THE MAXIMUM PENSION IN THE PORTUGUESE PENSION SYSTEM

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Abstract

Most industrialized countries adopted public pension systems based on Pay-As-You-Go mechanism. Changes in the structure of the population have a direct impact on the financial sustainability of these systems.

To analyze the equity and the financial solvency of the Portuguese pension system, we used the replacement rates and the internal rates of return, considering different wage scenarios and alternative contributory periods. Preliminary results show that Portuguese pension system is insolvent, in the financial sense adopted by Samuelson (1958). We also intend to evaluate the effect of the imposition of a maximum value for old-age pension on the financial sustainability of the Portuguese pension system.

Keywords: pension system, old-age dependency rate, internal rate of return, ageing population, retirement, old-age pension, replacement rate.

JEL: H55, J11, J26.

1. INTRODUCTION

Over the past century, most industrialized countries, including Portugal, have adopted public pension systems based on Pay-As-You-Go (PAYG) mechanism, according to which the actual contributors pay the pensions of the actual pensioners, with the expectation that future taxpayers pay their pensions when they retire. Changes in the structure of the population, especially in terms of the increase in the life expectancy and the decline in the birth rates, have a direct impact on the proportion of pensioners in the total population (increase) as well as in the proportion of workers (reduction). In this sense, the Portuguese pension system is submitted to two risks: the demographic risk and the financial insolvency risk. Demographic risk is associated with the reduction in the fertility rates, the augmentation in the life expectancy and the increase in the dependency rate. The financial insolvency risk, which is motivated by the

lack of equatorial correspondence between expenditures and revenues, is one of the problems that Portuguese pension system has to face. In this context, the study of the current and future financial situation of the Portuguese pension system, as well as the presentation of solutions for solving its financial problems are subjects with particular relevance.

One of the priorities of the European Union is to ensure an adequate income at retirement for European citizens. To achieve this objective in an aging Europe is considerable challenge. The recent financial and economic crisis has deepened and amplified the impact of demographic trends in the sustainability of social security systems. The slowdown in the economic growth, the public budgets, the financial stability and the employment become the need to adjust the Governments practices in relation to retirement and the way that people form about their pension rights more urgent. Most European countries have introduced reforms in their pension systems in order to improve the efficiency and security in pensions.

The World Bank (1994 and 2005) recommends the adoption of social security multi-pillar models, based on the perspective that a diversified system can provide incomes at old age, in a more effective and efficient way, providing greater security against economic, demographic and political risk.

Murteira (2007) argues that the discussion of the financing of social security systems is attached to economic problems like the output slow growth, the unemployment and a very poor distribution of income to work. The author considers that the current crisis has a transformative potential, proposing a reflection on the organizing principles of solidarity and a real commitment to an ideal of social justice and its institutionalization.

Duval (2003) studies the tax rates defined by the OECD countries and conclude that there is a wide dispersion in terms implicit tax rates between countries. He finds also that the implicit tax rates on continued work embedded in old-age pension systems and other social transfer programmes are higher in most Continental European Countries than in Japan, Korea, English-speaking and Nordic countries. High tax rates induce older male workers to anticipate their retirement decision. Situations of unemployment are also found to have a significant influence on retirement behavior, suggesting that policies to reduce structural unemployment may also contribute to raise the labor market attachment of older workers.

Gern (2002) gives us an idea of how OECD countries have done in terms of public pension systems, and in particular the reforms adopted to face the progressive aging of the population and the consequent unsustainability of the pension plans under the prevailing rules. The author concludes that the Governments tend to adopt measures that increase the degree of prefunding of pension obligations, through stronger funding of the public pension schemes

(Canada, Finland, Sweden, the United States) or through strengthening the role of private occupational pensions (Australia, Denmark, the Netherlands, Switzerland, the United Kingdom). Most part of the countries (Austria, Belgium, France, Germany, Italy, Japan, New Zealand, Portugal and Spain) have adopted reforms that maintain the predominant PAYGO systems (such as, to raise the retirement age, to eliminate rewards for early retirement and to downsize benefits), without increasing their funded elements. Gen (2002) considers that these parametric reforms can be seen as the first step toward developing a system with a major funded pillar.

James (1998) suggest a model based on three systems or pillars to provide income maintenance support to the aging that affects strongly the traditional social security systems. The model proposed is built around three systems - a public pillar, a mandatory savings plan and a voluntary savings system. Some countries of the world are implementing this model, by different ways: employees choose individually an investment manager for the funds to be received at retirement (the American model); another model consists in employers and/or union trustees choose an investment manager for an entire company or profession (the OECD model); the notional account model that is based in a pay-as-you-go first pillar supplemented by a second funded pillar (Sweden). The results show improvements in national savings and financial market development, promoting therefore the economic growth. Nevertheless, the author has no solution yet for the high administrative cost associated to this model.

The paper is organized as follows. Section 2 analyses the evolution of the main parameters relative to Social Security. Section 2 also presents the principal reforms adopted in Portugal. Section 3 briefly introduces the Portuguese pension system, in terms of its function form, contribution rates, statutory retirement age, minimum contributory period required to access to an old-age pension and conditions to access to early and deferred retirement. Section 4 analyzes the financial solvency of the Portuguese pension system. Section 5 intends to evaluate the influence of a parametric reform – to establish a maximum old-age pension – in the solvency of the Portuguese pension system. Our main conclusions are presented in section 6.

2. EVOLUTION AND PROJECTIONS OF THE MAIN PARAMETERS OF THE SOCIAL SECURITY

The increase in the life expectancy, associated with low birth rates, has a direct impact in the Social Security pension systems, since the aging population is favorable to increase the proportion of pensioners and at the same time to reduce the weight of workers on the total population.

In this section, we intend to describe briefly the recent evolution of the main demographic and economic variables that influence the financial position of the pension systems and the projections related to its future evolution. Since the aim of this study is the Portuguese pension system, we will essentially analyze the evolution of these variables in Portugal, comparing when possible with the trends observed in other European economies.

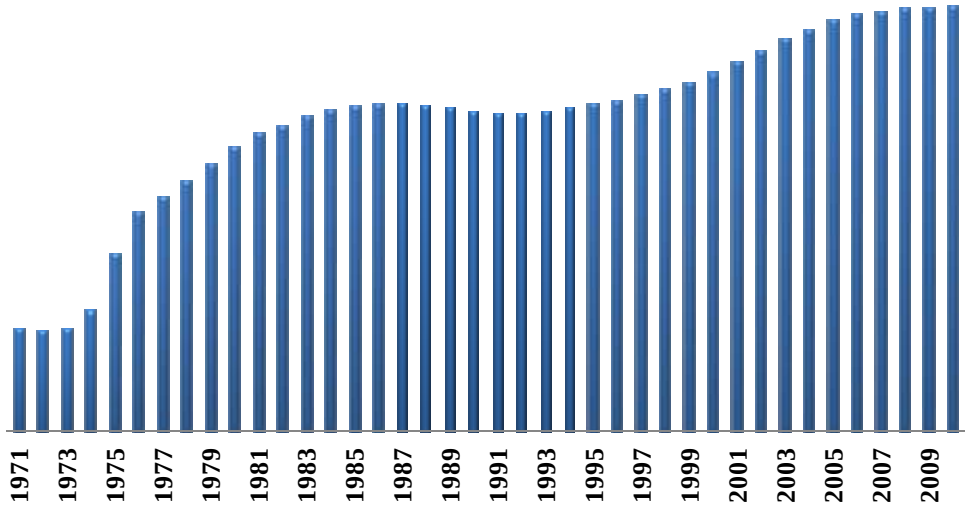
1.1. DEMOGRAPHIC VARIABLES

- **Population decline**

The variation of the population, defined as the difference between the population size at the beginning and at the end of the period, occurs due to two distinct aspects: the variation in the natural population and the variation in the net migration.

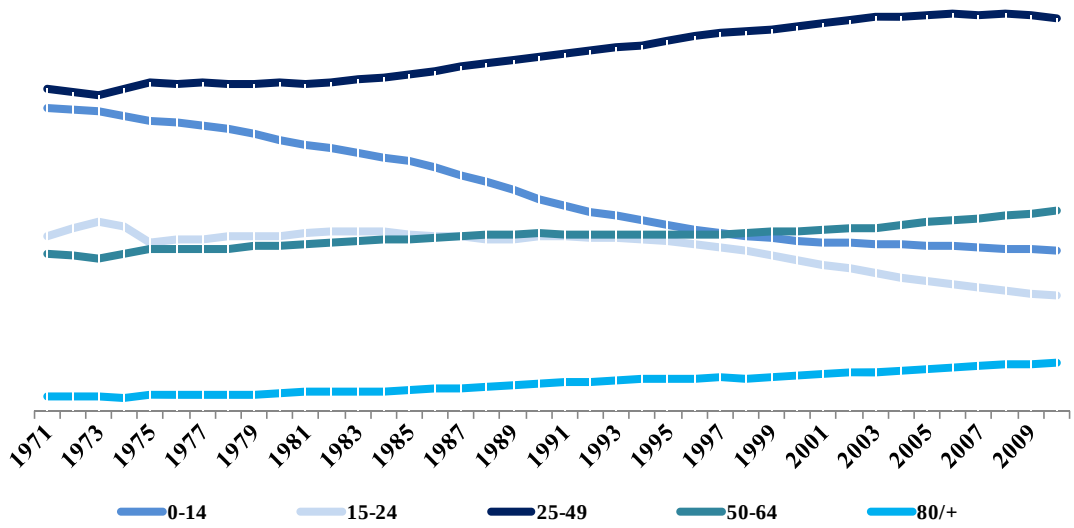
The evolution of the resident population in Portugal during the period 1971-2010 is presented in Figure 2.1.. As shown in the Figure, the Portuguese resident population has been growing, although slowly. Nevertheless there was a slight decrease in the number of residents in the late of 1980´s. We also present in Figure 2.2. the evolution of the resident population by age group. We verify a strong decrease of the younger age group (age below 24) in the total population. The increase of the total population has been supported by the increase in the working age population as well by the increase in the old-age population. These trends show realities widely recognized in the last century, such as the decrease in the birth rates and the increase in the life expectancy.

