

# THE REFORM OF THE PORTUGUESE PUBLIC EMPLOYEES' PENSION SYSTEM: REASONS AND RESULTS

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*In the context of the ageing population and with the Portuguese public social security system reaching maturity, pension expenditure recorded a marked upwards trend in the last decade, jeopardizing the system's long-term viability. This paper illustrates how the recent reforms in the social security system, in particular in the case of the public employees pension system, are expected to contribute to its financial sustainability and, hence, to the country's overall public finance sustainability. In addition, the potential distributive impact of the new rule on pensions indexation is analysed.*

## Introduction

Ensuring long-term sustainability of public finances has steadily become a main political priority in most developed countries. Both technological progress and lower fertility rates have increased the ratio of dependants to contributor, while tight budgetary constraints and additional pressure to increase spending in areas such as health care, have compelled public authorities in many developed countries to reform their social security systems.

In Portugal, the scenario was even more acute given the generosity of the overall pension regime, but in particular of the public employees' pension system. Until 2005, public employees hired until 1993 were entitled to keep their last wage after they retired as long as they had at least 36 years of contributive payments, and furthermore, pensions were *de facto* indexed to the evolution of public wages, causing pension levels to also increase over the years. When an increasing number of public employees entitled to full pension started retiring, the pressure on the system became unbearable.

Therefore, in 2005, a further convergence of the public employees' pension scheme with the private sector's one occurred and, in 2006, a major overhaul of the system was imposed and an agreement was reached based on new rules for the calculation of pensions and for their indexation over time. In particular, a sustainability factor was established such that the calculation of the pension dynamically reflected changes in life expectancy, while the yearly update of pensions became indexed to consumer inflation, depending on the GDP growth and the value of the pension.

In this context, the purpose of this paper is twofold. First, we analyse the impact of this set of changes on the system's sustainability, focusing most closely on the most significant changes; second, we measure the potential distributive impact of the new indexation rule. The paper proceeds as follows. In the following section, we describe the evolution of the Portuguese social security system since its inception, both in terms of its major institutional changes and its financial commitments; next, we evaluate demographic trends and their implications on pension expenditure; in Section 3 we discuss the situation of the pension system before the 2006 reform and in Section 4 we analyse the impact on public spending of the reform. We conclude by discussing our main findings.

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The views expressed in this paper are those of the authors and do not necessarily reflect those of the Ministry of Finance and Public Administration.

## 1 A historical perspective

The public employees' pension scheme was the first far-reaching system of social protection in Portugal. Until the inception of *Caixa Geral de Aposentações* (CGA), in 1929, only feeble attempts of social protection for few occupational groups had been made, based on the Bismarck's seminal social protection system, as in most other European countries. In the '30s, the public employees' pension scheme was extended to the descendants and spouses (survivors' pensions) and a general framework of social protection for the private sector workers, financed on a funded basis, was defined.

As in other European countries, during the '60s and '70s, the Portuguese social security systems progressively became universal and financed on a pay-as-you-go (PAYG) basis. In 1972, the public employees' retirement regime turned into an integrated legal framework, the so-called *Estatuto da Aposentação*, which provided a wider coverage of the scheme to all general government subsectors' employees and stipulated generous conditions to retirement: i) the old-age full pension was granted to beneficiaries who were 60 years old and after 40 years of contribution to the scheme; ii) the pension value was identical to the last net wage (or the last ten years average if higher); and iii) the pensions' updates followed, in general, the public sector wage growth. The system became financed by the employees' contributions (6 per cent of gross earnings), employers' contributions and State transfers. In 1979, the system became even more generous by only requiring 36 years of contribution to give entitlement to a full pension.

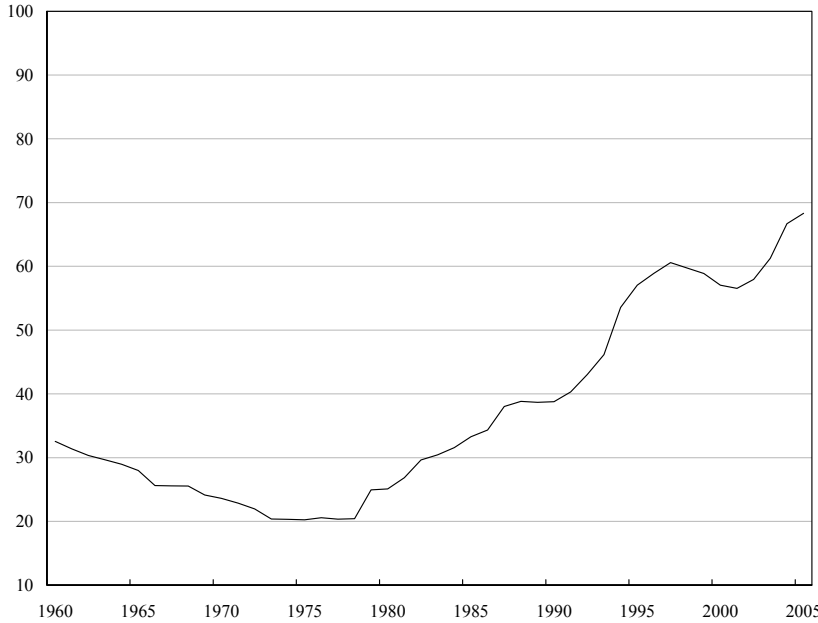
As regards the private sector social security scheme, it was enlarged in the '70s to agricultural workers, the self-employed and homemakers. A social pension for those above 65 years old and a 13<sup>th</sup> month of a pension were also given to retirees. Nevertheless, in 1984, when the first Social Security Framework Law was published, the pension system for private sector employees was less generous than the public employees' one: the legal retirement age was 65 for men and 62 for women, the reference earnings to the pension value were the average of the best ten out of the last fifteen years and the pensions' updates took into account inflation prospects. The financing system was also redefined with the contributive regime financed by employees and employers contributions and the non-contributive regime financed by State transfers. In 1986, the standard contributory rate for the general scheme of social security was fixed at 35 per cent (of which 11 per cent was relative to employees contributions), while in the case of public employees their contributory rate was 8 per cent (6.5 per cent for old-age and disability pensions and 1.5 per cent for survivors pensions).

Given the growth of pension expenditure compared to contributions revenue in the '80s, a result of the maturing process of the social security systems and the ageing of the population, the first reforms in both public pension schemes in Portugal occurred in the '90s, in the context of stricter budgetary discipline (Figure 1). In 1993, the *Estatuto da Aposentação* was revised and new public employees (*i.e.*, those hired from September 1993 on) started having the same pension scheme rules than the ones of the private sector. In the following year, the contributory rate of public employees rose to 10 per cent (7.5 per cent for old-age and 2.5 per cent for survivors pensions), converging to the Social Security rates.

The Social Security general regime was also revised in 1993, by increasing the legal retirement age for women to 65 years (the same as that of men) and rising the minimum entitlement contributory period from ten to fifteen years. The employers' contributory rate also rose to 24.5 per cent. In 1995, this rate was reduced by 0.75 percentage points but the Social Security benefited from the 1 per cent increase of the VAT standard rate that was assigned to this system.

