. (1986): "Increasing Returns and Long Run Growth", *Journal of Political Economy*, 94, 5 (October), pp:1002 - 1037.

The World Bank (1994): "Averting Old-Age Crisis: Policies to Protect the Old and Promote Growth", *Policy Research Report*, Washington D.C.

The World Bank (1995): *World Development Report 1995*, Washington D.C.

Venti, Steven F.; Wise, David A. (1990): "Have IRAS Increased U.S. Saving?: Evidence from Consumer Expenditure Surveys", *Quarterly Journal of Economics*, 105, 3 (August).

Appendix I: The Dynamics of the Endogenous Growth Model

To simplify the study of the endogenous growth model's dynamics, we first write an analogous, continuous time version of equations (9)-(10):

$$\dot{K}(t) = \frac{s}{P^*(t)}[A(t)K(t)]^{\alpha}H(t)^{\beta} - \delta K(t)$$

$$\frac{\dot{A}(t)}{A(t)} = \gamma\frac{\dot{K}(t)}{K(t)}$$

The solution of the last equation is given by $A(t) = CK(t)^{\gamma}$, where $C \equiv [\frac{A(t_0)}{K(t_0)}]^{\gamma}$. Substituting this result into the first equation and dividing by K(t), we have

$$\frac{\dot{K}(t)}{K(t)} = \frac{s}{P^*(t)}BK(t)^{\alpha(1+\gamma)-1}H(t)^{\beta} - \delta.$$

For $\alpha(1+\gamma) < 1$ (our estimations imply $\alpha(1+\gamma) = 0,544 < 1$), for any initial value $K(t_0)$, the ratio capital-output (weighted by the relative prices) converges to a value such that the growth rate reachs its steady state value $g_K = \frac{\beta g_H + \pi}{1-\alpha(1+\gamma)}$ (π is the (negative) growth rate of $P_K(t)/P_Y(t)$). This result is due to the concavity of $\frac{\dot{K}(t)}{K(t)} = F(K(t),.) = \frac{s}{P^*}BK(t)^{\alpha(1+\gamma)-1}H(t)^{\beta} - \delta$ with respect to *K(t)*. Moreover, it is easy to show that, in the balanced growth path -where the nominal output and the nominal value stock of physical capital grows at a common rate, *g*-, the value of the ratio $p_K(t)K(t)/p_Y(t)Y(t)$ is equal to $\frac{s}{g+\delta}$.

Appendix II: Estimation of Pension Benefits

A. Pacto de Toledo

The pension obtained under the Pacto de Toledo reform corresponds to the average real wage of the last 35 years before the first pension payment starts. However, the last two years of these 35 years are computed in nominal terms. Assuming that the inflation rate is $\pi = 3\%$, and that wages grow at a yearly rate of $g = 2\%$, the Pacto de Toledo corresponding pension is:

$$P_{PactoToledo} = \frac{w(T) + w(T-1)/(1+\pi) + w(t_0)/(1+\pi)[\int_{t_0}^{T-3} exp(g(t-t_0))dt]}{T} =$$

$$\frac{w(35) + w(34)/(1+0,03) + w(0)/(1+0,03)[exp(0,02)(33) - 1]/(0,02)}{35}$$

Using the data about initial wages for different workers, we obtain the pension values that appear in Table XI.

B. Capitalization of Pension Funds

In this case, the evolution of total wealth in pension funds *W(t)* follows the differential equation

$$\dot{W}(t) = r(t)W(t) + cw(t)(1-x)$$

where *r(t)* is the average rate of return implicit in our results of capital and output evolution, c is the wage fraction destinated to pension funds (equal to 0,248 in this exercise), $w(t) = w(t_0)exp[\int_{t_0}^{t} g_w(s)ds]$ is the wage at t ($g_w(s) = g_Y(s) - g_N$ is the rate of growth of real wages, equal to the rate of growth of output minus the rate of growth of working population), and x is the fraction of the yearly contribution destinated both to cover intermediation costs and incapacity pensions. We consider $x = 0,35$.