Figure 2. 1. Annual Resident Population, Portugal, 1971-2010.



Source: National Institute of Statistics – Portugal - Estimativas Anuais da População Residente (2011).

Figure 2. 2. Distribution of the Resident Population by Age Group, Portugal, 1971-2010.

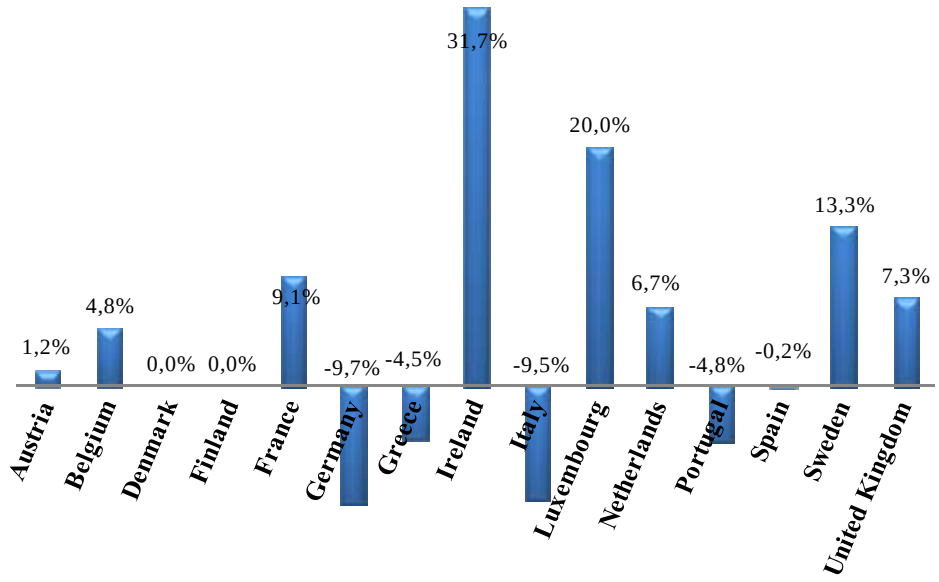


Source: National Institute of Statistics (2011).

The Eurostat (2008) projections relative to the total population for the period 2005-2050 are shown in Figure 2.3.. Eurostat project that the population resident in EU-15 will increase to almost 399 million by 2030, and thereafter should have decrease by about 14.8 million by 2050. The evolution of the population between 2005 and 2050 varies between Member States: the population of Ireland and Luxembourg will rise significantly (32% and 20%, respectively). On

the contrary, the number of inhabitants in Greece, Spain and Portugal should decrease more than 10%. The largest population decline will occur in Germany (-8.0 million) and Italy (-5.5 million). We should note that these projections are influenced by some variable factors, such as the net migration.

Figure 2. 3. Total Population Growth Rate, EU-15, 2005-2050.



Source: Eurostat (2008).

With regard to the net migration, this variable is influenced by the combination of social, economic and political factors. These factors may operate in the origin country (push factors) or in the destination country (pull factors). The relative economic prosperity and the political stability of the receptor country have a considerable pull effect in immigrants.

Net migration for the EU-15 reached a peak of almost 2 million people in 2003 (Eurostat, 2008).

Portugal has had a positive net migration balance. Nevertheless, since 2002 the growth trend of migration has reversed. This situation may be related to the weak economic growth rate, so that the country is less attractive to immigrants and residents to the emigrate abroad.

- **Fertility Rates**

The slowdown in the population growth can be partly attributed to the fact that women have few children. A fertility rate of about 2.1 children per woman is a reference situation that ensures the generational replacement. According to information available in Eurostat (2008), all

European countries show fertility levels above 2.1 children. In 2005, each European (EU-15) had an average of 1.55 children. At present, in Portugal, each woman has 1.32 children on average (World Bank, 2011).

- **Life Expectancy at Birth**

An important factor that explains the phenomenon of the aging population is the increase in the life expectancy, which may result from better living conditions, as well as health care development. The first part of the 20th century is characterized by the increase in the life expectancy as a result of the decline in the mortality rates. The second part of the 20th century is associated with better living conditions and by the development of the medicine in the area of old-age populations.

Table 2. 1. Life Expectancy at Birth, by Sex, EU-15, 1995-2005 (years).

	Male						Female					
	1995	**1997**	**1999**	**2001**	**2003**	**2005**	**1995**	**1997**	**1999**	**2001**	**2003**	**2005**
Austria	73,4	74,1	74,9	75,7	75,9	76,7	80,1	80,7	81,0	81,7	81,5	82,3
Belgium	73,5	74,2	74,4	75,0	75,3	76,2	80,4	80,7	81,0	81,2	81,1	81,9
Denmark	72,7	73,6	74,2	74,7	75,0	76,0	77,9	78,6	79,0	79,3	79,8	80,5
Finland	72,9	73,5	73,8	74,6	75,2	75,6	80,4	80,7	81,2	81,7	81,9	82,5
France	n/d/	n/d/	75,0	75,5	75,8	n/d/	n/d/	n/d/	82,7	83,0	82,7	n/d/
Germany	73,3	74,1	74,8	75,6	75,8	76,7	79,9	80,5	81,0	81,5	81,3	82,0
Greece	75,0	75,4	75,5	76,0	76,5	76,8	80,1	80,4	80,5	81,0	8,2	81,6
Ireland	72,8	73,4	73,4	74,5	75,9	77,3	78,3	78,7	78,9	79,9	80,8	81,7
Italy	75,1	75,9	76,6	77,2	77,1	n/d/	81,6	82,1	82,7	83,2	82,8	n/d/
Luxembourg	73,0	74,0	74,4	75,1	74,8	76,6	80,6	80,0	81,4	80,7	80,8	82,2
Netherlands	74,6	75,2	75,4	75,8	76,3	77,3	80,5	80,7	80,5	80,8	81,0	81,7
Portugal	71,7	72,2	72,6	73,3	74,2	74,9	79,0	79,3	79,7	80,5	80,6	81,3
Spain	74.4	75.2	75.3	76.2	76.3	77	81.8	82.3	83.4	83.2	83	83.7
United Kingdom	74,0	74,7	75,0	75,8	76,2	77,1	79,3	79,7	79,9	80,5	80,5	81,1
Sweden	76,2	76,8	77,1	77,6	78,0	78,5	81,7	82,0	82,0	82,2	82,5	82,9
EU-15 [a]	**73,8**	**75,3**	**74,8**	**75,5**	**75,9**	**76,7**	**80,1**	**80,5**	**80,9**	**81,4**	**76,6**	**82,0**

Source: Eurostat (2008). [a] Calculations by the author. n/d/: information not available.

