Notional Defined Contribution Accounts: Application to Portugal

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December 2013
ABSTRACT

The amount of implicit debt is quantified in relation to the contributive regime that supports the old age pension scheme of the Portuguese Social Security and the notional defined contribution accounts system concept as a solution of financial sustainability of that regime is presented, without the need for altering the overall tax rules.

In the management of the transition from a public defined benefit pension scheme to a defined contribution plan a series of theoretical principles are presented, namely, the data treatment, the acquired rights, the demographic deficits, benefits not financed and the distinct speed of conversion in the processes of such nature.

The Swedish public pension system and its automatic balancing mechanism are characterized. Their underlying principles are applied to the Portuguese reality, essaying different speeds of conversion and distinct ways of computing the acquired rights. The results of the implicit debt, replacement rates, expenses and financial results of the new regimes are presented, based on a set of demographic and economic assumptions, provided by benchmark entities.

Key words: Notional defined contributions accounts; automatic balancing mechanism; replacement rates, implicit debt, Swedish Public Pension system

JEL Classification: H55
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1. INTRODUCTION

A large number of nations had or have public pension schemes of defined benefits, financed by a pay–as-you-go scheme whereby old age pension is determined by a formula, as is currently the case in Portugal (Decree Law 187/2007). These systems have, however, reached their maturity, in other words, most people when reaching the age of retirement obtain the maximum accrued benefit.

Given the existence of a number of facts such as competitive pressure caused by economic globalization, decrease in employment, ageing of the population, decrease in fertility rates and in some countries low productivity, these models have begun to show some signs of difficulties in what concerns their sustainability. Portugal is not an exception to this framework, where the implicit debt to the Social Security Contribution System, taking into account a set of economic and demographic assumptions, see point 5.1, based on a perspective of continuity, is forecast to reach the amounts indicated in the following table.

<table>
<thead>
<tr>
<th>Social Security Contributive System</th>
<th>Implicit Debt (*)</th>
<th>As % of GDP of 2012</th>
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<tr>
<td></td>
<td>-413.990</td>
<td>-250,20%</td>
</tr>
<tr>
<td></td>
<td>-314.344</td>
<td>-190,00%</td>
</tr>
<tr>
<td></td>
<td>-243.092</td>
<td>-146,90%</td>
</tr>
<tr>
<td></td>
<td>-191.519</td>
<td>-115,70%</td>
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</tbody>
</table>

(Interest rate) flat yield curve

<table>
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<tr>
<th>(interest rate) flat yield curve</th>
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</thead>
<tbody>
<tr>
<td>1.0%</td>
</tr>
<tr>
<td>2.0%</td>
</tr>
<tr>
<td>3.0%</td>
</tr>
<tr>
<td>4.0%</td>
</tr>
</tbody>
</table>

(*) Millions of euros

Life expectancy in Portugal has been increasing at an average rate of 1.3 years per decade. As an example, a male individual born in the decade of the 80’s, has at the age of 65 a life expectancy of 14.25 years, whereas a newborn in 2010, has 18.21 years. When it comes to females, the estimates are 17.62 and 21.77, respectively. This effect has a negative impact on the sustainability of the Portuguese pension scheme structure because of the increase in expenses to it related.


Though in very distinct ways, each of the mentioned countries outlined a path to achieve a common objective: the implementation of a financially sustainable public pension system in the long run. Financial sustainability resides in the pension system having, over time, assets
that exceed liabilities, implying that in the future there won’t be changes in the contribution rate. These transitions led to the abandonment of defined benefit contributions and to the adoption of notional account defined contribution systems, financed on a pay-as-you-go basis with the inherent intergenerational solidarity principle.

The notional defined contribution system is an instrument specially focused on the financing of old age retirement pensions.

This document does not include the analysis related to the inclusion of pensions for disability, survivor, sickness, unemployment and other guarantees associated to the defined benefit plans, hopefully articulated separately from the notional defined contribution system. The study is based on the adequacy of a notional defined contribution system applicable to the Portuguese reality as a vehicle specifically oriented towards old age retirement pension plans.

In this working paper, the intention is to propose a solution for the sustainability of the portuguese social security contribution system, existing up to the end of 2013, based on notional defined contribution system, inspired on the principles of the Swedish model by which, like in other countries where this system has been adopted, it was possible to obtain financially sustainable structural systems Chlon-Dominczak et al (2012)).

2. THE CONCEPTUAL SOLUTION AND ITS ADVANTAGES

2.1. Concept of Notional Account

In Palmer (2006) (1) is defined the financing concept of the public pension system based on a structure of notional defined contribution accounts, the basis of which, is the individual register of contributions over an active lifetime, not financially materialized, with a yield of a notional interest rate, that is, a function of the performance of economic variables, such as GDP, total contributions or salaries per capita. The financing of this scheme is on a pay-as-you-go basis, with its component of intergenerational solidarity.

Having reached the minimum retirement age, the worker can convert his notional capital into a pension, partial or total retirement. In the case of partial retirement all earnings will be registered in his individual account, which, in the future and at effective retirement, will lead to a higher pension.

The notional account is divided by an annuity calculated as a function of life expectancy of the current year, obtained by current data or, as an alternative, forecasts can be used to obtain the value of the pension, such as is the case of the Latvian solution, Palmer (2006) (1). In Sweden the option was the first approach, as well as the incorporation of a discount rate that reflects real growth of the economy in the long run (Orange Report (2011)). The payment is supported by the contribution inflow of all active workers at the time and employers.
In a system of pure notional accounts, notional accounts and pensions are indexed at the same rate, which is not the case in the Swedish system, as referred in point 4.1.

According to the author, in Palmer (2000), for long term sustainability, notional account and pensions should be indexed to the growth rate of the contributive mass that finances them.

With the expectancy of solving the problem of the Portuguese Social Security system we consider that it is necessary to maintain financing on a pay-as-you-go basis, and hence notional accounts is a possible means, the advantages of which are presented further on.

For technical options, an individual account of materialized funding can exist simultaneously, whereby a part of the contributions of mandatory and universal adhesion will be channeled and capitalized in the traditional manner according to the interest rate of the financial applications.

Considering the levels of implicit debt of the Portuguese system and consequently the subsequent financial necessities, the existence of a financial component, should have relatively marginal weight impact. Some countries like Latvia had to defer the introduction of the notional accounts system specifically because of financial contingencies similar to those existing in Portugal, Palmer et al (2006).

### 2.2. Advantages of the Notional Accounts

Notional accounts allows the accumulation of wealth redistribution financed through the government budget to assure the payment of the minimum pensions, as well as those pensions for disability, survival (widowhood and orphans), unemployment allowances and other non-contributive benefits, all that are considered socially indispensable in a society that desires solidarity.

The advantages underlying this pension financing philosophy are as follows:

- Financial sustainability – maintenance of a financial equilibrium in the long run, without tax increases over time, given the direct relationship between contributions and benefits, Brooks et al (2006);
- Low transition costs – financial materialization is not required, Williamson (2004);
- Transparency – the participant is informed annually of the virtual amount of constituted savings, Williamson (2001);
- Immunity to political risk – given the high degree of transparency and the existence of regulated automatic balancing mechanisms, Williamson (2001);
- Flexibility of the retirement age – allows for the management of individuals from the time they exit the labor market, through partial or total retirement but that continue to make discounts whilst being active and until full retirement in order to increase their pension, Normann (2000);
- Opportunity for other structural changes – its implementation creates conditions for changes in other sectors, Normann (2000);
- Tax evasion combat and work incentives – the pension is higher if the amount contributed is higher, Normann (2000);
- Favors labor mobility – easy international portability, given that it is simple and possible to know the amount of the notional capital account to be transferred each year, Palmer (2006).