**Figure 1**

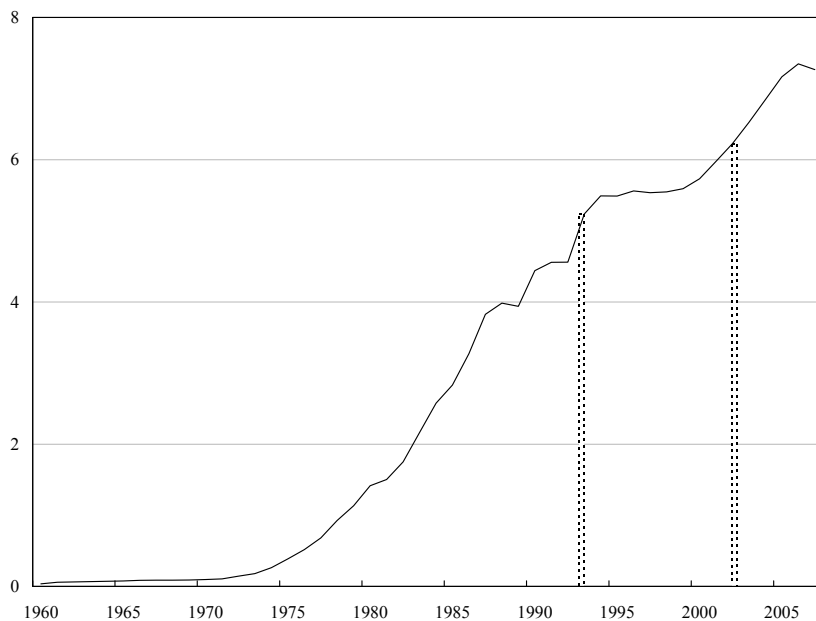
**Number of Pensions over Contributors – CGA  
(percent)**



Source: CGA.

**Figure 2**

**Pension Expenditure – Social Security  
(percent of GDP)**



Source: MTSS.

From 2000 to 2005, further measures were taken to improve the financial sustainability of the public pension systems. In the context of the first waves of retirement of the individuals with full contributive career and, hence, entitled to higher pensions, the public pension expenditure increased significantly in spite of a not so marked growth in the number of Social Security's pensions (Figures 2 and 3).

As to the CGA system, this trend was strengthened by the retirement of a large number of public employees that were hired after the 1974 Revolution and by the fact that public employees' scheme was still relatively more generous than the Social Security scheme (Figure 4). The need for reforms to the public pension systems was felt in several European countries, where the pension systems financed on a PAYG basis were reaching maturity when the large number of "baby boomers" was retiring and because of the ageing population.

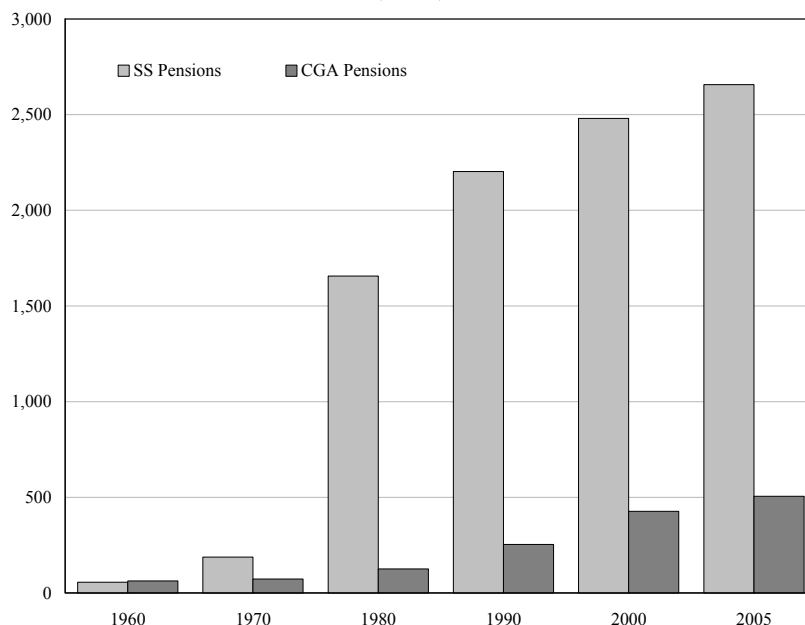
In this context, a new Framework Law for Social Security was established in 2002, which revised the rules for the pension value. These rules took into

account the complete contributive career, but raised the accrual rate from 2 to 2.3 per cent, depending on the reference earnings. However, these rules would apply only from 2017 onwards with a transitory period until 2042, while other measures, like the convergence of earnings-related minimum pensions to national minimum wage until 2006, put immediate pressure on public pension expenditure. In 2005, a second revision of the *Estatuto da Aposentação* occurred aiming at a further convergence of the CGA and the Social Security pension regimes. From 2006 onwards, new public employees were enrolled in the Social Security system, and it was defined by a progressive increase (at a pace of 6 months per year) in the legal retirement age of all public employees to 65 years old in 2015 and in the complete career length to 40 years in 2013. In addition, the pension formula of public employees enrolled in CGA until August 1993 would also converge to the one of private sector workers.

Nevertheless, these reforms proved to be insufficient to ensure the financial sustainability of

Figure 3

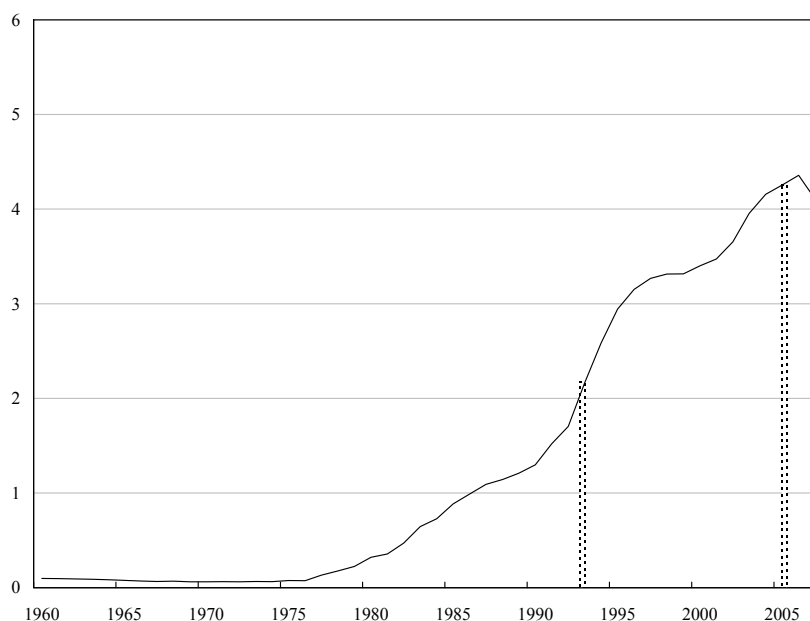
### Number of Pensions (Social Security and CGA) (10<sup>3</sup>)



Source: CGA and Ministry of Labour and Social Security (MTSS).

Figure 4

### Pension Expenditure – CGA (percent of GDP)



Source: CGA.