As shown in Table 2.1., this indicator has been increasing gradually both for men and women in all Member States. Projections indicate the maintenance of this trend in the future

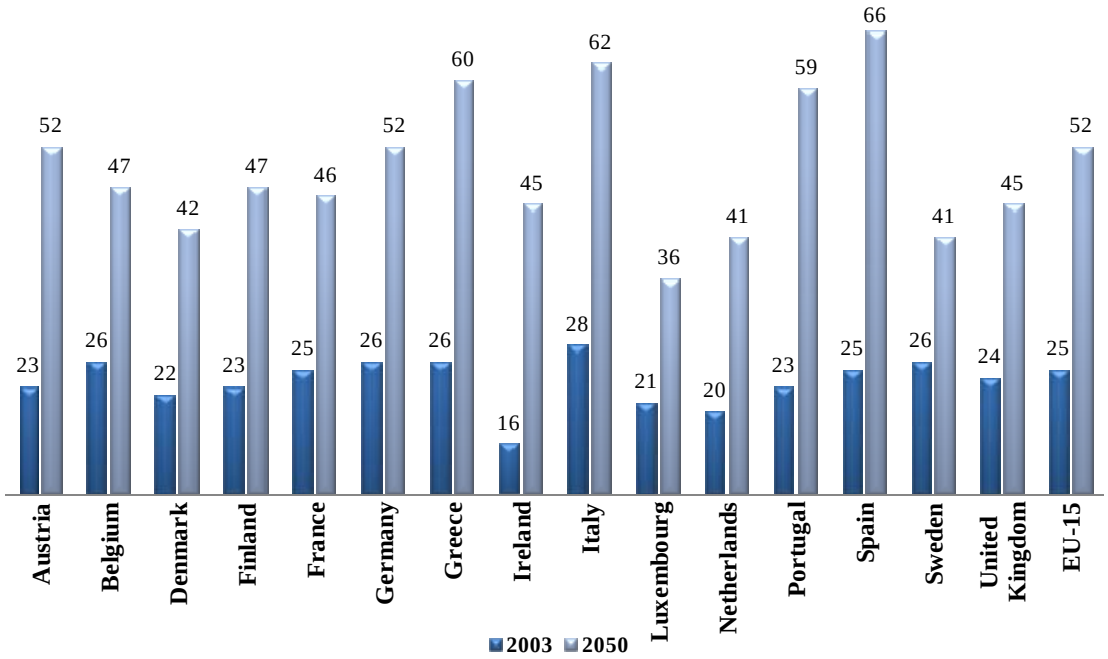
(Eurostat, 2008). Gender differences in the 1960s were associated with unfavourable conditions of male mortality. Later, the increase in the female life expectancy has dampened the gender differences. This convergence may come from closer lifestyles between men and women in Europe. Men average life expectancy birth rate was, in 2005, approximately 76,7 years old, while the women life expectancy was 81.9 years old.

We also verify that there are differences in life expectancy between the Member States. For men, the lowest life expectancy occurs in Portugal (74.9) and the biggest happens in Sweden (78.5); for women, there is a gap between 80.5 years in Denmark and 83.7 years in Spain. Between 1995 and 2005, the European life expectancy increased approximately 3 years between men and 1.84 years between women.

Eurostat projections relative to life expectancy for the EU-15 anticipates increases in life expectancy of about 6 years for men and 5 years for women, between 2005 and 2050 (Eurostat, 2008). The projections indicate that in the future there will be a growing number of elderly people. Thus, the EU's population pyramid will have a large increase in the proportion of elderly and very elderly people and a decrease in the weight of young people.

- **Old-Age Dependency Ratio**

Figure 2. 4. Old-Age Dependency Ratio (%), EU-15, 2003, 2050.



Source: European Commission (2006).

The evolution of old-age dependency ratio (ratio between the number of people aged 65 years or more and the number of people aged 15 to 64 years) reflects the increase in the weight of the elderly on the working age population, particularly in terms of social expenditure. Eurostat forecasts warn to the increase in the old-age people in the total population from 16.2% in 2005 to 28.4% in 2050 (Eurostat, 2008). This trend is also reflected in the expected evolution of the old-age dependency ratio: the European average old-age dependency ratio will double and will reach in 2010 the value 50%, which means that the actual situation of 4 active person to one old-aged person will change to a ratio of 2 to 1. In Portugal, in 2050, the elderly people will be 59% of the active people.

1.2. ECONOMIC VARIABLES

- **Employment**

Based on the projections of the European Commission (2006), we verify that the European employment rate will increase from 64.6% in 2003 to 71% in 2025 and approximately 72% in 2050. The expected increase of the employment rates should be associated with two factors: the increase of the female employment rate (explained by their higher educational level and by socio-cultural factors associated with the role of women in society) and the increase of the older workers employment rate (which will increase from 41.4 percentage points in 2003 to 58% in 2025 and 60.2% in 2050).

- **Social Protection**

The European social protection systems are highly developed. They are set to protect people against risks associated with unemployment, parental responsibilities, illness and disability, loss of spouse, old age, social exclusion and housing.

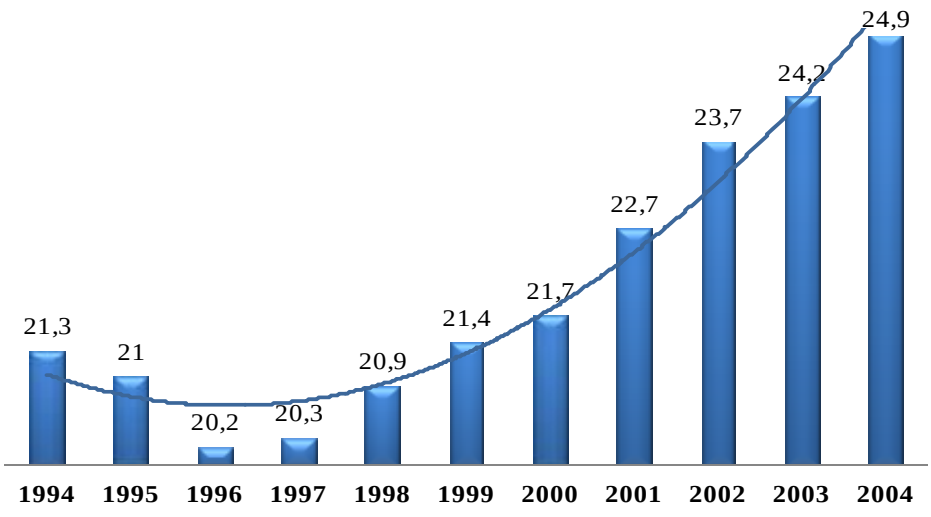
The evolution of the social protection expenditure is not uniform among European countries. As shown in Table 2.2., between 1994 and 2004, the share of the expenditure on social protection in each country's wealth decreased in Denmark, Spain, Finland, Netherlands, Ireland, Luxembourg, the United Kingdom and Sweden. In the other countries, the social protection expenditure increased in period analyzed.

Table 2. 2. Expenditure in Social Protection (% do GDP), EU-15, 1994-2004.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Austria	28,8	28,7	28,6	28,6	28,3	28,7	28,2	28,6	29,1	29,5	29,1
Belgium	28,7	27,4	28,0	27,4	27,1	27,0	26,5	27,3	28,0	29,1	29,3
Denmark	32,5	31,9	31,2	30,1	30,0	29,8	28,9	29,2	29,7	30,7	30,7
Finland	33,7	31,5	31,4	29,1	27,0	26,2	25,1	24,9	25,6	26,5	26,7
France	30,2	30,3	30,6	30,4	30,0	29,9	29,5	29,6	30,4	30,9	31,2
Germany	27,7	28,2	29,3	28,9	28,8	29,2	29,2	29,3	29,9	30,2	29,5
Greece	22,1	22,3	22,9	23,3	24,2	25,5	25,7	26,7	26,2	26,0	26,0
Ireland	19,7	18,8	17,6	16,4	15,2	14,6	14,1	15,0	16,0	16,5	17,0
Italy	25,3	24,2	24,3	24,9	24,6	24,8	24,7	24,9	25,3	25,8	26,1
Luxembourg	22,9	20,7	21,2	21,5	21,2	20,5	19,6	20,8	21,4	22,2	22,6
Netherlands	31,7	30,6	29,6	28,7	17,8	27,1	26,4	26,5	27,6	28,3	28,5
Portugal	21,3	21,0	20,2	20,3	20,9	21,4	21,7	22,7	23,7	24,2	24,9
Spain	22,8	21,6	21,5	20,8	20,2	19,8	19,7	19,5	19,8	19,9	20,0
Sweden	36,5	34,3	33,6	32,7	32,0	31,7	30,7	31,3	32,3	33,3	32,9
United Kingdom	28,6	28,2	28,0	27,5	26,9	26,4	27,1	27,5	26,4	26,4	26,3

Source: Eurostat (2008).

Figure 2. 5. Expenditure in Social Protection (% do GDP), Portugal, 1994-2004.

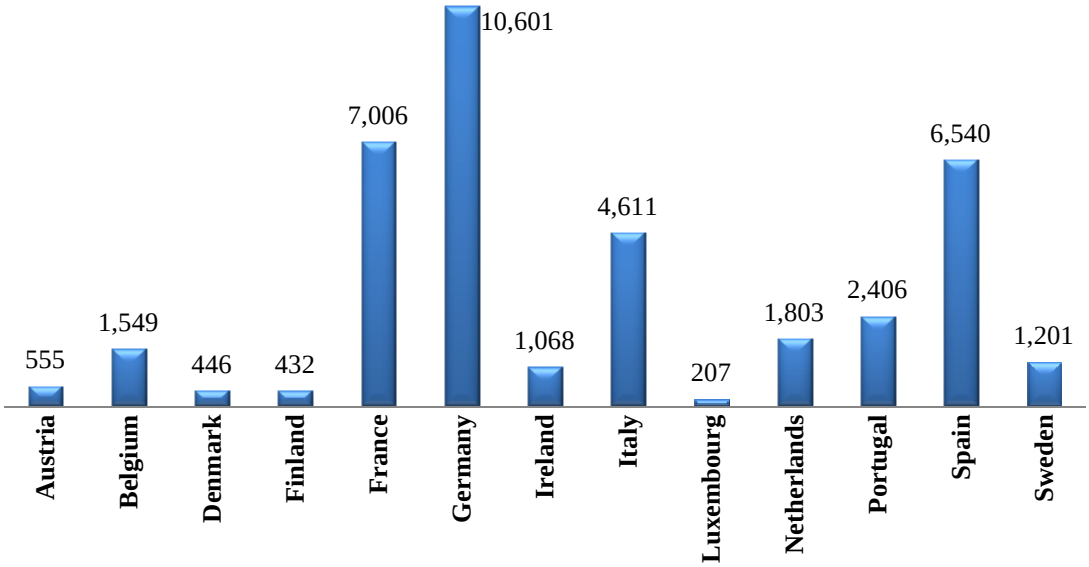


Source: Eurostat (2008).