Solving the previous differential equation, we have

$$W(T) =$$

$$exp(\int_{t_0}^{T} r(s)ds)[W(t_0)+(1-x)cw(t_0)[\int_{t_0}^{T} exp[\int_{t_0}^{t} g_w(s)ds]exp[-\int_{t_0}^{t} r(s)ds]dt]].$$

This equation gives total wealth in pension funds at the end of the contribution period. Assuming that pensions remain constant in real terms, the annuity corresponding to that wealth is

$$P_{capit.} = \frac{W(T)}{\int_{T}^{T^*} exp[-\int_{T}^{t} r(s)ds]dt}$$

where $T^* = max(E(Life)^{contributor}, E(Life)^{consort})$ is the maximum life expectancy of the contributor to the pension plan and his or her consort, that is, we include widow pensions in our calculations. Under the assumptions $r(s) = r = 0,05$ and $T^* = 20$, we obtain the pension benefits shown in Table XI.

TABLE I

Proportion to G.D.P. of Social Security Revenues and Pension Expenditures: 1963-1995

Years	Revenues	Pension Expend.
1963	0,04570	0,00922
1964	0,05026	0,01043
1965	0,04886	0,01118
1966	0,04833	0,01089
1967	0,06357	0,01400
1968	0,06162	0,01391
1969	0,06259	0,01622
1970	0,06340	0,01837
1971	0,07088	0,02585
1972	0,07589	0,02797
1973	0,07913	0,02822
1974	0,08074	0,03023
1975	0,09258	0,03407
1976	0,0995	0,04018
1977	0,10008	0,04283
1978	0,10541	0,05092
1979	0,10882	0,05692
1980	0,10126	0,05753
1981	0,10671	0,06515
1982	0,09922	0,06735
1983	0,10274	0,07156
1984	0,09792	0,07446
1985	0,0962	0,076
1986	0,09394	0,07537
1987	0,08812	0,07416
1988	0,08787	0,07442
1989	0,09065	0,07495
1990	0,092	0,07644
1991	0,0931	0,07824
1992	0,0977	0,08155
1993	0,10606	0,08813
1994	0,11028	0,09094
1995	0,10817	0,09359

TABLE II

Pay-As-You-Go Current System

Gross Wage Earnings	15 Years	35 Years
5.260.000	4.779.821	7.966.368
4.000.000	3.634.845	6.058.074
2.900.000	2.635.262	4.392.104
2.000.000	1.817.422	3.029.037
1.370.000	1.244.934	2.074.890

Pay-As-You-Go Pacto de Toledo Reform

Gross Wage Earnings	15 Years	35 Years
5.260.000	3.457.204	6.726.092
4.000.000	2.629.053	5.114.899
2.900.000	1.906.063	3.708.302
2.000.000	1.314.526	2.557.450
1.370.000	900.451	1.751.853

Assumption: real wage growth rate = 2%.

Source: Encuestas de Salarios (I.N.E). Own estimations.

TABLE III

Human Capital Data

Professional Categories	Gross Wage Earnings 1995	Structure of Ocupied Workers in terms of Educational Achievement		
		1964	1984	1994
College Degree	5.260.000	1,4	4,5	7,4
High-Skill	4.000.000	1,5	5,0	7,14
Middle-Skill	2.900.000	2,95	24,2	44,7
Low-Skill	2.000.000	78,8	53,3	32,7
Unskilled	1.370.000	9,1	10,7	7,2

Source: Encuesta de Población Activa y Encuesta de Salarios (I.N.E.). Own estimations.

TABLE IV

Actual Evolution of Savings Rates, Physical Capital and Ouput: 1996-2025
(with an output and capital accumulation estimated growth rates of 3%, in real thousand milion ptas.)

Years	Savings Rate	Capital	Output
1996	0,21	154.673.855	68.455.056
1997	0,21	159.314.070	70.508.708
1998	0,21	164.093.492	72.623.969
1999	0,21	169016297	74802688
2000	0,21	174086786	77046769
2001	0,21	179309390	79358172
2002	0,21	184688671	81738917
2003	0,21	190229331	84191085
2004	0,21	195936211	86716817
2005	0,21	201814298	89318322
2006	0,21	207868727	91997871
2007	0,21	214104789	94757807
2008	0,21	220527932	97600542
2009	0,21	227143770	100528558
2010	0,21	233958083	103544415
2011	0,21	240976826	106650747
2012	0,21	248206131	109850270
2013	0,21	255652315	113145778
2014	0,21	263321884	116540151
2015	0,21	271221541	120036356
2016	0,21	279358187	123637446
2017	0,21	287738932	127346570
2018	0,21	296371100	131166967
2019	0,21	305262233	135101976
2020	0,21	314420100	139155035
2021	0,21	323852703	143329686
2022	0,21	333568285	147629577
2023	0,21	343575333	152058464
2024	0,21	353.882.593	156.620.218
2025	0,21	364.499.071	161.318.825

TABLE V

Evolution of Savings Rates, Physical Capital and Output in a Neoclassical Model under the Transition to a Fully Funded Pensions System: 1996-2025
(in real thousand milion ptas.)