Table 1

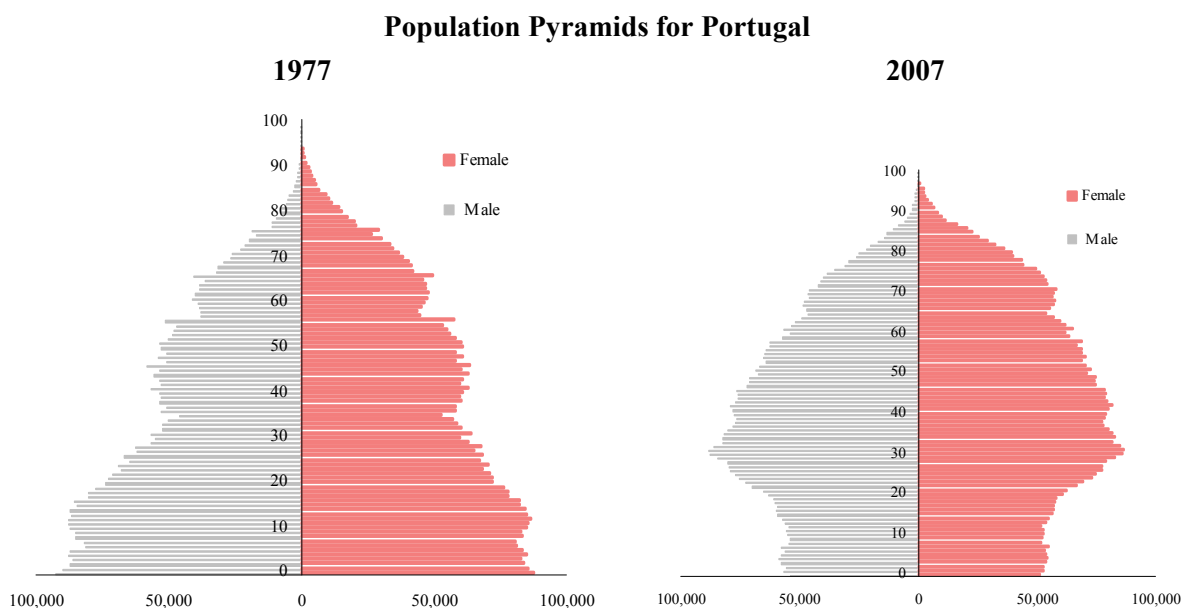
**The Evolution of the Portuguese Public Pension System**

1929	Creation of the public employees old-age pension scheme (Decree No. 16669 of 27 March)
1972	Creation of <i>Estatuto da Aposentação</i> (Decree-Law No. 498/72 of 9 December): integrated legal framework of public employees retirement regime
1984	First Social Security Framework Law (Law No. 28/84 of 14 August) System PAYG: contributive regime financed by employees and employers contributions and non-contributive regime financed by State transfers
1993	Revision of <i>Estatuto da Aposentação</i> (Decree-Law No. 277/93 of 10 August and others): from September on, the pension scheme of new public employees became subject to the rules of the private sector system (Social Security General Regime)
1993	Reform of the Social Security general regime (Decree-Law No. 329/93 of 25 September)
2002	New Framework Law for Social Security (Law No. 32/2002 of 20 December)
2005	Revision of <i>Estatuto da Aposentação</i> (Law No. 60-B/2005 of 29 December) – further convergence of CGA and Social Security pension regimes
2007	Reform of the Social Security pension regime (revision of the Framework Law – Law 4/2007 of January 16 and Decree Law 87/2007 of May 10)
2007	Transposition of Social Security reform measures to CGA from 2008 on, with a transitory period until 2015 (Law No. 52/2007 of 31 August)

Note: A more detailed description is presented in Annex A.  
Source: CGA and Ministry of Labour and Social Solidarity (MTSS).

the Portuguese public pension system and, in October 2006, the government and social partners agreed on a new social security reform. This agreement turned into a new Social Security Framework Law at the beginning of 2007 and the transposition of the reform measures to the CGA system in the second half of 2007 and early 2008 (Table 1). This means that the public employees' pension system is now under a transitory period (until 2015) of convergence to the (reformed) Social Security system. The main recent measures are: i) the anticipation of the new pension formula established in 2002; ii) the introduction of a sustainability factor that links the pension value to the evolution of life expectancy at 65 years old; iii) the definition of a rule for pension updates; and iv) the promotion of delaying retirement by increasing the financial penalty for early retirement and granting bonuses in case of postponing retirement. The detailed description and the estimated effects of these measures are presented in Section 4.

Figure 5



Source: EUROSTAT and National Statistics Institute (INE).

## 2 Implications of demography on pension expenditure

Portugal, like other European countries, has been deeply affected by ageing population. In particular, in the last 30 years, a deteriorating birth rate and gains in life expectancy led to a significant shrink in age cohorts below 30 y.o. and an increase in those between 30 and 60 y.o. and also in the oldest ones (Figure 5).

Migration flows have also had a role in the demographic structure: Portugal experienced significant net migration flows out of the country in the '50s and '60s followed by net migration inflows after the former colonies independence in the '70s. In the last decade, net inflows intensified, with emigrants belonging to older age cohorts returning to Portugal and with the entrance of immigrants mainly from Eastern European countries, Brazil and former Portuguese colonies in Africa.

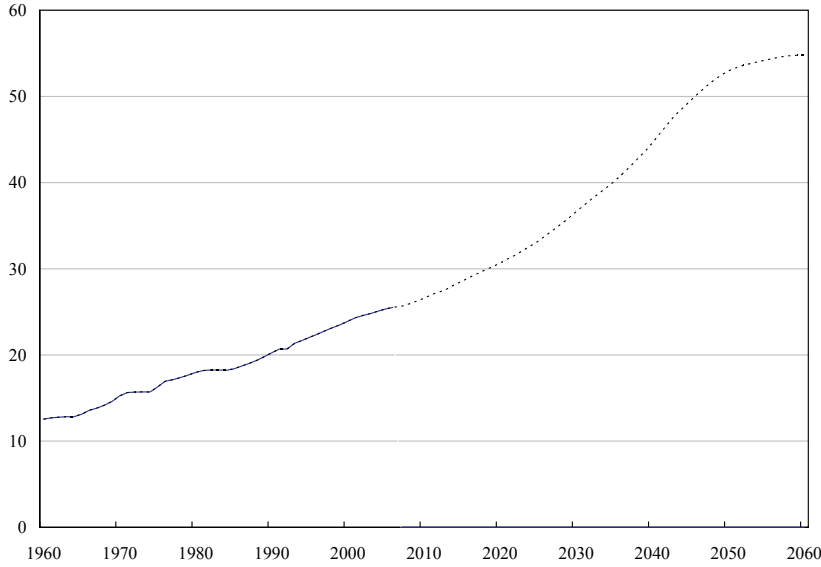
The change in the demographic pyramids yields an increasing old-age dependency ratio, which has duplicated between 1960 and 2007, while life expectancy at 65 grew around 4 years in the same period (Figure 6).

These developments coupled with productivity and economic growth are major factors that influence the dynamics of the Social Security systems financed on a PAYG basis. At the present time, the increase in the old-age dependency ratio poses a big challenge to the financial sustainability of these systems as it puts into risk the intergenerational income distribution from active to inactive population (Figure 6). The projected ageing population according to EUROSTAT's exercise EUROPOP2008 is visible in the following charts, with the patterns for men and women.