The Figure 2.5. shows that, during the period 1994-2004, the weight of the social protection expenditure in GDP in Portugal worsened by 3.6 percentage points. In 2004, the social protection financing corresponded to about one quarter of the wealth produced in the country.

It takes place below a brief analysis of the projected evolution of the number of pensioners (Figure 2.6.) and the number of contributors (Figure 2.7.) integrated in the European public pension systems, for the period 2004-2050, according to statistical information available.

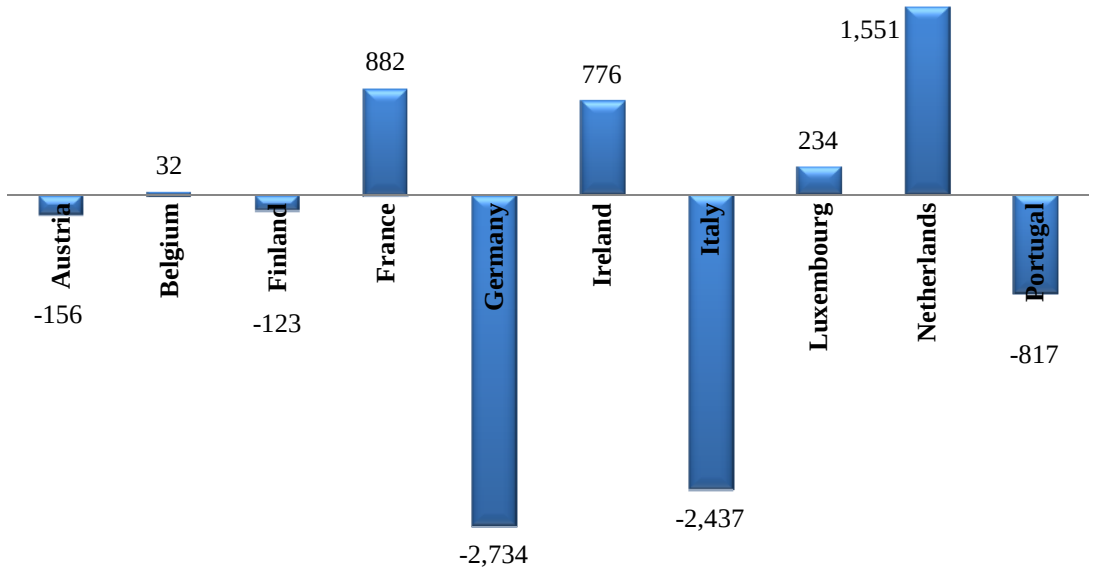
Figure 2. 6. Projected Changes in the number of Pensioners in Public Pension Schemes, EU-15, 2004-2050.



Source: European Commission (2006).

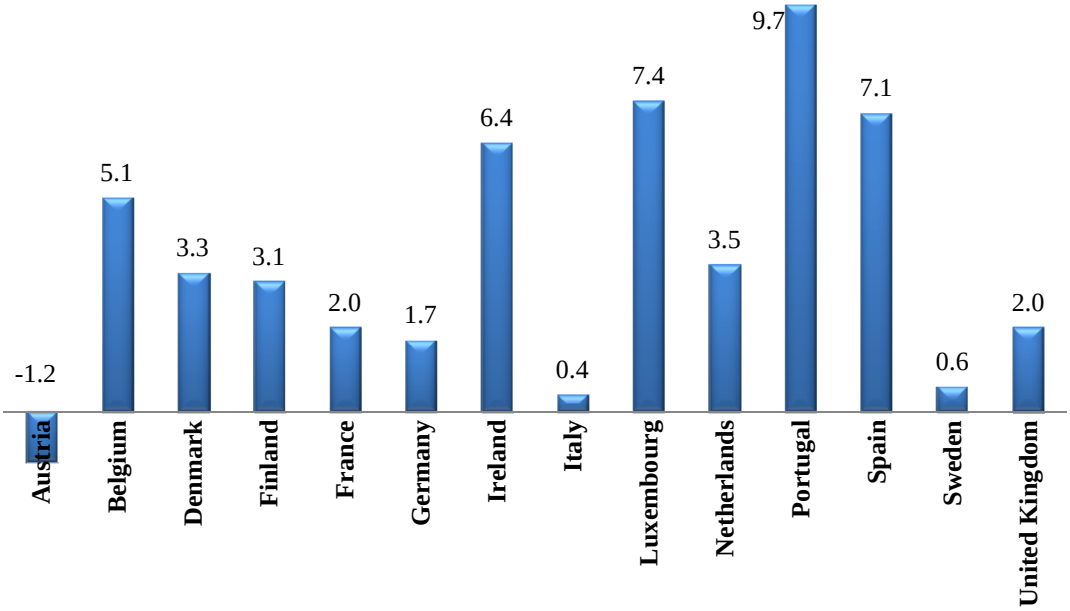
Germany, Italy, France and Spain were the countries that in 2004 presented the highest number of pensioners (respectively, 23,840; 15,595; 12,925; and 8,519). It is expected the largest increase of pensioners during the period 2004-2050 in those countries (10,601 in Germany; 4,611 in Italy; 7,006 in France; and 6,540 in Spain). Also in Germany and Italy will take place the highest decrease in the number of taxpayers, which will cause the financial sustainability deterioration of the respective pension system. Austria, Portugal and Finland will as well lose contributors. The number of beneficiaries of the system will remain relatively stable in Denmark (446), Finland (432) and Luxembourg (207). In Portugal, the number of pensioners will increase in 2,406 individuals in the period 2004-2050, with the largest increase occurring in the sub-period 2004-2030 due to the retirement of the baby boom generations.

Figure 2. 7. Projected Changes in the number of Contributors in Public Pension Schemes, EU-15, 2004-2050.



Source: European Commission (2006).

Figure 2. 8. Projected Changes in Public Pension Spending as a Percentage of GDP, EU-15, 2004-2050.



Source: European Commission (2006).

Figure 2.8. presents the projections of the public expenditure in pensions as percentage of GDP in the EU Member States for the period 2004-2050. It is expected a dramatic and generalized increase in the public pensions expenditure. The budgetary burden in public

pensions tends to be higher in countries where the distributive system is prevalent, particularly in Portugal (in 2004, 20.8%), Luxembourg (in 2004, 17.4%), Spain (in 2004, 15.7%) and Belgium (in 2004, 15.5%).

It is expected that public expenditure on pensions will increase in most European countries. However, in some countries, it is expected a decrease in the public expenditure because a part of this expenditure has been transferred to private pensions. Nevertheless, the adequacy of income at retirement remains a public responsibility.

Concluding, we emphasize that demographic, economic and social changes will affect the pension systems at various levels. The aging population will have a strong influence on the public finances future sustainability and therefore in the ability of societies to provide adequate pensions without compromising the investment in future generations. European Commission (2007) advice Member States to encourage "baby boom" age groups to remain in the labor market for longer.

Developed countries face an aging population marked by a massive increase of population aged 65 years or more, which means an increase of the old-age dependency ratio. Nevertheless, the age structure is not the only factor that influences the pension systems financing: it depends also on the employment rates, in particular the employment rate of the older workers. The employment rate effectively assumes the leading role in fighting the financial consequences of aging population in the pension systems. Nevertheless, increasing the employment rate does not solve all the problems associated with the phenomenon of aging, but may help temporarily.

The reforms implemented in the pension systems to promote its financial sustainability differ from country to country. The reforms adopted are influenced bythe way that pension systems are built, the Governments politics, the social partners perspectives and the economic and social resources.

3. THE PORTUGUESE PENSION SYSTEM

In this section we will introduce the Portuguese pension system. We will describe this system, with respect to its function form, contribution rates, statutory retirement age, minimum contributory period required to access to an old-age pension and conditions to access to early and deferred retirement

3.1. BASIC CHARACTERISTICS OF THE PORTUGUESE PENSION SYSTEM

The Social Security System in Portugal is financed by contributions and covers all active population (employees and independent workers) with contributory pensions, which depends on the incomes and the contributory period. The coverture of the Portuguese social protection system is wide, in terms of the eventualities covered, as well in terms of the population covered (in 2004, the old-age pensions covered 91% of the old-age population).

In Portugal, the most part of the population is integrated essentially in two systems: the System of Social Security Solidarity, represented by the National Center of Pensions, and the System of Social Protection to Civil Service, whose most visible part is the system relative to general pensions ("Caixa Geral de Aposentações"). The System of Social Security covers all employees and self-employed individuals of the private sector. The System of Social Protection to Civil service includes all civil servants integrated in the central, regional or local public administration, the police and the military forces. With logical and different stories, these two institutions entered in 2006, in a process of convergence, a process that is the most relevant change in decades in the field of social protection in Portugal.