Years	Savings Rate	Capital	Output
1996	0,2581	158.526.231	68.455.057
1997	0,2605	167.373.769	71.690.633
1998	0,2629	176.604.581	74.576.029
1999	0,2653	186.234.507	77.558.146
2000	0,2678	196.280.039	80.640.466
2001	0,2702	206.758.344	83.826.582
2002	0,2724	217.669.299	87.120.198
2003	0,2746	229.030.379	90.522.146
2004	0,2768	240.859.765	94.036.302
2005	0,2790	253.176.371	97.666.662
2006	0,2812	265.999.867	101.417.347
2007	0,2830	279.307.228	105.292.607
2008	0,2848	293.117.167	109.290.022
2009	0,2866	307.449.143	113.413.951
2010	0,2884	322.323.388	117.668.883
2011	0,2902	337.760.924	122.059.441
2012	0,2915	353.723.482	126.590.392
2013	0,2928	370.230.424	131.257.726
2014	0,2942	387.301.871	136.066.275
2015	0,2955	404.958.728	141.021.012
2016	0,2968	423.222.703	146.127.054
2017	0,2978	442.066.316	151.389.670
2018	0,2988	461.510.344	156.807.187
2019	0,2998	481.576.351	162.384.998
2020	0,3008	502.286.710	168.128.649
2021	0,3018	523.664.621	174.043.847
2022	0,3020	545.600.246	180.136.461
2023	0,3023	568.111.947	186.394.241
2024	0,3025	591.218.795	192.822.883
2025	0,3028	614.940.574	199.428.228

TABLE VI

Ordinary Least Square Estimation of Equation 11
(based on data for 1963-1995)

Variable	Beta	Standard Error	t - Statistic
g_k	0,544	0,07046	7,724
(Constant)	0,0066	0,45543	0,014

R Square	0,673
Adj. R Square	0,662
Standard Error	1,235
F - Statistic	59,7
Confidence Interval	(0,425 - 0,663)

Source: Own estimations.

TABLE VII

Evolution of Savings Rates, Physical Capital and Output in a Endogenous Growth Model without Savings Substitution under the Transition to a Fully Funded Pensions System: 1996-2025

(in real thousand milion ptas.)

Years	Savings Rate	Capital	Output
1996	0,2581	158.668.714	68.455.057
1997	0,2605	167.676.244	71.201.455
1998	0,2629	177.220.145	74.065.511
1999	0,2653	187.330.756	77.051.872
2000	0,2678	198.040.078	80.165.375
2001	0,2702	209.381.863	83.411.053
2002	0,2724	221.372.776	86.794.144
2003	0,2746	234.048.457	90.315.825
2004	0,2768	247.446.447	93.981.543
2005	0,2790	261.606.284	97.796.964
2006	0,2812	276.569.610	101.767.985
2007	0,2830	292.332.268	105.900.741
2008	0,2848	308.935.655	110.191.582
2009	0,2866	326.423.284	114.646.618
2010	0,2884	344.840.888	119.272.196
2011	0,2902	364.236.536	124.074.918
2012	0,2915	384.590.810	129.061.650
2013	0,2928	405.949.953	134.225.990
2014	0,2942	428.362.471	139.574.637
2015	0,2955	451.879.244	145.114.554
2016	0,2968	476.553.642	150.852.973
2017	0,2978	502.380.220	156.797.413
2018	0,2988	529.411.838	162.944.623
2019	0,2998	557.703.869	169.302.131
2020	0,3008	587.314.319	175.877.757
2021	0,3018	618.303.954	182.679.624
2022	0,3020	650.562.693	189.716.170
2023	0,3023	684.141.163	196.966.927
2024	0,3025	719.092.271	204.439.441
2025	0,3028	755.471.296	212.141.535

TABLE VIII

Evolution of Savings Rates, Physical Capital and Output in a Endogenous Growth Model with Savings Substitution of 20% under the Transition to a Fully Funded Pensions System: 1996-2025
(in real thousand milion ptas.)