As explained in the previous section, social security schemes have revealed a significant increase in their pension liabilities as a share of GDP, in particular in the last decade. As shown in the chart below, the relationship between pension expenditure as a percent of GDP and the old-age

**Figure 6**

**Old-age Dependency Ratio\***  
(percent)

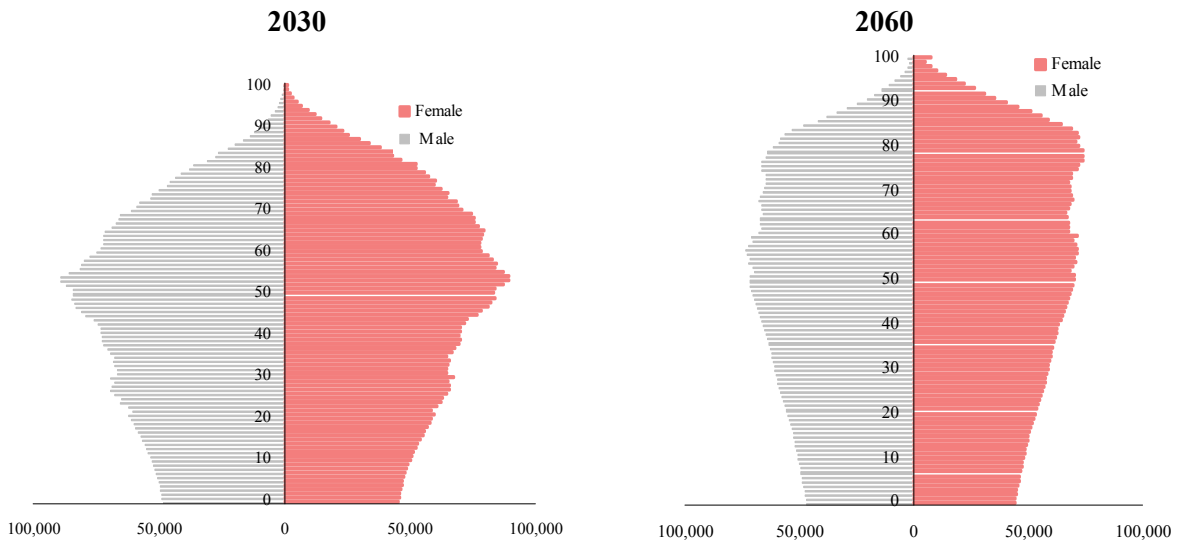


\* Ratio of individuals aged 65 and older over individuals aged between 15 and 64.  
Source: EUROSTAT and INE.

dependency ratio can be well approximated for by a linear relation.<sup>1</sup> Pension expenditure until now basically reflect the old-age pension formation rules in force until the beginning of the 1990s and the annual updates that have taken place. Without policy changes in the social security schemes and taking into account the observed variables till 2007, this linear regression indicates that pension expenditure would increase from 11 per cent of GDP in 2007 to about 30 per cent in 2060, when the forecast for dependency ratio reaches close to 55 per cent.

**Figure 7**

**Population Pyramids for Portugal – Projections**



Source: EUROSTAT (EUROPOP2008).

<sup>1</sup> In the linear regression model, both variables are integrated of order one according to the results of Dickey-Fuller tests; the residual of regression are stationary. The sample ranges from 1977 to 2007.

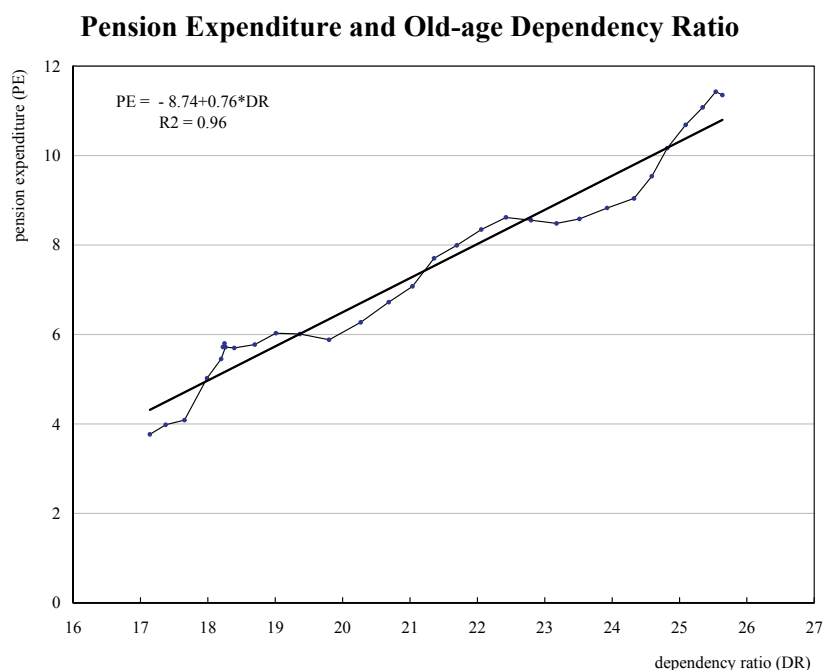
These results are compatible with other studies for Portugal, using specific pension modelling. Rodrigues and Pereira (2007) developed a general equilibrium model, and projected an increase in public pension expenditure close to 26 per cent of GDP by 2050 before taking into account the reforms since 1993, and EPC (2006) and Pinheiro and Cunha (2007) projected an increase of about 20 per cent of GDP by 2050 considering the reform measures adopted until 2005 using accounting models (Figure 9).

These projections revealed the measures implemented until 2005 insufficient to ensure the financial sustainability of the social security systems and, therefore, justify the need for the additional pension reform measures taken between 2006 and 2008.

### 3 The need of the public pension system reform

The serious financial imbalance of the Portuguese public pension systems by the mid-2000s decade was in fact revealed by several studies and the European Commission classified Portugal as a high risk country in

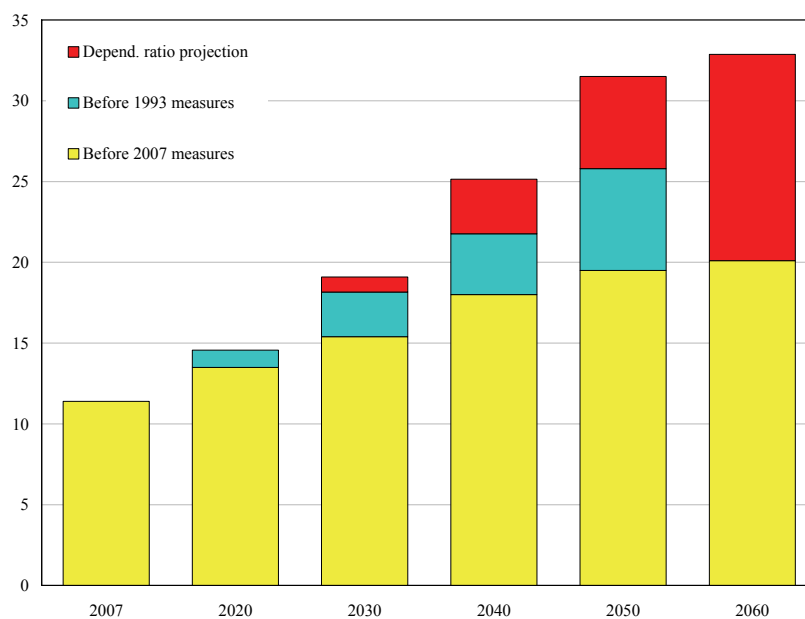
Figure 8



Source: authors' calculations.