The Portuguese pension system follows the Bismarckian model. It is based in the first public pillar and covers the most part of the population. The first pillar, public and mandatory, consists on different provisions. The social pensions represent non-contributory benefits for all residents aged 65 years or more. These benefits have a fixed value and are intended for people who have insufficient or lack of resources from contributory social security programs. There are other measures for persons who are in need of assistance, such as the Supplement for Dependent People and the Solidarity Supplement. The contributory pensions are financed by the application of a tax (contribution rate) on the working population labor remunerations.

The second pillar (private and volunteer) is not very developed, as what happens in most countries of Continental Europe. According to European Commission (2000), the assets of the supplementary professional systems were about 11.5% of GDP. These schemes normally correspond to pension funds managed by private institutions, including insurance companies and management companies of pension funds.

The third pillar is private, individual and volunteer. It can take different forms, including life insurance and pension funds.

3.2. ELIGIBILITY CONDITIONS OF THE PORTUGUESE PENSION SYSTEM

The eligibility conditions for accessing to an old-age pension are different depending on the beneficiary is covered by the System of Social Security Solidarity or by System of Social Protection to Civil Service. Since our empirical study covers only the private workers, we will analyze only the eligibility conditions of the System of Social Security Solidarity.

The general scheme of the Social Security System determines that to access to an old-age pension the beneficiary must present a contributory career with at least 15 years. Nevertheless, to access to a full pension, it is required to have the legal retirement age (65) and present contributions paid for 40 years. The early retirement is possible for insured persons aged at least 55 provided that they have completed their qualifying period and a contribution period with 30 calendar years (MISSOC, January 2011). The amount of early pension is reduced through the application of a reduction factor corresponding to *(1-x)*, in which *x* is the global reduction rate obtained by multiplying 0.5% by the number of months of anticipation.

The deferred pension is possible and unlimited. In this situation, the statutory pension increases by the application of a bonus corresponding to (*1+y)*, in which *y* is the global bonus rate, obtained by multiplying the monthly rate (which varies between 0.33% and 1% according to the number of contribution years fulfilled on the on which the pension begins) by the number of contribution months fulfilled between the age of 65 and the month on which the pension begins, with an upper limit set at the age of 70 years.

The system does not impose a statutory maximum pension, but it is provided a minimum pension which corresponds to 30% of average monthly earnings. However, the pension is subject to minimum values established by the law and are indexed to the an indexing reference of social support (IAS: “Indexante dos Apoios Sociais”).

There are several methods to calculate the pension reform, that will be applied depending on the time of entry into the labor market and the date of exit for retirement: *i)* the old method, *ii)* the new method and *iii)* the mixed method.

According to the old method, the calculation of the statutory old-age pension is based on the average of the best 10 years of wages in the last 15 years career, as shown in the mathematical expression [1.]. It is applied to individuals who entered into the system before 31 December 2001 and will retire before 2016.

$$P_{A_t} = T \sum_{t=X_e}^{X_j} \frac{Max_{10}(W_{X_j - t})}{10} \qquad \textbf{[1.]},$$

P_{A_t} : Value of the old-age pension at time *t*, calculated by the old method.

T : Global formation rate (the annual rate assumes the value of 2%).

X_e : Age of entry into the labor market.

X_j : Retirement age, until 31 December 2001.

W : Wage at $X_j - t, \forall (X_j - t) \leq 10$.

The new method is applied to all workers who have begun to contribute to Social Security after 31 December 2001. The old-age pension is calculated based on the wages earned in the whole contributory career (until 40 years). As shown in Equation [2.], the pension is set up by the product of the reference earning, the global formation rate and the sustainability factor.

$$P_{N_t} = T \sum_{t=X_e}^{X_j} \frac{W_{(X_j - t)} (1 + IRSAL)^{(X_j - t)}}{N} F_{S_t} \qquad \textbf{[2.]},$$

P_{N_t} : Value of the old-age pension at time *t*, calculated by the new method.

T : Global formation rate.

$W_{(X_j - t)}$: Wage related to $X_j - t$.

$IRSAL$: Nominal wages growth rate.

N : Contributory period, $\forall N : X_j - X_e$.

F_{S_t} : Sustainability factor at the moment *t*.

The Sustainability Factor is calculated according to the formula presented in Equation [3.].

$$F_{S_t} = \frac{EMV_{2006}}{EMV_{t-1}} \qquad \textbf{[3.]},$$

F_{S_t} : Sustainability factor at the moment *t*.

EMV_{2006} : Average life expectancy at age 65, verified in 2006.

EMV_{t-1} : Average life expectancy at age 65, verified in the previous year to the beginning of the pension *t*.

Workers who have made contributions to Social Security before 31 December 2001 but who will only retire after 2016 are integrated in the mixed regime. The old-age pension calculated by the mixed method is calculated proportionally taking into account the contributory

periods relative to the old method and to the new method, as shown algebraically in the expression [4.].

$$P_M = \frac{P_A N_A + P_N N_N}{N} \quad \textbf{[4.]},$$

P_{M_t} : Value of the old-age pension at the moment *t*, calculated by the mixed method.

P_{A_t} : Value of the old-age pension at the moment *t*, calculated by the old method.

P_{N_t} : Value of the old-age pension at the moment *t*, calculated by the new method.

N_A: Number of years of the contributory career with relevant earnings to the formation rate, completed by 31 December 2006.

N_N: Number of years of the contributory career with relevant earnings to the formation rate, completed from 1 de January 2007.

N : Total contributory period.

Since the mixed method is applied to workers who retire at present, we will use this method to test the equity and financial solvency of the Portuguese system in the next section. Therefore, we will use the formula [4.] to calculate the statutory old-age pension.

4. REPLACEMENT RATES AND FINANCIAL SOLVENCY OF THE PORTUGUESE PENSION SYSTEM

The empirical part of this research intends to analyze the equity and the financial solvency of the Portuguese pension system.

To examine the equity and the financial solvency of the pension system, it takes special relevance the determination of the value of old-age pensions, the replacement rates and the rates of return. We use the replacement rates to examine if the pensions generated by the system are adequate to the earnings received in the active life. We also use the internal rates of return to examine the financial solvency of the Portuguese pension system.

In the present section, we will evaluate the old-age benefits offered by the Portuguese pension system, depending on salary level and the tax period, and the respective replacement rates and rates of return. After, we will evaluate if the establishment of a maximum old-age pension in order to promote the financial solvency of the Portuguese pension system.

It should be noted that the research proposed will focus the distributive schemes of the first pillar contributory public pension system.

4.1. REPLACEMENT RATES

The replacement rate results from the ratio between the first pension received at the moment of retirement and the last salary received before retirement, as shown in the expression [5.]. This indicator gives an idea of the adequacy or not the old-age pension that the beneficiary will receive when he retires and, therefore, permits to conclude if the individual will increase or reduce its purchasing power. Thus, higher replacement rates provide greater proximity between the purchasing power in the situations before and after the entry into retirement.

$$RR = \frac{P}{W} \qquad \textbf{[5.]},$$

RR : Replacement rate.
P : First pension.
W : Last Wage.

The replacement rate has been used by several authors, either to make international comparisons or to isolated analysis of some country pension system, among which are studies of Börsch-Supan and Wilke (2004 and 2008), Vidal-Meliá, Domínguez-Fabián and Devesa-Carpio (2006), Hofer and Koman (2006) and Whitehouse (2006).

4.2. INTERNAL RATE OF RETURN

The internal rate of return (IRR) is a well known index in the economic analysis. When applied to study the pension systems, this indicator resumes the relationship between contributions made and benefits received during the individuals' life cycle.

The development of this section is based on the contributions prepared by Samuelson (1958) and Aaron (1966), under which a pension system financed by distribution or by intergenerational transfers will only be viable in the long-term if the IRR of the system does not exceed the real wage growth rate more the stable growth rate of the contributory population, that is, if the IRR is not superior of the tax base growth rate. Therefore, sustained on Domínguez-Fabián and Encinas-Goenechea (2008), we can say that the financial solvency of a distributive system depends on the average sustainable economic growth in the long term and that this growth will be important to achieve the financial solvency of the pension system.

Several authors have used the IRR methodology to study pension systems. We emphasize the studies carried out by Keyfitz (1985), Lapkoff (1985, 1988 and 1991), Boskin and Puffert (1987), Rofman (1993), Leimer (1995), Bravo (1996), Jimeno and Licandro (1996 and 1999), Schnabel (1997 and 1999), Devesa, Lejárraga and Vidal (1999) and Gil and López-Casasnovas (1999).

Based on Devesa, Lejárraga and Vidal (1999), the internal rate of return associated to a taxpayer who enters into the labor market with X_a years of age, in a pure distributive system to old-age pensions, is defined by the parameter *i* of composite capitalization law that permits the equivalence between the contribution flows and the pension flows. We used in this study the IRR based on the taxpayer or individual focus.