Years	Savings Rate	Capital	Output
1996	0,2485	158.004.935	68.455.057
1997	0,2504	166.281.784	71.036.848
1998	0,2523	175.023.024	73.724.557
1999	0,2543	184.253.591	76.522.219
2000	0,2562	193.999.731	79.434.032
2001	0,2581	204.289.069	82.464.359
2002	0,2599	215.135.740	85.617.733
2003	0,2617	226.568.948	88.895.457
2004	0,2634	238.619.398	92.302.254
2005	0,2652	251.319.368	95.843.033
2006	0,2670	264.702.794	99.522.894
2007	0,2684	278.767.841	103.347.138
2008	0,2698	293.548.505	107.313.286
2009	0,2713	309.080.457	111.426.652
2010	0,2727	325.401.131	115.692.748
2011	0,2742	342.549.807	120.117.303
2012	0,2752	360.513.594	124.706.265
2013	0,2763	379.330.744	129.455.056
2014	0,2773	399.041.323	134.369.536
2015	0,2784	419.687.298	139.455.782
2016	0,2794	441.312.627	144.720.104
2017	0,2802	463.916.234	150.169.050
2018	0,2810	487.542.082	155.800.651
2019	0,2818	512.236.162	161.621.506
2020	0,2826	538.046.592	167.638.460
2021	0,2834	565.023.710	173.858.617
2022	0,2836	593.087.894	180.289.346
2023	0,2838	622.282.571	186.915.181
2024	0,2840	652.653.063	193.742.853
2025	0,2842	684.246.669	200.779.337

TABLE IX

Estimation of the Transition Costs in terms of G.D.P. in the Endogenous Growth Model with Savings Substitution of 20%: 1996-2025

Years	Transition Costs
1996	0,0481
1997	0,0501
1998	0,0521
1999	0,0541
2000	0,0560
2001	0,0579
2002	0,0596
2003	0,0612
2004	0,0628
2005	0,0643
2006	0,0658
2007	0,0669
2008	0,0680
2009	0,0691
2010	0,0702
2011	0,0712
2012	0,0718
2013	0,0724
2014	0,0730
2015	0,0736
2016	0,0742
2017	0,0745
2018	0,0747
2019	0,0750
2020	0,0753
2021	0,0756
2022	0,0753
2023	0,0751
2024	0,0748
2025	0,0745

TABLE X

Average Rates of Return of Physical Capital and Wage Growth Rates in a Endogenous Growth Model with Savings Substitution of 20% under the Transition to a Fully Funded Pensions System: 1996-2025

Years	r	g_w
1996	0,1218	0,0200
1997	0,1207	0,0277
1998	0,1197	0,0278
1999	0,1186	0,0279
2000	0,1175	0,0281
2001	0,1164	0,0281
2002	0,1153	0,0282
2003	0,1143	0,0283
2004	0,1132	0,0283
2005	0,1121	0,0284
2006	0,1110	0,0284
2007	0,1100	0,0284
2008	0,1089	0,0284
2009	0,1079	0,0283
2010	0,1069	0,0283
2011	0,1059	0,0282
2012	0,1049	0,0282
2013	0,1040	0,0281
2014	0,1031	0,0280
2015	0,1022	0,0279
2016	0,1013	0,0277
2017	0,1004	0,0277
2018	0,0996	0,0275
2019	0,0988	0,0274
2020	0,0980	0,0272
2021	0,0973	0,0271
2022	0,0965	0,0270
2023	0,0959	0,0268
2024	0,0952	0,0265
2025	0,0946	0,0263

TABLE XI

Pay-As-You-Go Pension Benefits vs Fully Funded Pension Benefits computed under the three Growth Models

Gross Wage Earnings	Pay-As-You-Go Pension Benefits	Capitalized Annuity (Neoclassical Model)	Capitalized Annuity (Endogenous Model without Substitution)	Capitalized Annuity (Endogenous Model with Partial Substitution)
5.260.000	6.726.092	18.288.278	22.683.551	23.405.060
4.000.000	5.114.899	13.907.435	17.249.849	17.798.525
2.900.000	3.708.302	10.082.891	12.506.140	12.903.930
2.000.000	2.557.450	6.953.718	8.624.924	8.899.262
1.370.000	1.751.853	4.763.297	5.908.073	6.095.995

Assumptions:

Fully Funded Pension: 30 contribution years, retirement at 70, life expectancy at 90, a 24.8% pay-roll tax rate, 10% financial intermediation cost and 5% capitalization rate of total wealth in Pension Funds.

Pay-as-you-go Pension (Pacto de Toledo reform): retirement at 70, 2% real wage growth rate, the last 35 years wage earnings computed in real terms but the last two in nominal terms.

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