Figure 9

### Projections for Pension Expenditure, 2007-60 (percent of GDP)



Source: Rodrigues and Pereira (2007), Pinheiro and Cunha (2007) and authors' calculations.



**Table 2**  
**The Four European Models**

Equity	Efficiency	
	Low	High
High	Continental	Nordics
Low	Mediterranean	Anglo-Saxons

Source: Sapir (2005).

terms of the sustainability of public finances (DGEFIN 2006).

Pension system reform has been widespread throughout Europe and other OECD countries mainly in the last decade. As referred to in Sapir (2005), "Europe's labour and social institutions need urgent reform if we are

to grasp the opportunities offered by globalization and avoid the threats. (...) Critically, the 'Continental' and 'Mediterranean' models, which account together for two-thirds of the GDP of the entire EU-25 and 90 per cent of the 12-member euro area, are inefficient and unsustainable. These models must therefore be reformed, probably by adopting features of the two more efficient models [Nordic and Anglo-Saxon]. These reforms may also involve changes towards more or less equity." The author argued that the European institutions were established in the 1950s and 1960s when the economic environment was relatively stable and predictable, but that the institutions are no longer adequate in a world of rapid changes. He classifies the four European Models according to their efficiency (incentives provided to work or employment rates) and equity (probability of escaping poverty) (see Table 2) and finds Portugal in the Mediterranean group in terms of equity and in the Anglo-Saxons group in terms of efficiency but below the average of these.

Models that are not efficient are not sustainable in face of the public finance pressure coming from globalization, technical change and population ageing. The combination of the latter with low employment rates jeopardises the future benefits of the institution. The Mediterranean countries<sup>2</sup> concentrate their social spending on old-age pensions and generally have high employment protection but rather low unemployment benefits. They are also less successful in keeping the employment rate for older workers high and the unemployment rate for younger workers low. The degree of equity is generally proportional to the level of taxation, but models that are not equitable may be financially sustainable. Therefore, increasing the incentives to work without raising the poverty risk would be desirable.

Previously, for instance, Disney (2000) discussed the reform options in OECD countries for public pension programmes in difficulties. He analysed the strengths and weaknesses of the reform strategies being discussed and implemented in various countries and considered two main strategies: i) retaining a strong unfunded component and ii) involving a strong funded private component. In the first group, two options are possible: a "parametric" reform or an "actuarially fair" programme and in the second group either by "clean break" privatization (*i.e.*, no further contributions are made into the existing unfunded programme) or by a partial privatization (only certain individuals are allowed to join the funded scheme or allowing individuals the choice of joining a funded or unfunded scheme). The strategy of keeping a strong unfunded component was presented as a defensible one, in particular the "parametric" reforms by "raising legal retirement age, or more specifically linking it explicitly to expected longevity is generally a key policy to the problem of financing public pension programmes." Funded schemes can also be attractive: a funded scheme is transparent "in the sense that benefits are explicitly related to contributions and capital market performance rather than to some formula of the public programme." The transition

<sup>2</sup> Greece, Italy, Portugal and Spain.

issue has to be handled and there is the conflict over who bears the burden of the transition: current taxpayers or pensioners or future generations of taxpayers and pensioners. Another drawback relates to the fact that it “rules out any explicitly redistributive component to the public pension programme and it subject participants to potential investment risk and annuity rates will continue to fall as longevity increases”.

Recent developments in financial markets turned this discussion more pertinent. PAYG schemes are relatively robust to the financial crisis. In the case of persistent economic downturn and higher public debt it may increase the need for adjustments in the pension schemes in order to ensure their long term sustainability. Private pension funds saw their asset value dropping by 20 per cent on average in the OECD countries between January and October 2008 (OECD 2009). Even if long-term investment performance is rather healthy it highlights the need of looking again to the best way of dealing with funded schemes. Defined benefit (DB) schemes are the main private schemes that are now paying (defined) pensions but the reduction of their assets may imply adjustments to indexation or contributions or even to close them to new members. At the same time, defined contribution (DC) plans are expected to intensify their growing trend. However, in these schemes the beneficiary takes the investment risk and they may not ensure an adequate income at retirement.

Against this background, the reforms of the existing unfunded pension systems reveal to be of utmost importance across European/OECD countries. This is equally true for the Portuguese public pension system.

## 4 Recent reform measures

### 4.1 Description of the reform

As previously described, in October 2006 the government and social partners reached an agreement on the reform of the social security pension system and the main measures of this reform were also applied to the CGA scheme since 2008.<sup>3</sup> The most representative measures are:

#### i) Sustainability factor

To tackle the considerable impact that the increase in life expectancy has on the social security systems, the sustainability factor was introduced. The sustainability factor is the ratio between life expectancy in 2006 and life expectancy in the year prior to retirement. It is applied to all new required pensions since the beginning of 2008:

$$Pension_t \times \left( \frac{LE_{2006}}{LE_{t-1}} \right)$$

where:

LE is the Average Life Expectancy at the age of 65, published in an annual basis by the INE, and  $t$  is the year the pension is required.

It should be stressed that contributors can opt for a combination between two extreme alternatives:<sup>4</sup>

- they can delay their retirement until they completely offset the effect of the sustainability factor; or
- they can retire at the statutory age and accept the financial penalty levied on the pension.

<sup>3</sup> Laws No. 52/2007 and No. 11/2008.

<sup>4</sup> A third possibility is also available. This involves additional voluntary contributions to public or private capitalization schemes. In its essence, this alternative is already available through pension savings funds (known as PPRs).

Table 3

## The Sustainability Factor Evolution

	2007	2010	2020	2030	2040	2050	2060
Sustainability factor	1.00	0.97	0.93	0.88	0.84	0.81	0.77

Source: INE and Eurostat (EUROPOP 2008).

In the model developed for CGA, it was assumed that in order to partly offset the financial penalty derived from this factor, CGA contributors tend to postpone the retirement age in line with the evolution of the sustainability factor until the legal age limit for retirement (70 years old).

Taking into account the evolution for the weighted average of (male and female) life expectancy at 65 in the EUROPOP2008 scenario, pointing to an increase of around 5 years by 2060 the projected trend for the sustainability factor is outlined in Table 3.<sup>5</sup>

ii) *The new rule for updating pensions*

This new rule determines that, from 2008 on, the annual increase of pensions is linked to an effective change rate of the Consumer Price Index (CPI) and also to the effective growth of Gross Domestic Product (GDP), which affects the social security revenue pattern. This means a change from recent years, where there have been pension increases significantly higher than inflation, above all as a result of the rise in the minimum pension level.<sup>6</sup> The new rule brings pension updates within a regulatory framework, removing the discretionary element. The annual increase of all types of pensions<sup>7</sup> should be set according to Table 4.

At this point, it should be mentioned that in order to assure that the National Minimum Wage itself constitutes an instrument of Labour Market policy, it was replaced as a reference for the indexation of pensions by a new social support index *Indexante de Apoios Sociais* (IAS). For 2007, it was defined as the 2006 mandatory minimum wage updated by the consumer inflation of that year (Law 53-B/2006). This Law provides that the rule for IAS updating in the future is to be identical with the rule for updating lower pensions (lower bracket), which is independent from the annual update set for the National Minimum Wage.