The actuarial value of the contributions made by a worker during his active life, discounted at the rate *I* to the moment of retirement, is reflected in the Equation [6.], following the nomenclature adopted by Devesa, Lejárraga and Vidal (1999).

$$V_{contr} = \sum_{t=0}^{X_j - 1 - X_a} {}_tP_{Xa} c_{Xa+t} W_{Xa} (1+\alpha^*)^t (1+\beta)^{-t} (1+i)^{-t} \qquad \textbf{[6.]},$$

i: Real internal rate of return.

X_a: Age of entry into the labor market.

X_j: Age of entry into retirement.

${}_tP_{Xa}$: Probability that an individual with X_a years old achieves the age X_{a+t}.

c_{Xa+t}: Contributory rate at X_{a+t} years of age. It includes the contributions made by employee and employer.

W_{Xa}: Wage at X_a years of age.

α^*: Cumulative nominal wages annual growth rate (constant).

$W_{Xa+t} = W_{Xa}(1+\alpha^*)^t$: Wage at X_{a+t} years of age.

β: Cumulative inflation annual growth rate (constant).

The actuarial value of the old-age pensions received by an individual during his active life, discounted at the rate *i* to the moment of retirement, is determined by the mathematical expression [7.]. We use again the nomenclature adopted by Devesa, Lejárraga and Vidal (1999).

$$V_{PENS} = \sum_{t=Xj-Xa)}^{w-1-X_a} P_{Xj}\, {}_tP_{Xa} (1+\lambda^*)^{t-(Xj-Xa)} (1+\beta)^{-t} (1+i)^{-t} \qquad \textbf{[7.]}$$

γ^*: Cumulative nominal old-age pensions annual growth rate (constant).

w: Limit of age assumed in the mortality table.

P_{Xj}: Initial old-age pension.

We will consider that a system is solvent in the long run if it generates an IRR less than 3% (assuming the hypothesis that the economy grows in the long run at the rate of 3%). On the contrary, the pension system faces financial solvency problems in the long run..

4.3. WORKING HYPHOTESIS

We assumed a hypothetical worker, integrated in the public pension system, who earns a certain salary and has a contributory career. The calculations are based on hypothetical cases, according to recent legislation adopted.

1) The worker is integrated in the general scheme of the public pension system for dependent workers of the private sector.

2) In order to adopt wage levels that cover the most part of the residents in Portugal, we consider different values of initial salaries, which range between €500 and €7,000 per month (or €7,000 and € 48,000 per year).

4) The minimum age of entry into the labor market is 25 years old. We do not consider the possibility of interruptions in the career.

8) The tax base growth rate 3%.

9) The future Consumer Price Index is 3%.

10) The salaries growth rate is 4%.

11) The pensions growth rate is 3%.

12) The individual retires in 2011.

13) The contribution rate to the retirement pension results from the ratio between the expenditure on old-age pensions and the total expenditure on pensions.

14) We use the 2007-2009 survival tables (National Institute of Statistics, 2010).

Based on the hypothesis described above, we assumed three scenarios concerning both the wage level and the retirement age as well as the age of entry into the contributory system. The three scenarios include sub-scenarios, which corresponds to different (annual) wages at the age of entry into the labor market.

Scenario 1 (Table 4.1.) is related to individuals with 40 years contributory careers (retirement age: 65 years; age of entry in labor market: 25 years). Scenario 2 (Table 4.2.) corresponds to the contributory period with 30 years, which means that the individual enters into the labor market with 35 years old and retires with 65 years old. Scenario 3 (Table 4.3)

refers to contributory periods with 20 years (the individual starts his contributory career with 45 years old and enters into retirement with 65 years old).

We will analyze for each scenario (and sub-scenario) the replacement rate and the IRR generated.

Table 4.1. Scenario 1 – Contributory period: 40 years.

Scenario 1	Last salary/month (€)	Last salary/year (€)	Age of entry into the labor market (years)	Retirement age (years)	Contributory period (years)
Scenario 1.1	500	7.000	25	65	40
Scenario 1.2	750	10.500	25	65	40
Scenario 1.3	1.000	14.000	25	65	40
Scenario 1.4	1.500	21.000	25	65	40
Scenario 1.5	2.000	28.000	25	65	40
Scenario 1.6	2.500	35.000	25	65	40
Scenario 1.7	3.000	42.000	25	65	40
Scenario 1.8	4.000	56.000	25	65	40
Scenario 1.9	5.000	70.000	25	65	40
Scenario 1.10	6.000	84.000	25	65	40
Scenario 1.11	7.000	98.000	25	65	40

Table 4.2. Scenario 2 – Contributory period: 30 years.

SCENARIO 2	Last salary/month (€)	Last salary/year (€)	Age of entry into the labor market (years)	Retirement age (years)	Contributory period (years)
Scenario 2.1	500	7.000	35	65	30
Scenario 2.2	750	10.500	35	65	30
Scenario 2.3	1.000	14.000	35	65	30
Scenario 2.4	1.500	21.000	35	65	30
Scenario 2.5	2.000	28.000	35	65	30
Scenario 2.6	2.500	35.000	35	65	30
Scenario 2.7	3.000	42.000	35	65	30
Scenario 2.8	4.000	56.000	35	65	30
Scenario 2.9	5.000	70.000	35	65	30
Scenario 2.10	6.000	84.000	35	65	30
Scenario 2.11	7.000	98.000	35	65	30

Table 4.3. Scenario 3 – Contributory period: 20 years.

SCENARIO 3	Last salary/month (€)	Last salary/year (€)	Age of entry into the labor market (years)	Retirement age (years)	Contributory period (years)
Scenario 3.1	500	7.000	45	65	20
Scenario 3.2	750	10.500	45	65	20
Scenario 3.3	1.000	14.000	45	65	20
Scenario 3.4	1.500	21.000	45	65	20
Scenario 3.5	2.000	28.000	45	65	20
Scenario 3.6	2.500	35.000	45	65	20
Scenario 3.7	3.000	42.000	45	65	20
Scenario 3.8	4.000	56.000	45	65	20
Scenario 3.9	5.000	70.000	45	65	20
Scenario 3.10	6.000	84.000	45	65	20
Scenario 3.11	7.000	98.000	45	65	20

4.4. REPLACEMENT RATES AND INTERNAL RATES OF RETURN FOR THE PORTUGUESE PENSION SYSTEM

We present below the results of the calculations made for the pension system in Portugal. We show for each contributory period, the value of the replacement rate and the IRR associated to different wage levels.

Table 4.4. Replacement Rates and Internal Rates of Return by Salary
Scenario 1 (Contributory period: 40 years)

	Last salary/year (€)	First pension/year (€)	RR (%)	IRR (%)
Scenario 1.1.	7.000	8.680	124	11,3
Scenario 1.2.	10.500	8.680	83	3,3
Scenario 1.3.	14.000	11.039	79	3,1
Scenario 1.4.	21.000	16.548	79	3,1
Scenario 1.5.	28.000	22.055	79	3,1
Scenario 1.6.	35.000	27.555	79	3,1
Scenario 1.7.	42.000	33.052	79	3,1
Scenario 1.8.	56.000	44.047	79	3,1
Scenario 1.9.	70.000	55.021	79	3,1
Scenario 1.10.	84.000	65.990	79	3,1
Scenario 1.11.	98.000	76.964	79	3,1

Age of entry into the labor market: 25. Retirement age: 65. Source: Calculations by the author.

Table 4.4. shows the values of the annual old-age pension, the replacement rate and the IRR associated to scenario 1 – contributory period with 40 years. We verify that individuals who receive annual salaries inferiors or equals to € 10,500 will receive, when they enter retirement, a pension equivalent to the value of solidarity supplement for the elderly. In most cases, except for salaries below € 10,500, individuals will lose purchasing power comparing to the situation when they were active, as they will receive a pension identical to 79% of last salary

received. Even so, the value of IRR (superior to 3%) leads us to conclude the financial insolvency of the Portuguese pension system. We can also conclude that the IRR and the replacement rate are independent of the wage level, showing that the Portuguese pension system is equitable.

Table 4.5. Replacement Rates and Internal Rates of Return by Salary Scenario 2 (Contributory period: 30 years)

	Last salary/year (€)	First pension/year (€)	RR (%)	IRR (%)
Scenario 2.1.	7.000	8.680	124	11,3
Scenario 2.2.	10.500	8.680	83	5,0
Scenario 2.3.	14.000	8.680	62	3,8
Scenario 2.4.	21.000	12.441	59	3,6
Scenario 2.5.	28.000	16.577	59	3,6
Scenario 2.6.	35.000	20.708	59	3,6
Scenario 2.7.	42.000	24.835	59	3,6
Scenario 2.8.	56.000	33.086	59	3,6
Scenario 2.9.	70.000	41.319	59	3,6
Scenario 2.10.	84.000	49.549	59	3,6
Scenario 2.11.	98.000	57.782	59	3,6

Age of entry into the labor market: 35. Retirement age: 65. Source: Calculations by the author.