Without prejudice to the annual adjustments since its implementation, these contemporary model structures that have been adopted in the previously mentioned countries, have successfully accommodated the economic, demographic and financial shocks that have occurred since the financial crisis began in 2008, Chlon-Dominczak et al (2012). The system has demonstrated flexibility to adjust dynamic reform, labor and fiscal policies, assuring dignified and comfortable living standards, proportional to the work effort along professional working life and complying with the expected of a public pension system.

3. TRANSITION MANAGEMENT

3.1. Conversion Principles

In the definition of the new structure based on the notional defined contribution scheme the treatment of acquired rights within the scope of the old system is one of the most influential factors in the value of future pensions and, in so being, very sensitive in what concerns social impact. It is therefore important to reflect on the various forms of treatment. According to Palmer (2006) (2) there are two distinct principles to be observed in the conversion of acquired rights under a model of defined benefits into a distributive model of notional accounts, namely:

- Acquired Rights Principle: a fair transition into a new system preserves acquired rights;
- Contribution Principle: a fair transition into the new system grants rights based on effectively paid individual contributions, including a rate of return on them.

This rate will be one that the system can support, given its assets and the value of its liabilities. Naturally, the application of each of these principles will result in different values of acquired rights.

3.1.1. Acquired Rights Principle

In a typical defined benefit system, acquired rights are normally a function of the years in the workforce, the final wage and life expectancy hence, its real cost is only known with precision at the time of death of the beneficiary. For this reason, there are two options for its calculation at the time of conversion:
- Option I – wait until the worker retires to calculate acquired rights.
- Option II – calculate acquired rights at the time of conversion, taking into account the estimate of the benefit value, the decrements associated to the contingencies the individual is subject to, as well as, the proportion of time elapsed since his admission until the moment of conversion and respective discount rate.

In both options, generational life expectancy must be estimated as rigorously as possible given that in the first option, this factor is determined at the retirement age and in the second at the time of conversion.

3.1.2. Contribution Principle

With this principle the contributions made up to the moment of conversion are guaranteed, thus the importance of indexation of the contributions, which can be made at the growth rate of the total contributive mass, the growth rate of the average salary (Swedish case), inflation or, in the case of the Portuguese system at the rate in which contributions are revaluated in the defined benefits formula, as put forward in article 27 of decree law 187/2007.

The Contribution Principle was selected as the preferred method for the quantification of the initial notional capital because it eliminates the burden from future generations of having to support costs associated to the retirement of current pensioners and because it is adaptable to the notional accounts philosophy.

3.2. Management of the Transition Speed

A particularly delicate and crucial concern to bear in mind with the implementation of a notional defined contribution scheme is to allow that the transition must be smoothed out as much as possible to the replacement levels in order to minimize impacts.

The simplest way to move from a defined benefit system to a notional defined contribution scheme is to apply it only to the workers that begin their professional activity. This approach allows that participants stay longer under the old system, taking the incorporation of the whole population longer, and therefore a much slower approach. The advantage lies with the fact that it is not necessary to estimate initial notional capital, because those that just entered the labor force will be the only ones subject to the new system.

The procedures analyzed are intimately related to the abandonment of a defined benefit system, as is the Portuguese case, which has the characteristic of deferring the financing of life expectancy and other benefits that aren’t directly related to the contributions of future generations, leading to creation of more taxes, which does not occur under the notional accounts system.

A slow transition will perpetuate this situation over time. An immediate transition will end with the creation of non-financed rights or alternatively, create a tax to support them.
Therefore, the higher the contribution rate under the old system, more important it is to speed up conversion specifically because of resource redistribution and cost containment.

A quick transition with immediate application to the working population presents the advantage of a rupture with the old system and beginning of the new one with all of the previously mentioned advantages. In particular, as a consequence of an immediate transition the redistribution of the rights under the benefit plan among potential winners and losers will tend to be accentuated, the difference being larger if the gap between the notional account system and the prior benefit plan is larger.

As an alternative to immediate transition, a gradual transition with distinct operational means could be chosen. A possible way is to apply it immediately to a certain sub set of individuals whose age falls within a certain range from the minimum retirement age. If the global impact, measured in terms of cost is low then the adoption of the new rules should be extended to neighboring subsets. If, however, the difference between the benefits under the new system and the old system begins to accentuate, then a transition that gradually weighs the benefit determined under the old system and the benefit determined under the new should be found so that equal treatment among individuals exists materialized in the smoothing out of the replacement rates.

If the decision falls upon the gradual transition option, therefore longer, the individuals with less contribution time, the potential losers, will in general be more defended, whilst those which have contributed longer, eventually the winners, could see their advantages reduce over a longer time span.

The disadvantage of a slow transition is that both systems coexist with the onus on future generations of financing the system via payroll tax. The transition managers, can define different dynamics in the changing process that range from a slow, gradual or immediate transition.

In presence of the arguments presented, an immediate transition has a number of advantages as opposed to the other alternatives within a structural change context.

### 3.3. Determination of the Initial Notional Capital of Conversion

On the basis of past salaries, the initial capital, \( CI_{T,i} \), for individual \( i \), at time \( T \), will be given by:

\[
CI_{T,i} = \sum_{t=1}^{T} C^{ci} W_{t,i} I_{t}^{ci}
\]

with:

\[
I_{t}^{ci} = \prod_{t=1}^{T-1} (1 + \beta_t)
\]
\[ I^c_t = 1 \]

where:
\( W^c_{it} \) – Salary of worker at moment \( t \)
\( c^c_{it} \) – Contribution Rate
\( I_t \) - Revaluing index of the contributions made up to moment \( t \)
\( T \) - Moment in which initial capital is calculated and credited in the account
\( \beta_t \) – Rate of return of moment \( t \)

Total capital will at retirement be comprised of the initial notional capital, determined at the time of introduction of the notional account system, accrued of additional adequately revaluated contributions in subsequent years. According to expression (3.1) there are three fundamental parameters in the determination of the initial capital \( W^c_{it}, c^c_{it}, \beta_t \). Further on, the possible ways of obtaining this value are analyzed.

### 3.3.1. Past Salaries

In the event of a record with past individual salaries, this record should be used in the determination of the initial notional capital. In the event of its unavailability, an estimate should be determined using official national wide statistics. Some ways of obtaining that capital are described:

#### 3.3.1.1. Estimating Past Salaries

In the treatment of salaries, which are the determinant variable in the calculation of the initial notional capital and consequently on the absolute value of contribution inflow, three alternatives are considered, depending on the existence or not of real historic data:

**Alternative I:**
Use of the Contribution Effectively Paid in the Past – if possible to obtain past contributions, which is the same as working with a salary record, the problem in the calculation of the initial notional capital is limited to the revaluation of contributions already made thus, the workers are entitled to an initial notional capital corresponding to their effective contribution.

**Alternative II:**
Use of the History of Past Salaries Conjugated with the Contribution Rate of the Future Notional Accounts System - If a record of past salaries is available, the new contribution rate with revaluation can be applied to obtain the initial notional capital.