To determine the reference GDP growth rate it was established that, in the first year of implementation of this new rule (2008), the GDP considered should be the real growth rate of GDP in the previous year and, thereafter, the consideration of average GDP growth rate of the two previous years.<sup>8</sup> The relevant CPI corresponds to the effective average growth rate of CPI (without considering housing prices) regarding the last 12 months available on November 30 of the year before the pensions update.

<sup>5</sup> See Annex B.

<sup>6</sup> The main reason for this was the convergence of minimum old age and disability pensions to the mandatory minimum wage until 2006 as set down in the Social Security Framework Law of 2002 (Law 32/2002).

<sup>7</sup> Including minimum pensions that range from 44.5 per cent to 89 per cent of IAS and are updated according to the first bracket of the pensions value.

<sup>8</sup> This average was firstly used for the 2009 update, taking into account the GDP growth in 2008 and 2007. The annual GDP growth rates to be considered are the ones ended on the third quarter of the year prior to the pension update or the quarter before if there are no official figures regarding the third quarter until December 10.

Table 4

## Rule for Updating Pensions

	GDP Real Variation Rate Less than 2%	GDP Real Variation Rate From 2% to 3%	GDP Real Variation Rate Equal or Greater than 3%
<b>Pensions under 1.5 IAS</b>	CPI change rate	CPI change rate + 20% GDP real variation rate (minimum: CPI change rate + 0.5 percentage points)	CPI change rate + 20% GDP real variation rate
<b>Pensions 1.5 to 6 IAS</b>	CPI change rate – 0.5 percentage points	CPI change rate	CPI change rate + 12.5% GDP real variation rate
<b>Pensions 6 to 12 IAS</b>	CPI change rate – 0.75 percentage points	CPI change rate – 0.25 percentage points	CPI change rate
<b>Pensions above 12 IAS</b>	no update	no update	no update

Note: IAS stands for the social support index *Indexante de Apoios Sociais*.

Source: MTSS.

In the modelling of CGA pensions it was assumed that this rule corresponds to indexation to the consumer price index growth plus 0.1 percentage points (minus 0.4 percentage points), depending on the economic growth above (below) 2 per cent. These drifts were obtained by using the 2007 distribution for CGA pension amounts and computing a weighted average of the drifts for each bracket of pension value, according to the above mentioned rule. In 2007, 32 per cent of the pensioners belonged to the first interval, 60 per cent to the second and 8 per cent to the highest one. This distribution was held constant throughout the projection horizon. However, the evolution of this distribution is somehow undetermined: on the one hand, as the IAS benchmark is updated according to the lower bracket, higher pensions tend to steadily move to lower brackets; on the other hand, the maturing of the system and incentives to postpone retirement lead new pensions to be higher than those that leave the system. If this second effect prevails, the hypothesis considered tends to be conservative as future updating will be less generous than assumed.

According to the CGA legislation, this rule applies from 2008 on only for pensions less than 1.5 IAS, from 2009 on for pensions between 1.5 and 6 IAS and from 2011 on for pensions above 6 IAS. However, in the projection exercise, it was assumed that the rule applied to the whole range from 2008 on for all pensioners.

The approved legislation foresees that this rule for updating pension will be reassessed every five years, in order to check its adequacy in terms of social security system financial sustainability and of the pensions' real value. However, in the current exercise, under a "no policy change" general rule, it was considered to prevail.

iii) *An early transition to a pension benefit formula that considers contributions over the whole career*

The Decree Law 35/2002 set out a formula for calculating the amount of new pensions in the social security general regime<sup>9</sup> which differs from the one set out in the Decree Law 329/1993 in

<sup>9</sup> That is the one that applies to CGA (new) subscribers since September 2003.

Table 5

## Pension Accrual Rate

Contributive Career	Reference Earnings	Accrual Rate
less than 21 years	-	2.00%
21 or more years	until 1.1 IAS	2.30%
	from 1.1 to 2 IAS	2.25%
	from 2 to 4 IAS	2.20%
	from 4 to 8 IAS	2.10%
	upper 8 IAS	2.00%

Source: MTSS.

two fundamental points: it takes the earnings over the whole contributive career (instead of the best ten out of the last fifteen years) and sets out different accrual rates, depending on the workers compensation (the higher the compensation, the lower the marginal rate, varying between 2.3 and 2 per cent) and on career length, as presented in Table 5.

The 2002 decree also established a transition period, during which the pension to be applied will be whichever is higher, either the new regime one or as calculated as a weighted average of the pension from the last regime and from the new regime, where the weights correspond to the number of years of service before and after 2001. The same decree set down 2017 as the start of the transitional period, but in 2006 the decision was taken to bring forward the transition to the new formula to 2007. As far as the transition to the new pension benefit formula affects the income of new pensioners there are transition clauses to the full application of the new rules:

- to all contributors registered on Social Security before 2001 and that will retire before 2016, the pension is calculated according to a temporary benefit formula that accounts proportionately for the length of service before and after 2007 through the application of a formula that takes into account both the old and new benefit:

$$Pension = \frac{P_1 \times C_1 + P_2 \times C_2}{C}$$

where: *Pension* is the monthly amount of statutory pension (before the application of the sustainability factor);  $P_1$  stands for the pension calculated with the benefit formula that accounts for the best ten out of the best fifteen years of wage history<sup>10</sup> (old formula);  $P_2$  stands for the pension calculated according to the new formula that considers the whole contributory career;  $C$  is the number of years of contributory career with registered wage;  $C_1$  stands for the number of years of contributory career with registered wages until the 31st of December 2006; and  $C_2$  stands for the number of years of contributory career with registered wages after the 1st of January 2007;

- for those registered on Social Security before 2001 but that will retire after 2016, pension will be calculated as a weighted average between the pensions that result from the new benefit

<sup>10</sup> It is set according to the number of calendar years with a contributory density equal to or higher than 120 days (up to the limit of 40).

formula and the old benefit formula, with reference to the length of service before and after the 31st of December 2001.

In the computation of pensions, the component that takes into account the best ten out of the last fifteen years of declared wages will always be based on the effective last years of contributory career and not on the last fifteen years before the introduction of the mechanism of transition to the new benefit formula;

- for all individuals first registered on Social Security after 2002, the pension will be calculated with the new rules, accounting the whole contributory career (up to the limit of 40 years).

In the case of CGA scheme, the anticipation of this transitional period is in force after 2008. However, the effects of this change are quite mitigated in this subsystem; for the contributors covered by the *Estatuto da Aposentação*, the only relevant change is higher accrual rates for the years of contribution from 2008 on instead of 2017 on. For the other public employees (enrolled since September 1993), the new rules also apply what concerns the consideration of the whole contributive career instead of the best ten out of the last fifteen years, but the probability of contributors retiring before 2016 is quite small and, therefore, the impact is negligible. Table 6 synthesizes the evolution of pension calculation rules for CGA contributors.