Table 4.5. presents the first old-age pensions, the replacement rates and the IRR´s related to contributory periods with 30 years (scenario 2). The replacement rate is about 60%, which means that individuals will receive a pension inferior to that they would have obtained if their contributory period was 40 years. On the other hand, with a contributory period with 30 years, the internal rate of return of the system goes from 3.1% (contributory period with 40 years) to 3.6%, worsening the pension system financial insolvency.

Table 4.6. shows the results related to old-age pensions, replacement rates and the internal rates of return associated with different wage levels, assuming that individuals enter into the labor market at the age of 45 and retire with 65 years old (scenario 3). In line with the results previously obtained, lower contributory careers imply lower replacement rates and higher internal rates of return. If individuals make contributions for less time, the old-age pension will be lower, because the formula for calculating the first pension depends on the number of years with contributions. On the other hand, with regard to the financial solvency of the system, lower contributory periods imply lower receipts for the system, threatening financing of the system. Thus, the system guarantees rates of return of the resources invested in the system superior to those obtained in the market, promoting the financial unsustainability of the system in the long run.

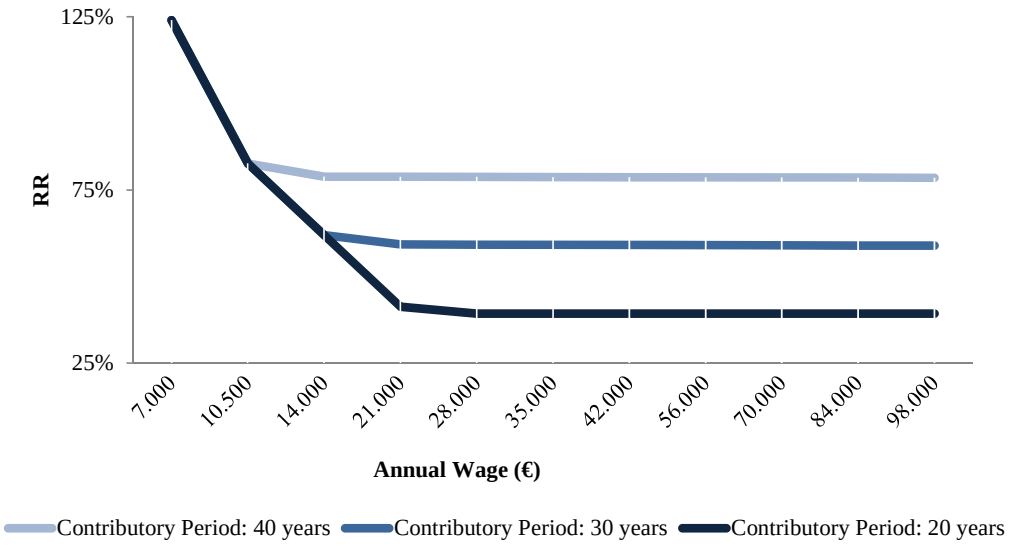
Table 4.6. Replacement Rates and Internal Rates of Return by Salary Scenario 3 (Contributory period: 20 years)

	Last salary/year (€)	First pension/year (€)	RR (%)	IRR (%)
Scenario 3.1.	7.000	8.680	124	11,3
Scenario 3.2.	10.500	8.680	83	8,4
Scenario 3.3.	14.000	8.680	62	6,8
Scenario 3.4.	21.000	8.680	41	4,6
Scenario 3.5.	28.000	10.998	39	4,4
Scenario 3.6.	35.000	13.749	39	4,4
Scenario 3.7.	42.000	16.498	39	4,4
Scenario 3.8.	56.000	21.998	39	4,4
Scenario 3.9.	70.000	27.497	39	4,4
Scenaio 3.10.	84.000	32.995	39	4,4
Scenaio 3.11.	98.000	38.495	39	4,4

Age of entry into the labor market: 45. Retirement age: 65. Source: Calculations by the author.

Figures 4.1. and 4.2. show, respectively, the evolution of the replacement rates and the IRR depending on the salary level, for different contributory periods (40, 30 and 20 years). Observing Figure 4.1., we can conclude that replacement rates have a reduced sensitivity in relation to the salaries, showing that the Portuguese pension system characterized by the equity (except for the lowest pensions). We find also that, for each wage level, the initial pensions and the replacement rates increase successively when the contributory period augments from 20 to 40 years, which means the system encourages people to enter into the market as soon as possible. We verify also that as lower is the contributory period, the higher must be the wage level that gives access to a minimum old age pension.

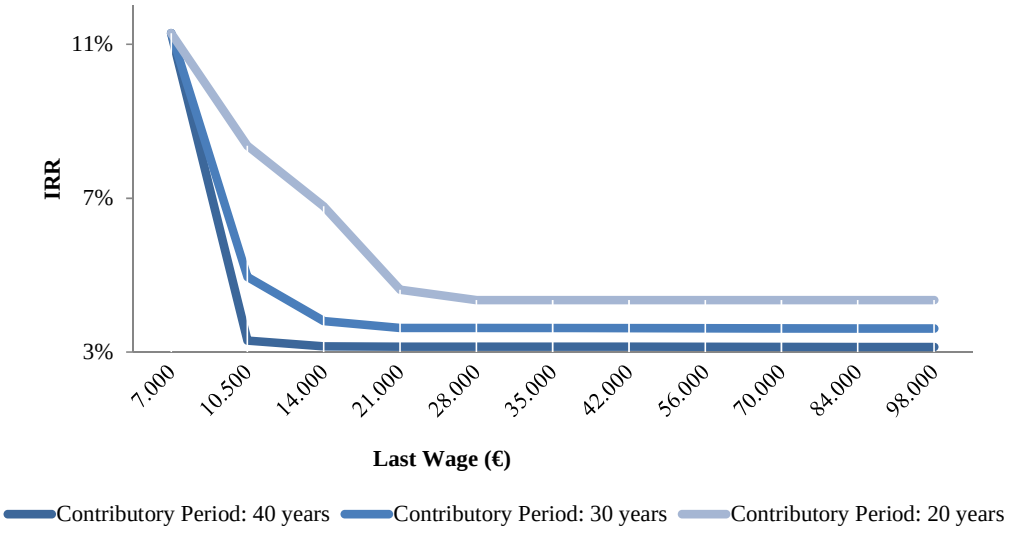
Figure 4.1. Replacement Rates (%) by Wage. Contributory period: 20, 30 and 40 years.



Source: Calculations by the author.

With regard to the evolution of the IRR (Figure 4.2.), we find, for a constant contributory period, the independence of the indicator to different wage levels. It is evident the financial insolvency of the Portuguese pension system for all scenarios examined (IRR higher than 3%), which leads us to affirm that the contributions received by the system are not enough to pay old-age benefits to future pensioners.

Figure 4.2. Internal Rate of Return (%) by Wage.
Contributory period: 20, 30 and 40 years.



Source: Calculations by the author.

5. THE MAXIMUM PENSION IN THE PORTUGUESE PENSION SYSTEM

Several European countries define a maximum old-age pension in the respective law. Among the EU-15 countries, only Germany, Austria, Italy, Portugal and Sweden do not define an upper limit that the old-age pension must comply.

In the present section, we intend to test the implementation of a maximum pension in the financial situation of the Portuguese pension system. Specifically, we will analyze, for each scenario described, the implementation of maximum values to old-age pension in the IRR and in the replacement rate, with different wage levels and diverse contributory periods. As shown in table 5.1., we assume that the maximum pension varies between € 14,000 and € 84,000 per year (€ 1,000 and € 8,000 per month).

Table 5.1. Values of the maximum pension.

	Monthly maximum pension (€)	Annual maximum pension (€)
Measure A	1,000	14,000
Measure B	1,500	21,000
Measure C	2,000	28,000
Measure D	2,500	35,000
Measure E	3,000	42,000
Measure F	4,000	56,000
Measure G	5,000	70,000
Measure H	6,000	84,000

Table 5.2. presents the results relative to the replacement rates and the internal rates of return, associated to the implementation of different values of the maximum pension in individuals with contributory careers with 40 years, who earned in the active life initial annual wages which vary between € 7,000 and € 98,000. We verify that the existence of a maximum pension improves the pension system financial situation. The lower is the value of the maximum pension, the higher is the number of scenarios or situations that ensure the solvency of the system. For example, if the annual maximum pension is € 84,000, the system is not solvent; on the contrary, if the maximum pension is € 14,000, the system is solvent for wages equal or higher than € 21,000.

For scenarios correspondent to low wages the maximum pension has to be low to become the system solvent. For example, for annual initial wages equal to € 21,000 the system is solvent if the annual maximum pension is € 14,000. So, the lower is the country´s average wage level, the lower is the maximum pension that guarantees the solvency of the system.

With regard to the replacement rates, since the implementation of the maximum pension means in most cases a lower initial pension, this will reduce the pensioners' purchasing power when they enter into retirement. The reduction of the purchasing power will be as higher as the lowest is the value of the maximum pension and as higher is the last salary received in the active life.