**Alternative III:**
Use of the Individuals’ Years of Contribution- assuming that at the moment of implementing the new system, no trustworthy information on individual earnings or past contributions is
available but that there is a trustworthy record of the number of years of contributions, this number can be combined with three other sub options for the treatment of salaries:

a) Combination of Individual Service Years With Average National Salary at the Time of Implementation - uses the average salary of all participants, of the year prior to the introduction of the new scheme which, multiplied by the individual service years of each worker gives the initial capital. It has the advantage of the scheme starting with a scale in accordance with the level of development of average income.

b) Combination of Individual Service Years with the National Average Salary, Real or Historical, per Gender and Age - similar to the previous method, but in this case the national wage may be statistically distributed by gender and age. This assumption may lead to stricter amounts than the former particularly in populations that present average wage differences influenced by those two factors. Though it would be rigorous to use historical data, the use of current data is also an alternative.

c) Combination of Individual Service Years with Individual Average Salary Determined on the Basis of Estimates Immediately Preceding and / or Following the Introduction of the New Scheme - this assumption tries to reflect the past distribution of individual average earnings and simultaneously the contributions based on the current situation of the participant. It is a fair assumption, since it admits that current individual earnings reflect the past positioning relative to other workers. It should be noted that it discriminates in favor of those who have made discounts for a longer time in the domain of the formal economy compared to those who have recently left the parallel economy and have only just started to contribute. Thus, when applied to countries where labor informality is high, in using current salary information after the implementation of the new system, a premium is incorporated for those who declare income and consequently contribute after conversion.

The decision as to which of the previous options is to be chosen should be supported on the information available for the calculation of the initial notional capital, avoiding discriminatory criteria difficult to defend politically.

At the time of conversion, regardless of the initial assumptions chosen for the calculation of initial notional capital, if guaranteed rights that aren’t financed in the notional accounts exist, a tax, duly identified as an exogenous component of the transition process should be created.

3.3.1.2. Contribution Rate

A way of determining the contribution rate to be used in the calculation of the initial notional capital is the adoption of Alternative I, of point 3.3.1.1., using the contribution rates actually paid in previous years. However, since the contribution rates determine the scale of a pension system, they may not be compatible with the objective of reducing expenditure.
The simple alternative of maintaining in the new system of notional accounts the financing rate of the defined benefit plan may lead to higher costs, therefore, it is recommended that it be reduced, but much depends on the objectives of the decision makers.

If opting for a reduction of the contribution rate in the new scheme and if the defined benefit system is still in force for a portion of the population, an exogenous tax to the notional accounts intended to bridge the funding gap may need to be created and as time elapses it will tend to zero.

It should not be forgotten that, at the outset, the objective of the change is to have a financially sustainable system in the long run, where the level and maintenance of the contribution rate are key issues.

### 3.3.1.3. Internal Rate of Return

Consistent with the existing literature, Borsh-Supan (2006), Lindeman et al (2006), Palmer et al (2006), Franco et al (2006) e Chlon-Dominczak (2) (2006), for a public pension system to be financially solvent, it must respect the basic condition of the direct link between contributions and benefits which means that, in the case of the notional defined contribution scheme the notional account and pensions should be indexed to the growth rate of the base contributive salary, Aaron (1966), being that comprised of productivity accrued of the growth of the labor force, Palmer (2000). In so being, the rate of return based on economic variables and the use of life expectancy per generation direct the system towards equilibrium in the long run, thus ensuring the maintenance of the contribution rate.

Sweden has opted for the indexation of the accounts to average salary, having also adopted an automatic balancing mechanism that guarantees its solvency if the number of participants decreases, a situation in which the earnings of the notional accounts could increase more rapidly than the contributive basis that supports it. The political preference came upon this solution, because at the outset, the ratio between average pensions and average salary will remain constant.

### 3.4. Management of the Demographic Deficit

If the size of the active generation of workers, close to retirement age, is higher than that of younger workers who will be responsible to bear the costs of pensions, then the architecture will start off with a demographic deficit. As such, there will, obviously, be a need for a specific tax overhang to cover this failure, unless a reserve has been duly set up in the past.

Financing may be based on the launching of specific taxes with different settlement times, focusing distinctly on different generations therefore, one should start first by pensioners, followed by the labor force and lastly by the future workers.
The fairest solution would be to affect this tax to the larger cohort whose acquired rights are not completely funded. The reason being that the underlying philosophy of notional accounts is that all receivable benefits should, in terms of financing, be the responsibility of the respective workers therefore a reduction in the initial notional capital of each of them may be an alternative.

The absence of a reserve fund or a consigned payroll tax for this purpose on the large cohort aimed at reducing the initial notional capital will entail the payment of a tax in the future originated by an implicit debt accumulated in the past.

If the mentioned tax is not created and taking into account that the system has a built-in automatic balancing mechanism, when in the presence of imbalances between assets and liabilities, an adequate adjustment of liabilities must take place, though, it may only be reflected in the future generation.

Thus, despite the technical treatment of the conversion of acquired rights under the defined benefit system to the system of notional accounts being a key aspect to consider in terms of financial sustainability, it may not be guaranteed in the long run if there is no reserve fund to co-participate in the pension payment of large cohorts, if deemed necessary. Moreover, their existence ensures that the respective generation finances its own commitments.

3.5. Specific Tax for the Financing of Acquired Rights under the Old System

The existence of a baby boom under the conditions of the old rules, without a reserve fund and that will later retire, is not the only event that lacks a financier tax. Indeed, in the context of transition, there are others that may require reserving, in particular acquired rights from the defined benefit scheme: the commitments associated with old age pensions of disabled and survived persons.

Similarly, any special rights arising from the old system may be subject to financing by means of a specific tax. Similarly to the defined benefit plan with redistributive pay-as-you-go financing, workers will also bear the burden of those pensions during the transition to the notional accounts system. Benefits of the above nature should, however, be externalized from the notional defined contribution scheme as this is a specially geared vehicle for old age retirement plans that should be supported by the state budget or through a higher rate of contribution credited to the notional accounts.

Of course, if a reserve, designed to withstand the acquired rights described above, is set up and transferable to the notional accounts, then there may be no need to launch such a specific tax.

In so being, social policies of various kinds, ranging from the upholding of rights, benefits of the old system, guaranteed minimum pensions and funding for large cohorts which remain in
coexistence with notional accounts may require the creation of payroll taxes specifically for their financing given that the notional accounts’ contribution rate will not support those costs. The allocation of financial resources for the realization of those benefits might result from budget transfers or bond issuing. The issuing of bonds may pass by the recognition of that debt in a fund, classified as an asset of the system that will be monetized according to necessities. In practical terms, both approaches are equivalent.

The process of changing to a system of notional accounts naturally entails costs, whereby a very substantial part relates to the level of the initial notional capital and consequently with its implicit debt at the time. In this particular aspect, implicit debt generated under the old system will continue and perhaps even increase despite solutions that confer advantages to existing employees or to current pensioners in detriment of the new. For this reason, the speed of the transition process is correlated to the level of implied debt at the time of conversion from one structure to another.

4. THE SWEDISH CASE

4.1. Characteristics

The Swedish public pension system is comprised of two components: a component of notional defined contribution accounts, financed on a pay-as-you-go basis, and a component of financial funded accounts, with contribution rates of 16% and 2.5% respectively, with respect to which 93% of the income is eligible for the constitution of old age pensions’, and the remainder directed toward social insurance. The discounts transferred to the accounts are subject to a ceiling that is determined yearly.

According to Baroni et al (2012), about 90% of the population receives benefits from an occupational pension fund, which is of a complementary nature of the two previous accounts.

With respect to the notional accounts, the present object of analysis of this study, during the accumulation phase, the interest rate of notional accounts is determined in accordance with the performance of the so called Income Index, that is, salary evolution per capita or equivalently, the average wage.