#### iv) *Additional penalty for early retirement*

Another of the measures – within the scope of the so-called “promotion of active ageing” – consists in introducing a disincentive to early retirement, with a bigger financial penalty for retirement prior to the legal retirement age, but computed on a monthly basis (0.5 per cent for each month of anticipation) instead of on a yearly basis (4.5 per cent per year). This measure entered into force in 2007 for Social Security but, in the case of CGA, it is to be applied to new pensions from 2015 on. The current projection exercise includes the additional financial penalty and does not consider any changes in the probability of those eligible actually retiring. This assumption is a cautious one in what concerns the effects of this reform measure.

Table 7 compares the evolution of entitlement conditions for full old-age pensions and early retirement pensions in the CGA scheme.

#### v) *Other measures*

##### *Promoting active ageing*

Aside from the reform measures included in the projections there are other measures aimed at promoting active ageing, namely: for long contributory careers, the no-penalty retirement age can be reduced one year for each of the three years of the contributory career above 30 years at the age of 55 (beneficiaries can retire, without penalty, at the age of 64 with 42 years of contributions, at the age of 63 with 44 years of contributions, at the age of 62 with 46 years of contributions and so on).

When claimed after 65 years of age (with more than 15 calendar years of earnings registration and, at most, 70 years of age), the pension is increased by applying a monthly rate to the number of months of effective work completed between the month the pensioner reaches 65 years of age and the month of the pension beginning, as presented in Table 8. This means, for instance, that an individual with 65 years old that decides to postpone retirement for one year will get a 3.96 per cent bonus if he has a career of 20 contributive years or 12 per cent in the case of having 40 contributive years.

##### *Introduction of a ceiling to higher pensions*

In a context of sustainability strengthening of social security and in order to complement the professional solidarity embedded in the pension benefit formula, but also safeguarding the

Table 6

## Calculation Rules for Full Old-age Pension in the CGA Scheme

CGA Regime	From 1993 on	DL 35/2002	From 2006 on	From 2007 on	From 2008 on
<i>Estatuto da Aposentação</i> (hired until August 1993)	P = 90% last wage (LW) (since 1972)		P = P1 + P2 P1 = LW x C1 x R1 P2 = RE x C2 x R2 RE = all career reference earnings (of 2 <sup>nd</sup> part) C1 = % career until 2005 C2 = % career since 2006 R1 = accrual rate 2.5% (variable with C from 36 to 40) R2 = accrual rate (2% until 2015 and 2 to 2.3% hereafter)		FP = P x SF SF = sustainability factor P = P1 + P2  P1 = LW x C1 x R1 P2 = RE x C2 x R2  R2 = accrual rate (2 to 2.3%)
Hired from September 1993 on	P = BE x 40 x 2% BE = best earnings 10 out of last 15 years				
until 2001		Best of A) or B)* A) P <sub>2017 on</sub> = P1 + P2 P1 = BE x C1 x 2% P2 = RE x C2 x R2 C1 = % career until 2001 C2 = % career since 2002		P <sub>2007-16</sub> = P1 + P2 P1 = BE x C1 x 2% P2 = RE x C2 x R2 C1 = % career until 2006 C2 = % career since 2007	FP = P x SF
since 2002		B) P <sub>2017 on</sub> = RE x 40 x R2			FP = P x SF

Notes: \* In the case of public employees, the best case is B) as they have less than ten contributive years (BE = RE) and the accrual rate is higher in case B). The shaded cells refer to regimes no longer applicable.

Table 7

**Entitlement Conditions (Transitory Period)**  
**A) Full Old-age Pension**

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
LRA	60	60.5	61	61.5	62	62.5	63	63.5	64	64.5	65
Contr. years	36	36.5	37	37.5	38	38.5	39	39.5	40	40	40

Notes: LRA stands for legal retirement age.

Special regimes have longer convergence periods to LRA = 65 and 40 contributive years.

**B) Early Retirement Pension**

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Age	55	55	55	55	55	55	55	55	55	55	55
Contr. years	36	36	36	33	30	25	23	21	19	17	15

Note: For each year before LRA there is a 4.5 per cent penalty in the pension value. From 2015 on it increases to 0.5 per cent per month of anticipation. In case only LRA is attained, the pension value is reduced proportionally to the contributive years missing.

Source: CGA.

Table 8

**Incentives for Postponing Retirement**

<b>Contributive Career</b>	<b>Monthly Bonus Rate (percent)</b>
From 15 to 24	0.33
From 25 to 34	0.50
From 35 to 39	0.65
40 or more	1.00

Source: MTSS.

earning-related principle, it was considered adequate to establish a pension ceiling (at 12 IAS). It must be stressed that pensions that result from a benefit formula that accounts the average of lifetime wages do not have any ceiling. This way this measure has a temporary effect. In terms of the pension ceiling, it was decided:

- to introduce a pension ceiling for the new pensions, exclusively for the component that considers the best ten out of the last fifteen years of recorded earnings (P1);
- when the pension component calculated with the new formula (P2) is higher than the pension component calculated with the old formula (P1), no pension ceiling will be applied to P1;
- if P1 and P2 are higher than the pension ceiling and P1 is larger than P2, then only the new formula will be applied (where there is no pension ceiling);
- all existing pensions above the ceiling will not be annually updated. This rule does not apply when the two prior conditions are verified for the new pensions and for those computed under



Table 9

**Projected Public Pension Expenditure and Contributions**  
(percent of GDP)

	2007	2020	2030	2040	2050	2060	2060-07	Peak Year
Public pension spending after reform	11.4	12.4	12.6	12.5	13.3	13.4	2.1	2053
Public pension spending before reform	11.4	13.3	14.7	15.5	16.9	17.5	6.1	2060
Contributions after reform	10.7	10.4	9.6	9.2	9.0	9.0	-1.7	2010

Source: MTSS and authors' calculations.

previous legislation (considering that the value of P2 is calculated according to the new formula). This rule, as the new indexing rules, should be reassessed every five years.

However, this restriction only applies to a few cases (less than 1 per cent of all pensions).

#### 4.2 *Effects of the recent reform measures*

The reform measures that entered into force in 2007 for the Social Security regime and in 2008 for the CGA scheme are measures that, by their nature, will provide effects essentially in the long run. These effects were estimated through projection exercises carried out by authors for the CGA scheme and by the Ministry of Labour and Social Solidarity for the Social Security system. In the case of the Social Security system, the reform measures and modelling assumptions are similar to those of the CGA scheme, except in the following cases:

- i) regarding the introduction of the sustainability factor, it was assumed that Social Security contributors accept the financial penalty retiring at the statutory age, with no changes in the behaviour of the economic agents. This assumption makes the projections "conservative". In fact, an increase in the retirement age would lead to a higher participation rate for older workers (whose importance is increasing) raising the contributory revenue, which is only partially offset by a marginal increase of the new pensions value for those contributors who retire later.<sup>11</sup>
- ii) in the new updating rule for Social Security pensioners, it was assumed that it corresponds fundamentally to the consumer price indexation plus 0.35 percentage points (minus 0.15 percentage points), depending on the economic growth above (below) 2 per cent. These drifts were obtained from the 2005 distribution for Social Security pension amounts and computing a weighted average of the drifts for each bracket of pension value according to the above mentioned rule. In 2005, 72 per cent of the pensioners belong to the first bracket, 24 per cent to the second and 4 per cent to the highest one.