Table 5.2. Replacement Rates and Internal Rates of Return with Maximum Pension
Scenario 1 (Contributory period: 40 years)

		Scenario 1.1.	Scenario 1.2.	Scenario 1.3.	Scenario 1.4.	Scenario 1.5.	Scenario 1.6.	Scenario 1.7.	Scenario 1.8.	Scenario 1.9.	Scenario 1.10.	Scenario 1.11.
Annual Salary (€)		**7,000**	**10,500**	**14,000**	**21,000**	**28,000**	**35,000**	**42,000**	**56,000**	**70,000**	**84,000**	**98,000**
MEASURE A € 14,000	**IRR**	11.3	3.3	3.1	*2.6*	*1.7*	*0.9*	*0.3*	*-0.7*	*-0.9*	*-1.1*	*-1.5*
	RR	124	83	79	67	50	40	33	25	20	17	14
MEASURE B € 21,000	**IRR**	11.3	3.3	3.1	3.1	3.0	*2.3*	*1.7*	*0.7*	*0.0*	*-0.7*	*-1.0*
	RR	124	83	79	79	75	60	50	37	30	25	21
MEASURE C € 28,000	**IRR**	11.3	3.3	3.1	3.1	3.1	3.1	*2.6*	*1.7*	*0.9*	*0.3*	*-0.2*
	RR	124	83	79	79	79	79	67	50	40	33	29
MEASURE D € 35,000	**IRR**	11.3	3.3	3.1	3.1	3.1	3.1	3.1	*2.4*	*1.7*	*1.1*	*0.6*
	RR	124	83	79	79	79	79	79	62	50	42	36
MEASURE E € 42,000	**IRR**	11.3	3.3	3.1	3.1	3.1	3.1	3.1	3.0	*2.3*	*1.7*	*1.2*
	RR	124	83	79	79	79	79	79	75	60	50	43
MEASURE F € 56,000	**IRR**	11.3	3.3	3.1	3.1	3.1	3.1	3.1	3.1	3.1	*2.6*	*2.1*
	RR	124	83	79	79	79	79	79	79	79	67	57
MEASURE G € 70,000	**IRR**	11.3	3.3	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	*2.8*
	RR	124	83	79	79	79	79	79	79	79	79	71
MEASURE H € 84,000	**IRR**	11.3	3.3	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
	RR	124	83	79	79	79	79	79	79	79	79	79

Source: Claculations made by the author.

Table 5.3. shows the replacement rates and internal rates of return associated to different wage levels, under the imposition of maximum initial pensions, which range between € 14,000 and € 84,000, considering that individuals have contributory careers with 30 years.

Considering a contributory period with 30 years, the implementation of a maximum old-age pension will guarantee the sustainability of the system if the value of the maximum pension is equivalent or lower than € 42,000. Comparing this result with that obtained in Table 5.2., we can conclude that the reduction of the contributory period will limit the efficiency of the measure proposed because the number of scenarios with an IRR solvent have became few.

As mentioned above, the replacement rate obtained with a maximum old-age pension is inferior to that obtained without the maximum pension. So, we conclude again that the maximum pension will reduce the pensioners' purchasing power.

Table 5.3. Replacement Rates and Internal Rates of Return with Maximum Pension
Scenario 2 (Contributory period: 30 years)

		Scenario 1.1.	Scenario 1.2	Scenario 1.3.	Scenario 1.4.	Scenario 1.5.	Scenario 1.6.	Scenario 1.7.	Scenario 1.8.	Scenario 1.9.	Scenario 1.10.	Scenario 1.11.
Annual Salary (€)		**7,000**	**10,500**	**14,000**	**21,000**	**28,000**	**35,000**	**42,000**	**56,000**	**70,000**	**84,000**	**98,000**
MEASURE A €14,000	**IRR**	11.3	5.0	3.8	3.6	3.0	*2.1*	*1.3*	*0.2*	*-0.7*	*-1.4*	*-1.7*
	RR	124	83	62	59	50	40	33	25	20	17	14
MEASURE B €21,000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.0	*1.8*	*0.9*	*0.2*	*-0.4*
	RR	124	83	62	59	59	59	50	37	30	25	21
MEASURE C €28,000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.6	3.0	*2.1*	*1.3*	*0.7*
	RR	124	83	62	59	59	59	59	50	40	33	29
MEASURE D €35,000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.6	3.6	3.0	*2.2*	*1.6*
	RR	124	83	62	59	59	59	59	59	50	42	36
MEASURE E €42.000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.6	3.6	3.6	3.0	*2.3*
	RR	124	83	62	59	59	59	59	59	59	50	43
MEASURE F €56,000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5
	RR	124	83	62	59	59	59	59	59	59	59	57
MEASURE G €70,000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	RR	124	83	62	59	59	59	59	59	59	59	59
MEASURE H €84,000	**IRR**	11.3	5.0	3.8	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	RR	124	83	62	59	59	59	59	59	59	59	59

Source: Calculations by the author.

Table 5.4. presents the results relative to the replacement rates and the internal rates of return associated to the implementation of a maximum pension (between € 14,000 and € 84,000), for contributory careers with 40 years.

We verify that the implementation of a maximum pension permit the financial solvency of the systems, only in the following situations: maximum initial pension equivalent to € 28,000 and cumulatively initial wages equivalent to € 98,000; maximum pension of € 21,000 and cumulatively initial wages equal or higher than € 70,000; maximum pension of € 14,000 and cumulatively initial wages equal or higher than € 56,000.

We conclude again that the implementation of a maximum pension will reduce the replacement rates.

Table 5.4. Replacement Rates and Internal Rates of Return with Maximum Pension
Scenario 3 (Contributory period: 20 years)

		Cenário 1.1.	Cenário 1.2.	Cenário 1.3.	Cenário 1.4.	Cenário 1.5.	Cenário 1.6.	Cenário 1.7.	Cenário 1.8.	Cenário 1.9.	Cenário 1.10.	Cenário 1.11.
Annual Salary (€)		**7,000**	**10,500**	**14,000**	**21,000**	**28,000**	**35,000**	**42,000**	**56,000**	**70,000**	**84,000**	**98,000**
MEASURE A €14,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	3.5	*2.0*	*0.9*	*0.0*	*-0.7*
	RR	124	83	62	41	39	39	33	25	20	17	14
MEASURE B €21,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.1	*3.0*	*2.0*	*1.3*
	RR	124	83	62	41	39	39	39	37	30	25	21
MEASURE C €28,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.4	4.4	3.5	*2.7*
	RR	124	83	62	41	39	39	39	39	39	33	29
MEASURE D €35,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.4	4.4	4.4	3.9
	RR	124	83	62	41	39	39	39	39	39	39	36
MEASURE E €42,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.4	4.4	4.4	4.4
	RR	124	83	62	41	39	39	39	39	39	39	39
MEASURE F €56,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.4	4.4	4.4	4.4
	RR	124	83	62	41	39	39	39	39	39	39	39
MEASURE G €70,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.4	4.4	4.4	4.4
	RR	124	83	62	41	39	39	39	39	39	39	39
MEASURE H €84,000	**IRR**	11.3	8.4	6.8	4.6	4.4	4.4	4.4	4.4	4.4	4.4	4.4
	RR	124	83	62	41	39	39	39	39	39	39	39

Source: Calculations by the author.

6. CONCLUSIONS

We analyzed the equity and financial solvency of the Portuguese pension system. To do this we have calculated the value of old-age pensions, the replacement rates and the internal rates of return. To determine the old-age pension, we considered different wage scenarios and alternative contributory periods. The replacement rate (RR), an indicator commonly used in pension analysis, can be interpreted as a measure of the generosity of pension system because it shows the ability of the pension system to ensure the maintenance of living standards of workers when they retire. This indicator, although it is used by various research and organizations, does not analyze pension systems in terms of solvency. To study the financial solvency of pension systems in Portugal, the internal rate of return (IRR) was calculated, which summarizes the relationship between contributions and benefits received during the life cycle. Following Samuelson (1958), we assumed that if the IRR obtained was higher than the tax base growth, the pension system must be considered financially insolvent, since they provide better value for money to taxpayers than it generates its own economy and workforce.

For all scenarios under analysis, we found that the contributions received by the system will be insufficient to meet the commitments assumed by the system in terms of old-age benefits. The results relative to the influence of the contributory period in the behavior of the replacement rate and the IRR leads us to conclude that the system encourages individuals to enter as early as possible into the labor market. We also found that the extension of the period contributory brings significant improvements to the financial solvency of the pension system in Portugal. The results obtained for the pension system in Portugal show the existence of a low sensitivity (negative) of the replacement rate relative to the wages.

In order to mitigate the effects of aging, several European countries have implemented reforms in the respective pension systems. In this sense, in the second part of this research, we have evaluated the imposition of a maximum value for old-age pension in the financial solvency of the Portuguese pension system. We concluded that the implementation of a maximum pension improves the financial sustainability of the pension system in the long term. This measure will be as more effective as the value of the maximum pension legally established is reduced and cumulatively as the average wage of the country is high. On the other hand, the implementation of a maximum pension will reduce the initial old-age pension, causing a deterioration of the pensioners´ purchasing power.

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