Regarding the payment period, pensions, according to the Orange Report of 2011, are updated annually by the ratio between the annual Income Index and that of the previous year divided by 1.016. In practical terms, this corresponds approximately to the annual variation of the Income Index deducted of the rate of 1.6% used in the annuity calculation of the retirement amount. In the years in which the Balance Index is activated, the Income Index is replaced by the Balance Index as explained in point 4.3. The minimum retirement age is 62 and partial retirement is possible.
The minimum guaranteed pension, disability and survivor pensions as well as any other non-contributive benefits are not included in the notional accounts and are financed annually through the state budget.

4.2. Turnover Duration

One of the main innovations of the current Swedish model was the creation of a balance sheet to determine their solvency position. For this purpose, the way found to record its main asset, the future contribution inflow was based on the so called contribution asset, that is, the result of the product of the annual contribution inflow by expected turnover duration, explained herein.

The rationale underlying this concept is that, in a pay-as-you-go, in equilibrium, the value of assets and liabilities are equal, thus no reserve fund exists. That is, the present value of liabilities on a certain date is given by the present value of future pensions of a population deducted of the present value of future contribution inflows, which corresponds to the contribution asset.

Thus, in order to introduce this concept, let us take, as examples, the mandatory retirement age of 65 years and a maximum age given by the technical limit of life tables, which is 120 years. With resort to an indexation rate for pensions and another for cash flow discounts that coincides with the salary growth rate, and a discrete time series, is possible to write a mathematical expression that translates the mathematical concept of the contribution asset described in the aforementioned paragraph.

\[
\sum_{t=0}^{120} \sum_{x=65}^{120} k \cdot \bar{w} \cdot l_x^t - \sum_{t=0}^{64} \sum_{x=0}^{64} c \cdot w_x \cdot \bar{w} \cdot l_x^t = CA
\]

Where,
- \(l_x^t\) – Number of persons of age \(x\), in year \(t\)
- \(\bar{w}\) – Total average salary
- \(w_x\) – Salary pattern, that is average salary of age \(x\) as a function of the total average salary of the population
- \(c\) – Contribution rate
- \(k\) – Replacement rate
- \(CA\) – Contribution asset

Assuming that population is in a steady state, that is birth, mortality and migration rates are constant over time, meaning that there are the same number of people in each age group and in each year and only considering the existing population at a certain date, that is, a closed group, the total amount of contributions and pensions disbursed is equal to the value of a year multiplied by the respective age, so it’s possible to rewrite (4.1) as follows:
\[ \sum_{x=65}^{120} x \cdot k \cdot \bar{w} \cdot l_x - \sum_{x=0}^{64} x \cdot c \cdot w_x \cdot \bar{w} \cdot l_x = CA \]  
(4.2)

For the system to be in equilibrium, the value of contribution inflow in the year must be equal to the pensions disbursed in this same year, hence the formula can be written as follows:

\[ \sum_{x=0}^{64} c \cdot w_x \cdot \bar{w} \cdot l_x = \sum_{x=65}^{120} k \cdot \bar{w} \cdot l_x \]  
(4.3)

In this way, it is possible to represent the rate of contribution as a function of the replacement rate.

\[ c = k \cdot \frac{\sum_{x=65}^{120} l_x}{\sum_{x=0}^{64} w_x \cdot l_x} \]  
(4.4)

Taking into account that the contribution asset is calculated as a product of the contributions of that year and expected turnover duration, then:

\[ CA = TD \cdot \sum_{x=0}^{64} c \cdot w_x \cdot \bar{w} \cdot l_x \]  
(4.5)

By substituting (4.5) in (4.2), we obtain:

\[ \sum_{x=65}^{120} x \cdot k \cdot \bar{w} \cdot l_x - \sum_{x=0}^{64} x \cdot c \cdot w_x \cdot \bar{w} \cdot l_x = TD \cdot \sum_{x=0}^{64} c \cdot w_x \cdot \bar{w} \cdot l_x \]  
(4.6)

Substituting (4.4) in (4.6) and solving some arithmetic:

\[ k \cdot \bar{w} \cdot \sum_{x=65}^{120} x \cdot l_x - k \cdot \frac{\sum_{x=65}^{120} l_x}{\sum_{x=0}^{64} w_x \cdot l_x} \cdot \bar{w} \cdot \sum_{x=0}^{64} x \cdot w_x \cdot l_x = TD \cdot \bar{w} \cdot k \sum_{x=65}^{120} l_x \]  
(4.7)

Simplifying a little, we obtain:

\[ \frac{\sum_{x=65}^{120} x \cdot l_x}{\sum_{x=65}^{120} l_x} = TD \]  
(4.8)

Thus, based on expression (4.8), it is shown that for a steady state population, the value of the contribution asset that will achieve the balance is equal to the contribution inflow of the year multiplied by the difference between the average age of pensioners and the average age of contributors.
contributors that is, it represents the average time a contribution is in the system until being returned to the contributor. This metric was used in the practical application lodged on 5.

In Settergren et al (2006) a similar deduction is made, but for a continuous time.

4.3. Automatic Balancing Mechanism

As explained in Settergren (2001), the Swedish model of public pensions has a built-in automatic balancing mechanism, which aims to ensure the solvency of the system, in the long run, in the case of it being threatened by demographic and economic reasons, for example, the shrinking of the workforce or as a result of financial risks like the reduction of the reserve fund given the performance of the capital markets. Thus, under certain economic, financial and demographic circumstances it is not possible that the notional accounts and pensions earn the growth rate of the average wage (variation of the Income Index, the natural Indexation of the Swedish model) and simultaneously guarantee its financial sustainability without altering the contribution rate. Through the Balance Ratio it is possible to evaluate the solvency position, by quantifying the ratio between assets and liabilities underlying the architecture. The first component of the balance sheet consists of the sum of the present value of future contribution inflows accrued of the reserve funds, and liabilities given by the amount of the notional accounts accrued of the present value of pensions being disbursed. If this ratio is less than one, then the system is insolvent because assets are less than liabilities. In so being adjustments have to be made, such as a reduction in the indexation factors or even a cut in accounts and pension values, as occurred in Sweden in 2010 and 2011 and the Balance Index, given by the following equality, activated.

\[ \text{Balance Index} = \text{Balance Ratio} \times \text{Income Index} \]

Evolution of liabilities will take place according to the performance of the Balance Index, until the balance ratio is once again higher than one, a situation in which pensions will increase greater than the increase in the Income Index, as can be seen analytically by the previous expression, repositioning the value of the accounts and pensions to their previous level prior to activation of the Balance Ratio, the so called acceleration phase. The graph below illustrates this process. Once the values equal those prior to activation of the automatic balancing mechanism, the system resumes its natural indexation to the Income Index.
Whenever the Balance Index is greater than one, a surplus that won’t be distributed is being produced and will be incorporated into the system. When the ratio is equal to one, the scheme will be balanced and indexation will be on the Income Index.

The functioning, description and activating conditions of this automatic balancing mechanism are regulated in the Swedish legislation, which allows it to be relatively immune to political manipulation.

In practical terms this automatic balancing mechanism reduces the liabilities of the architecture, repositioning it on a path of long term solvency.

Taking into account the functioning of this mechanism, the asset and liabilities valuation method is a key factor in this process. It is important to point out that in obtaining the Balance Ratio, the Swedish model uses historical data to determine those two components of the balance sheet, as referred (Orange Report (2011)).

4.4. **Buffer Fund**

The Swedish Model of notional accounts has a buffer fund that is financed by the surplus between contributions and pension disbursements and charged in the opposite situation. This Fund consists of financial assets that are invested in capital markets and therefore is credited or debited depending on these gains or losses, respectively.

5. **PRACTICAL APPLICATION**

5.1. **Assumptions and Methodology**

A model of economic - actuarial nature was used which permitted the projection until 2060 of the main physical indicators of the contributory regime of the social security system, such as:
the number of pensioners, the number of taxpayers, the contribution density and financial items, including costs with pensions, contributions, levies and average pensions. Minimum guaranteed pensions were not projected.

The macroeconomic scenario throughout the projection horizon was predetermined according to the assumptions presented below, so the model does not react endogenously to reformist policies or to variations in the perception of the economic players as to the sustainability of the system.

The economic, demographic and actuarial assumptions used, though optimistic, are in line with estimates recently published by the European Commission within the *Ageing Working Group*.

In what follows, consideration is given to two forms of transition to the new contributive social security system beginning in 2014. The first consists of an immediate transition, with abandonment of the current system and implementation of a new one with the maintenance of the contribution rates defined in the Contributory Welfare System of Social Security Regime Code for old age contingency, inspired on the technical principles of the Swedish model.

The second is a gradual transition, with two hypotheses: one is the adoption of the same pace adopted in the Swedish transition and a second, based on a distinct weighting that will be characterized further on. For each one of these, the effect of assuming the maintenance of the past pattern of retirement ages for those that benefit partially or totally of the notional accounts system versus the possibility in setting the retirement age at 65 will be considered.

Therefore and in compliance with the applicable law in force, it was admitted that under the current rules, individuals can only retire upon reaching the age of 65, in other words, anticipated retirement is not a possibility.

In both approaches, liabilities were determined using average salaries and pensions according to age, gender and labor contract, being the latter specific to dependent and independent workers.

### 5.1.1. Assumptions

The base scenario considered was the one described in “The 2012 Ageing Report, Economic and Budgetary Projection for the 27 EU Member States”, (2010-2060) [European Economy 2|2012 (provisional version)], herein referred to as the Ageing Report.

#### 5.1.1.1. Demographic

Projections carried out by Eurostat – Eurostat’s Population Projection EUROPOP 2010: published in April 2011 for the 27 member states. The key variables used were: fertility rates;
mortality rates and net migration flow, assuming convergence among the EU member states in the long run.

Fertility: Total Fertility Index (T.FI.) considered in the EUROPOP 2010 projections.

Mortality and Life Expectancy: Prospective Mortality Tables for the Portuguese Population, obtained with resource to the Poisson-Lee-Carter (Bronhs et al (2002)) method applied to total gross mortality rates per gender registered in the Portuguese population over the last 30 years, with closing date of the life tables at 120 years, and through application of the methodology proposed by Denuit e Goderniaux (2005).

Net Migration Flow: the estimated in the EUROPOP 2010, scenario produced by Eurostat;

Demographic and Economical Dependency Ratios: the estimated by Bravo (2012).

5.1.1.2. Actuarial

Decrements associated to present contingencies: birth, death, disability, old age retirement and abandonment from the system for other reasons.

Prospective Mortality Tables: those calculated for the Portuguese population under the terms referred in 5.1.1.1.1.

5.1.1.3. Macroeconomic

5.1.1.3.1. Labor Market


Long Term Unemployment Rate: Natural Unemployment Rate (NAWRU-Non-accelerating wage rate or unemployment) carried out by the European Commission in the Ageing Report.

Short Term Unemployment Rate:
- Census on Employment by the Instituto Nacional de Estatística (INE).

5.1.1.4. Economic


5.1.1.5. Financial

Rate of Return on Financial Assets: 4%

5.2. Immediate Transition

For this form of conversion it was admitted that the existing defined benefit system is abandoned on December 31, 2013 with the transfer, as of January 1, 2014, of the entire Portuguese population to the new model based on notional accounts in accordance, with the technical principles defined in the Swedish model and solely specific to the financing of old age pensions.

In the definition of the new architecture and similarly to the Swedish system, liabilities consisting of the notional accounts and pensions in payment, are indexed to the growth of the average salary. In the particular case of pensions in payment, the deduction of the rate of 1,6% incorporated in the calculation of the annuity was considered as referred in 4.1..

The amount of the notional accounts resulted from the incidence of the contribution rate of 20,21% on the average salary mass multiplied by the average number of years of discounts to the social security system on the transition date. To this component of the balance sheet the present value of pensions of existing pensioners was also added.

On the asset side, the amount estimated under the new system resulted from the calculation of the present value of contributions using turnover duration, accrued of the forecast, on the startup date, for the Social Security Financial Stabilization Fund (FEFSS), indexed at a rate of 4%, excluding any revenue or expenses occurred during 2013.

Contributions, another asset component, grow in line with the evolution of the employed population, which is a function of the active population, which in turn, is also a function of the total population and increase in the average wage. Retirement is only allowed at the age of 65.
Based on the above items, the automatic balancing mechanism defined in the terms referred in point 4.3. is set up.

The implicit debt of the social security contribution system underlying this architecture, i.e., the difference between the present values of revenues and pension related costs according to the defined economic and demographic assumptions, is estimated at EUR 39.300 million. Deducting the 11,7 billion planned for FEFSS usable to bridge the negative balances the initial deficit in 2014, would be around EUR 27,6 billion.

Given that at the end of that year, the Balance Ratio of 0,9306 is less than 1, the Balance Index would be activated in 2015, reducing notional accounts and pensions in 5,7%. As such and given that at the end of 2015 that ratio is 1,0374 and therefore higher than 1, pensions would increase by 5,52% in 2016, an increase higher than that determined by the application of the Income Index of 1,72%, the mechanism being at this stage in a so called accelerating phase, with the repositioning of the notional account and pension amounts to levels prior to the activation of the mechanism.

At the end of 2016, on registering once again a Balance Ratio of 1,0364, also greater than 1, pensions would benefit from an increase of 5,45% determined by the Balance Index. It should be reiterated, that this increase is significantly higher than what would have been obtained if the Income Index of 1,80% was used, clearly demonstrating the accelerated repositioning path to levels prior to the activation of the mechanism. Even so, at the end of that year, accrued returns obtained through the application of the Balance Index and by the Income Index will become equal at 4,93%, therefore the automatic balancing mechanism will be disabled at the beginning of 2017 and the system will evolve according to the projections presented in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess</td>
<td>277.701</td>
<td>283.583</td>
<td>296.500</td>
<td>311.390</td>
<td>329.622</td>
<td>390.222</td>
<td>626.491</td>
<td>904.254</td>
<td>1.270.789</td>
<td>1.758.364</td>
</tr>
<tr>
<td>Present Value of Contributions</td>
<td>266.001</td>
<td>274.937</td>
<td>290.270</td>
<td>306.143</td>
<td>325.065</td>
<td>385.102</td>
<td>585.641</td>
<td>791.570</td>
<td>1.096.310</td>
<td>1.559.218</td>
</tr>
<tr>
<td>FEFSS</td>
<td>11.700</td>
<td>8.645</td>
<td>6.230</td>
<td>5.246</td>
<td>4.556</td>
<td>5.121</td>
<td>40.850</td>
<td>112.685</td>
<td>305.288</td>
<td>415.19%</td>
</tr>
<tr>
<td>Liabilities + Results</td>
<td>305.288</td>
<td>304.733</td>
<td>285.810</td>
<td>300.460</td>
<td>311.390</td>
<td>343.467</td>
<td>513.558</td>
<td>823.140</td>
<td>1.233.316</td>
<td>1.733.998</td>
</tr>
<tr>
<td>Notional Accounts</td>
<td>164.896</td>
<td>172.374</td>
<td>169.196</td>
<td>185.086</td>
<td>201.864</td>
<td>238.775</td>
<td>387.825</td>
<td>593.073</td>
<td>809.393</td>
<td>1.156.058</td>
</tr>
<tr>
<td>Income Index</td>
<td>100%</td>
<td>101.34%</td>
<td>103.08%</td>
<td>104.93%</td>
<td>107.74%</td>
<td>117.17%</td>
<td>165.38%</td>
<td>244.99%</td>
<td>359.03%</td>
<td>515.19%</td>
</tr>
<tr>
<td>Balance Ratio</td>
<td>100%</td>
<td>93.06%</td>
<td>103.74%</td>
<td>103.64%</td>
<td>104.32%</td>
<td>113.61%</td>
<td>121.99%</td>
<td>129.85%</td>
<td>103.04%</td>
<td>101.41%</td>
</tr>
<tr>
<td>Balance Index</td>
<td>100%</td>
<td>94.30%</td>
<td>99.51%</td>
<td>104.93%</td>
<td>107.74%</td>
<td>117.17%</td>
<td>165.38%</td>
<td>244.99%</td>
<td>359.03%</td>
<td>515.19%</td>
</tr>
<tr>
<td>Turnover Duration</td>
<td>32.29</td>
<td>32.29</td>
<td>32.76</td>
<td>33.21</td>
<td>33.64</td>
<td>34.64</td>
<td>34.75</td>
<td>32.85</td>
<td>32.94</td>
<td>34.44</td>
</tr>
<tr>
<td>Growth without Activating Mechanism</td>
<td>1.34%</td>
<td>1.72%</td>
<td>1.80%</td>
<td>2.68%</td>
<td>2.01%</td>
<td>4.00%</td>
<td>4.01%</td>
<td>3.80%</td>
<td>3.58%</td>
<td></td>
</tr>
<tr>
<td>Growth with Activating Mechanism</td>
<td>-5.70%</td>
<td>5.52%</td>
<td>5.45%</td>
<td>2.68%</td>
<td>2.01%</td>
<td>4.00%</td>
<td>4.01%</td>
<td>3.80%</td>
<td>3.58%</td>
<td></td>
</tr>
<tr>
<td>Accumulated Growth without Activating Mechanism</td>
<td>1.34%</td>
<td>3.08%</td>
<td>4.93%</td>
<td>7.74%</td>
<td>17.17%</td>
<td>65.38%</td>
<td>144.99%</td>
<td>259.03%</td>
<td>415.19%</td>
<td></td>
</tr>
<tr>
<td>Accumulated Growth with Activating Mechanism</td>
<td>-5.70%</td>
<td>-0.49%</td>
<td>4.93%</td>
<td>7.74%</td>
<td>17.17%</td>
<td>65.38%</td>
<td>144.99%</td>
<td>259.03%</td>
<td>415.19%</td>
<td></td>
</tr>
</tbody>
</table>

U: thousands of euros

In the event of wanting to obtain a yearly projection it is suggested to contact the author (1).

The items presented in the above table are based on the following concepts:
Present Value of Contributions - Corresponds to estimated present value of future contribution inflow given by the product of the yearly contribution inflow and turnover duration.

FEFSS – Social Security Stabilizing Financial Fund (Fundo de Estabilização Financeira da Segurança Social) – is a fund with the objective of capturing the surpluses of the social welfare system and bearing the negative differences between revenue and expenditure if applicable.

Notional Accounts – Corresponde to the capitalized values of contribution inflow at the growth rate of the average salary.

Present Value of Pensions – Discounted value of future expected pensions at a rate of 1,6%.

Result of year n – Given by the difference in the variation of assets and liabilities in consecutive years, that is:

\[
(Asset_n - Asset_{n-1}) - (Liabilities_n - Liabilities_{n-1})
\]

Profit or Loss Brought Forward n-1 - is given by the sum retained earnings in year n-1 with the Result of year n-1.

Turnover Duration - Obtained by the application of the expression (4.8).

Income Index – Natural index of the system given by the evolution of the average annual salary.

Balance Ratio – Is the result of the quotient between the assets and liabilities of the system.

Index Balance - With a temporary duration is enabled under the circumstances set out in 4.3..

At the startup of the system there is a very high deficit which can be explained by two factors:

- By the fact that present value of pensions is essentially made up of retirements under the old scheme, which provides much higher replacement rates than those of the new proposal;

- By the fact that the amount of contribution inflow used in the calculation of the asset is very low, due to the relatively small size of the employed population.

This insufficiency leads to the activation of the automatic balancing mechanism until early 2017, reducing in this way the value of liabilities in previous years.

Over the years due to the assumptions used in the projection in particular, the activity and unemployment rate, employed population increases resulting in an increase of contribution inflow that exceeds increases in average salary. Whilst on the liability side, the increase is nonetheless caused by the inclusion of the new contributions in the notional accounts, on the asset side that increase is multiplied by the duration turnover, which in turn also increases given the increase in life expectancy and in so being contributes decisively to the solvency of the system.
Another factor that greatly contributes to the solvency of the system during the early years is the replacement of the pensioner population done by the fallout of retirees from the former system by the entry of new, according to the rules of the new architecture. Since the latter are holders of lower replacement rates this phenomenon loses importance over time, as the existence of the pensioner population under the old system becomes residual.

From 2030 onwards the situation is reversed due to low fertility rates and a consequent reduction of the workforce, causing increases in the contribution inflow that are lower than the growth rate of the average salary, therefore leading to convergence between liabilities and assets since the first is indexed to the growth of the average salary. The following graph presents the replacement rates obtained within the context of this transition, that is, the ratio between the first pension and last salary, as well as the effect observed by the activation of the automatic balancing mechanism.

**Replacement Rate – Relationship between the First Pension and Last Salary**

The replacement rates presented will be as high as the number of contributing years and may be complemented with other retirement funding sources, such as a component of materialized financial accounts that the system may incorporate, either by personal savings or occupational pension funds.

It should be noted that this form of conversion fully ensures the acquired rights under the previous scheme, which amount to around EUR 164.9 billion.
No capping was introduced on contributions, as in this case and given the values of the contribution rate, the impact measured in global terms is marginal.

5.3. Gradual Transition

An alternative to the previous solution is to proceed to a gradual transition whereby a portion of the population would enjoy a pension determined under the rules of the defined benefit scheme, whilst another would receive a pension resulting from a weighted proportion of the pension that would be obtained under the old system and notional accounts and a third group would receive a pension determined only under the notional account system.

For the individuals benefitting from a weighted pension or sole beneficiaries of the notional accounts, two hypothesis’ will be analyzed: the first being that pensioners will retire under the same conditions as in the past, in relation to the existing labor force, that is, from the age of 60 to 63 inclusively. It was assumed that the rate of retirement in the subsequent year would be 10%, at 64 it would be 96%. From the age of 65 onwards up to 68 inclusively it would be 99% and in the transition from 69 to 70 years of age everyone would retire. The second hypothesis only takes into account retirement at the age of 65, irrespective of the system.

Applying to the first hypothesis the transition speed of the Swedish model initiated in 1995 and characterized by using the following weighting and pioneer ages:

- those born before 1938 remained in the old system;
- those born between 1938 and 1953 are subject to the transition scheme and will receive a pension resulting from the application of a weighting between new and old rules. Each generation will see their participation in the new system increased by 0,05% (1/20). The younger the person is, the lower the proportion of the pension under the defined benefit system. Those born in 1938 are the first to be covered and will receive from the old system 80% and 20 from the new scheme. Those born in 1939 would receive 75% of the defined benefit and so forth;
- those born in 1954 and later on completely within the notional defined contribution system.

Thus, by making a parallel to January 1, 2014, the following age ranges would be obtained:

- People aged 61 and over remain in the defined benefit regime;
- People in the age range between 45 and 60 would receive a pension resulting from the application of a weighting to the old and new system;
- People aged 44 or less are covered solely by the notional accounts scheme.

The calculations performed indexed notional accounts and pensions to the growth rate of the contribution inflow, assuming that salaries increase at a nominal rate, as a function of the CPI
and real growth of salaries. This last factor is a function of GDP increases and effective working hours. Consistent with the theoretical explanation, this form of indexation positions the architecture being studied on the path towards sustainability in the long run. This is the reason why an automatic balancing system identical to that of the Swedish model was not taken into account.

**SWEDISH MODEL**

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>CONT. RATE</th>
<th>INTEREST RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>i.</td>
<td>20,21%</td>
<td>Implicit Debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx. Cont. Extra.</td>
</tr>
<tr>
<td>ii.</td>
<td>14,88%</td>
<td>Implicit Debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx. Cont. Extra.</td>
</tr>
<tr>
<td>iii.</td>
<td>22,71%</td>
<td>Implicit Debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx. Cont. Extra.</td>
</tr>
<tr>
<td>iv.</td>
<td>24,71%</td>
<td>Implicit Debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx. Cont. Extra.</td>
</tr>
</tbody>
</table>

*U: values in million euros*

The choice of these contribution rates is justified as follows:

- the rate of 20,21% corresponds to the set out in the Contributive Regimes to the Social Security Welfare System Code;
- the rate of 14,88% corresponds to 93% of the contribution of 16% to the notional account used in the Swedish model;
- the rates of 22,71% and 24,71% result in the first case of the reallocation to the old age contingency of the released surplus, approximately 2,5%, in comparison to the required for abandoning the disability and survivor covers of the old system as referred in point 5.6 and in the second hypothetical scenario if the intention is to accrue 4,5%.

The rates Tx. Cont. Extra. represents an extraordinary contribution to be added to the notional rate used in the respective scenario and necessary for the pay-off of the implicit debt in each scenario, to be borne by the active population until the end of the projection horizon - 2060.

In both of the options for gradual transition, an alternative to the latter, choosing a distinct weighting different from the Swedish model based on the proportionality between permanence in the old system and the new one leads to the results of the following table.
In both of the previous options the proportion between the two systems that of defined benefit and defined contribution, initial notional capital existing on the date of transition is incorporated into the defined contribution model and results from the product of the salary on that date and service years, on average.

In the second approach, which follows, and where the only difference is the assumption that everyone retires at the age of 65, two sets of results were obtained. Under the option where weighting, according to the criteria of the Swedish model was used the results obtained are presented in the following table:

**SWEDISH MODEL – 65 years**

When surpluses occur, the maximum contribution rates that equal them to zero are the same in all scenarios, being 15,723% for a discount rate of 1%, 16,065% for a discount rate of 2%, 16,398% for a discount rate of 3% and 16,716% for a discount rate of de 4%.
Assuming as an alternative, a proportional weighting to the time spent in each of the systems, the results obtained are those shown in the table below:

**PROPORTIONAL MODEL – 65 years**

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>CONT. RATE</th>
<th>DISCOUNT RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td>i.</td>
<td>20,21%</td>
<td>Surplus</td>
</tr>
<tr>
<td>ii.</td>
<td>14,88%</td>
<td>Implicit Debt / Surplus</td>
</tr>
<tr>
<td>iii.</td>
<td>22,71%</td>
<td>Surplus</td>
</tr>
<tr>
<td>iv.</td>
<td>24,71%</td>
<td>Surplus</td>
</tr>
</tbody>
</table>

*U: Values in million euros*

When surpluses occur, the maximum contribution rates that equal them to zero are the same in all scenarios, with 15,695% for a discount rate of 1%, 16,025% for a discount rate of 2%, 16,35% % for a discount rate of 3% and 16,665% for a discount rate of 4%.

Comparatively, by analyzing this table it can be seen that if the transition pace used in the Swedish case was to apply, that is, same age repartition in the universe of the population encompassed by the three forms of pension calculation, but assuming a different weighting than that used in Sweden, the adoption of the proportionality to the time of discounts in each one of the systems would lead to amounts lower than that of the implicit debt, using the same assumptions. It is referred that a contribution capping of eight Social Aid Indexes were used.

To facilitate reference, the graphs and respective replacement rates are in the annex to this working paper.

**5.4. Initial Notional Capital**

In this exercise the treatment of initial notional capital on the date of transition, resulted from the product of the salary on that date by the respective service years. Alternatively, one could adopt the initial notional capital set out in article 27 of Decree Law 187/2007, which corresponds to the product of the revaluated salaries on the date of transition by respective service years. The salary revaluation results from the application of a weighting factor of 75% of the CPI, excluding housing, and 25% of the average evolution of the gains subjacent to social security contribution whenever this evolution is higher than that of the CPI excluding housing accrued of 0,5 percentage points. The resulting indexation can’t exceed CPI, excluding housing, accrued of 0,5 percentage points. This option would lead to initial notional capital, replacement rates and implicit debt levels different to those presented in this paper. Information on its application can be obtained directly from the author (1).
5.5. Analysis of the Results

5.5.1. Immediate Transition

From a perspective of fairness, immediate transition has the big advantage of providing smooth replacement rates over time for different ages without causing injustices. The replacement rates are a little over 50% for longer contribution periods, that is, longer than 45 years, obtaining reasonable values that complement instruments of individual or group adhesion focused on retirement.

It has the additional advantage of eliminating the guarantees conferred under the defined benefit plan all at once and moving on to a new structural solution respecting the acquired rights on the startup date.

After the cut down on accounts and pensions, the long term projections demonstrate the sustainability of this solution given that assets always exceed liabilities, in other words, the contribution rate remains unaltered over time.

5.5.2. Gradual Transition

5.5.2.1. Application of the Swedish Criteria

The application of the principles underlying the Swedish model, assuming that for those covered by the weighted system and those covered exclusively by the notional accounts regime, that retirement takes place according to past age pattern and in the presence of the different contribution rates considered, lead to unsupportable levels of implicit debt given the Portuguese GDP.

It is noteworthy that in the two scenarios closer to the contribution rates in force, scenarios i) and iii), the replacement rates fall within the following intervals respectively \([40\%, 55\%]\) and \([50\%, 60\%]\), as presented in the Annex.

In the alternative hypothesis of setting the retirement age at 65 in any of the scenarios we can observe that the system has a positive present value of the future results, being this concept defined as the difference between the present values of revenue and contribution inflow.

The difference between the negative and positive nature of the systems’ present value of the futures results of these two approaches is originated from the fact that at setting a retirement age at 65 revenue will be higher given that the workforce responsible for financing the system is active and on the other hand by a decrease in pension disbursement. Both of these factors together favor the creation of surpluses and thus reinforce the sustainability of the model.
5.5.2.2. Application of the Proportionality Criteria in Relation to the Time Spent in Each of the Regimes

Comparably to the two previous homologous options that take into account the Swedish proportionality, in the two that follow, where a proportionality to the time spent in each of the regimes and respective discounts is considered, one can observe a reduction in the amount of implicit debt, because of the lesser weight of the pension component of defined benefit in what concerns the allocation to each of the regimes.

From a general standpoint, in the majority of the scenarios analyzed, compulsory retirement set at the age of 65 leads to surpluses in the system, as opposed to the possibility of retiring before the age of 65 considering past behavioral pattern (for those in the weighted regime or notional accounts). In this last case where retirement age is flexible, the amounts of implicit debt are apparently unsupportable given national GDP.

The use of the time proportionality with the abandonment of the weighted pensions period and beginning of the new system retirements under notional accounts, present some undesirable jumps, given that initial capital of the latter is high at the beginning. Therefore during this period and in particular for those aged 70, significantly higher pensions are obtained than in the old regime. By reducing the influence of initial capital over time the replacement rates also show a tendency to decrease.

The criteria used in Sweden, by having a constant increase in each year in the change from the defined benefit scheme to the notional accounts allows that the pension component under the new system reaches a proportion of 100% at the end of the transition period, thus leading to much smoother replacement rate curves in comparison to those obtained using time proportionality, see attachment.

Considering the levels of implicit debt related to the gradual transition, it was chosen not to analyze the slow transition, in which the new system would only be applicable to those entering the workforce on January 1, 2014. The costs associated to the slow transition would be extremely high and therefore unsupportable.

5.5.2.3. Immediate versus Gradual Transition

Moreover and considering that equity should prevail in the change from one system to another because it leads to smoother replacement rates over time, an immediate transition of the system provides more equitable pension levels among persons of different ages, which does not happen under a gradual transition scenario where neighboring age limits, those that correspond to the intervals’ extreme limits lead to unlevelled pensions which is unfair, Palmer (2006)(2).
The immediate transition process safeguards the rights acquired under the old regime, which configures to be a relevant and desirable social measure when considering a change of this nature.

Considering the levels of implicit debt involved, the minimum retirement age should be set at 65, just like in other countries that have been adopting later retirement as one of the first measures to solve the problem of sustainability.

5.6. Disability and Survivor Pensions

According to the Code of the Contributive Regimes to the Social Security Welfare System (Código dos Regimes Contributivos do Sistema Previdencial da Segurança Social), the contribution rates in the case of disability and survivor (widowhood and orphans) are 4,29% and 2,44% respectively. Projections show that in proceeding to the transition to a new system abandoning the current one, the rates of 1,16% and 0,96% would suffice to guarantee old age pension disbursement to the beneficiaries in those two situations, based on the total payroll if retirement age was set at 70, according to the referred in 5.3. Under the assumption that individuals work up to the age of 65 and not discarding that the value in absolute terms is the same, when expressed as a function of this other total payroll the previously referred rates would be 1,18% and 0,976%, respective.

In a scenario, where new disability and survivor conditions are included in light of past experience, the disability rates would be 1,343% in the event of some individuals retiring at the age of 70 and 1,37% if retiring at the age of 65. For the case of survivor pensions the rate would be 2,624% over a payroll of the contributors up to the age of 70 and 2,667% in the event of retirement at 65, the rates are practically unaltered in this situation. Worth pointing out is the fact of a slight contribution insufficiency to support survivor pensions, in comparison to the legal requirements. The following chart summarizes this information and the differentials between the necessary rates and the legally defined ones.

<table>
<thead>
<tr>
<th>Pensions</th>
<th>Closed Gr.</th>
<th>Closed Gr. 65</th>
<th>Open Gr.</th>
<th>Open Gr. 65</th>
<th>Legal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survivor</td>
<td>0,9602</td>
<td>0,9755</td>
<td>2,624</td>
<td>2,666</td>
<td>2,44</td>
</tr>
<tr>
<td>Disability</td>
<td>1,16</td>
<td>1,18</td>
<td>1,343</td>
<td>1,37</td>
<td>4,29</td>
</tr>
<tr>
<td>Total</td>
<td>2,1202</td>
<td>2,1555</td>
<td>3,967</td>
<td>4,036</td>
<td>6,73</td>
</tr>
<tr>
<td>Differential</td>
<td>4,6098</td>
<td>4,5745</td>
<td>2,763</td>
<td>2,694</td>
<td>0</td>
</tr>
</tbody>
</table>

Closed Gr. – admitting retirement at 70, the required rates for old age pensions of the currently disabled or survivor.
Closed Gr. 65 – admitting retirement at 65 the required rates for old age pensions of the currently disabled or survivor.
Open Gr. – admitting retirement at 70 and new future circumstances, the required rates for old age pensions of the currently disabled or survivor.
Open Gr. 65 - admitting retirement at 70 and new future circumstances, the required rates for old age pensions of the currently disabled or survivor.
Legal – legal rate required

Notwithstanding the slight readjustments necessary to offset the contribution insufficiency for survivor pensions, the aggregate excesses of the above mentioned constraints between the legally required and the necessary rate, could be accrued to the existing rate of 20,21% to finance old age pensions of the active workforce and amortize implicit debt or alternatively channeling part of it or totally to the constitution of a financial materialized account.

6. CONCLUSIONS

The contribution rate for the financing of old age pensions of 20,21% has been used historically, though the actuarial reason that led to this is unknown.

The projections carried out allow us to conclude that the abandonment of the current contributive system requires rates of 1,16% and 0,96 of the total salaries to support the existing disability and survivor pensions, values significantly lower than the 4,29% and 2,44% set out in the Code of the Contributive Regimes for the Social Security Welfare System for each of the contingencies.

Furthermore, considering that new disability and survivor situations generate surpluses, as referred in 5.6 these could be totally or partially reallocated to the financing of implicit debt subjacent to the old age retirement contingency or, reallocated to the constitution of financial account.

With the advance in medicine and in the presence new clinical criteria to be set legally, it is only natural that through time the rate necessary to support the occurrence of future disabilities decrease and even though its effect may be marginal it would increase the differential in favor of the systems' sustainability.

In either of the approaches carried out, it is desirable that minimum retirement age be set legally at 65, directing the system on the path of sustainability. The effect of such a measure is evident in the present value of the futures results obtained.

As evidenced in the graphics herein, a gradual transition has the inconvenience of leading to high contribution rates for the amortization of the existing implicit debt, which results from the coexistence of the defined benefit scheme. On the other hand, the ages at the extremity of the intervals where the conditions for the attribution of a pension change, causes inequities on the resulting replacement rates for neighboring ages, in some cases, with significant amplitudes.
The immediate transition drawn up according to the principles underlying the Swedish public pension model surpasses this inequity problem of the replacement rates by obtaining smooth curves, inclusively for very close age ranges and therefore resulting in an equitable treatment of the population involved. Simultaneously, and despite a temporary reduction in pensions and notional accounts for two years 2015 and 2016, it provides as an ultimate solution to the problem of Social Security financing by maintaining the contribution rates relatively close to the existing ones and preserving the rights previously acquired.

The results obtained with the adoption of the immediate transition and its advantages clearly demonstrate that this is the solution to the problem of the sustainability of the Portuguese Contributive Regime of the Social Security System if upon setting the parameters they are duly safeguarded as laid out in this working paper.
7. **BIBLIOGRAPHY**


Orange Report (2009), Annual Report Of The Swedish Pension System


SWEDISH MODEL

Scenario i – Contribution Rate: 20.21%

Scenario ii – Contribution Rate: 14.88%

Scenario iii – Contribution Rate: 22.71%
Scenario iv – Contribution Rate: 24,71%

PROPORTIONAL MODEL

Scenario i – Contribution Rate: 20,21%

Scenario ii – Contribution Rate: 14,88%
Scenario iii – Contribution Rate: 22.71%

Scenario iv – Contribution Rate: 24.71%

SWEDISH MODEL – 65 years

Scenario i – Contribution Rate: 20.21%
Scenario ii – Contribution Rate: 14.88%

Scenario iii – Contribution Rate: 22.71%

Scenario iv – Contribution Rate: 24.71%
PROPORTIONAL MODEL – 65 years

Scenario i – Contribution Rate: 20.21%

Scenario ii – Contribution Rate: 14.88%

Scenario iii – Contribution Rate: 22.71%
Scenario iv – Contribution Rate: 24.71%

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