According to the projection results for both subsystems, those measures will allow for a reduction of less than 1 percentage point of GDP in 2020 but around 4 percentage points by 2060<sup>12</sup> (Table 9). Another important feature is that the peak year for pension expenditure is now within the

<sup>11</sup> For further details on this issue, see Pinheiro and Cunha (2007).

<sup>12</sup> These projections were made in the context of the Economic Policy Committee Working Group on Ageing Population and Sustainability and, therefore, used the common assumptions on demography and macroeconomic developments (EPC 2008). The main assumptions used in these projections are presented in Annex B and the CGA model is described in Annex C.

projection horizon (2053) while in the scenario before the recent reform, measures show that the pension expenditure trend was continuously increasing. Given the assumptions regarding demography and employment, which foresee a progressively higher employment rate for older workers as a result of the measures designed to promote active ageing, the contributions revenue trend tends to stabilize from 2040 onwards.

The effects of the reform measures in containing the public pension expenditure growing trend are quite visible when analysing its evolution since 1960 until the horizon of the projections (Figure 10).

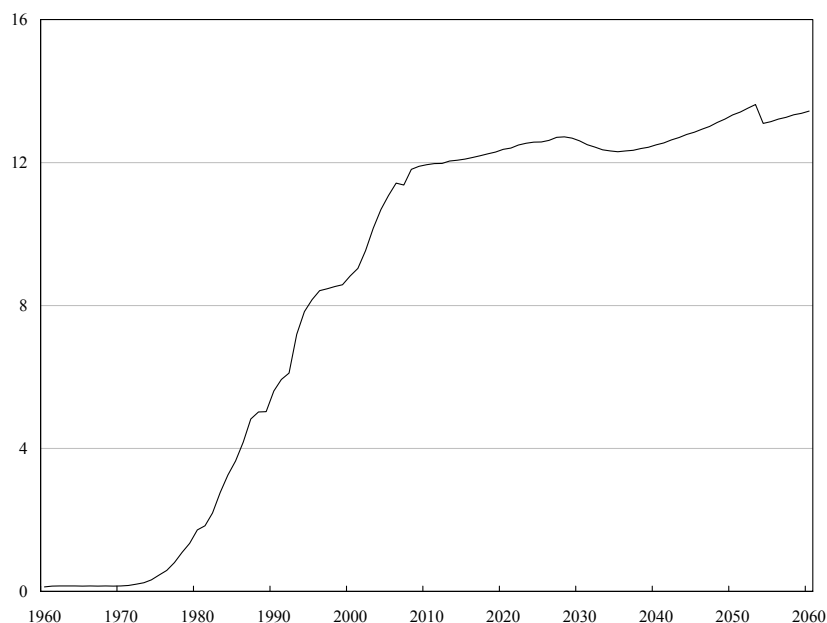
In the particular case of CGA, as it is a closed system since 2006, the effect of the more recent reforms is more limited in the long run, representing a 0.3 percentage points of GDP reduction in the public expenditure by 2060 (Table 10). However its impact increases by 2040, while the number of pensioners is still growing. The new rules also anticipate the peak year for CGA pension expenditure to be 2009 while the former maximum was reached in the 2020s, when the cohorts corresponding to peak admissions in the Public Administration retire.

In order to better assess the effects of the reform measures on the pension system of all public employees, we run the CGA model in the counterfactual situation of non-closure of CGA to new registrations, assuming that these would come under the rules pertaining to public employees registered in the Social Security system. As additional assumptions it was considered that: i) no enrolment of non-public employees would take place as has happened in the past, mainly with the employees of public-owned or formerly public-owned enterprises that were traditionally registered in the CGA; and, ii) the number of new public employees would respect the rule “2 out 1 in” until 2011, as defined in the December 2007 update of the Portuguese Stability Programme, and the share of public employees in total employment would remain stable thereafter. It should be recalled that in the context of the Public Administration reform enhanced in 2005, the reduction in the number of admissions in public service cut the public employment share from about 15 per cent in 2005 to 13.5 per cent in 2007 and it is estimated to remain at around 12 per cent after 2011.

In this scenario, the recent reform measures allow a declining in the pension expenditure related to public employees of 0.6 percentage points of GDP by 2060, representing a reduction of almost 2 percentage points of GDP from 2007 expenditure (Table 11).

**Figure 10**

**Pension Expenditure**  
(percent of GDP)



Source: CGA, MTSS and authors' calculations.

Table 10

**Projected CGA Pension Expenditure and Contributions**  
**“CGA Closed System”**  
*(percent of GDP)*

	2007	2020	2030	2040	2050	2060	2060-07	Peak Year
CGA pension spending after reform	4.1	4.0	3.9	2.9	1.8	0.9	-3.2	2009
CGA pension spending before reform	4.1	4.3	4.3	3.4	2.2	1.2	-3.0	2025
Contributions after reform	2.1	1.1	0.5	0.1	0.0	0.0	-2.1	2007

Source: CGA and authors' calculations.

Table 11

**Projected Public Employees' Pension Expenditure and Contributions**  
**“CGA Open System”**  
*(percent of GDP)*

	2007	2020	2030	2040	2050	2060	2060-07	Peak Year
CGA pension spending after reform	4.1	4.0	3.9	3.1	2.4	2.2	-1.9	2009
CGA pension spending before reform	4.1	4.4	4.4	3.7	3.1	2.8	-1.3	2026
CGA pension spending before 1993 reform <sup>(1)</sup>	4.1	4.9	5.1	4.9	4.4	4.0	-0.1	2029
Contributions after reform	2.1	1.6	1.4	1.3	1.3	1.3	-0.8	2007

Note:

<sup>(1)</sup> But starting from actual 2007.

Source: CGA and authors' calculations.

As a way of evaluating the process of convergence of the CGA to the Social Security regime that started in 1993, the estimated effects of the reforms since then are worth a reduction of 1.8 percentage points of GDP by 2060. It should be noted that this effect is somehow underestimated as the exercise takes as a starting point the 2007 pension expenditure value which is already affected by the measures adopted in the meantime. In the no convergence scenario, the pension expenditure is related only to public employees, and it would rise by 1 percentage points by 2030 and afterwards it would decrease reflecting the evolution of public employment until the 1990s and its reduction in the 2000s.

How these reductions in public pension expenditure reflect on the pensioners' welfare is also a question that should be analysed. Two measures usually used are the replacement rate and the

Table 12

**Replacement Rate**  
(percent)

	2007	2020	2030	2040	2050	2060
<b>Replacement rate</b>						
CGA <sup>(1)</sup>	81	75	72	72	-	-
Social security scheme <sup>(2)</sup>	58	53	49	53	54	56
Old age <sup>(3)</sup>	61	55	51	55	55	58
<i>Coverage</i>						
CGA	14	14	14	13	11	8
Social Security	83	82	82	83	86	88

Notes:

<sup>(1)</sup> Ratio between the average pension of new pensioners (earnings-related old-age and disability pensioners) and the average wage of CGA contributors.

<sup>(2)</sup> Ratio between the average pension of new pensioners (earnings-related old-age and disability pensioners) and the average declared wage of general regime of wage earners.

<sup>(3)</sup> Considering only old-age pensions.

Source: CGA, MTSS and authors' calculations.

benefit ratio. The first one compares the value of new pensions with the last wages and the second one relates the average pension to the average wage of the economy. Table 12 shows the evolution of the “average” gross replacement rate, where is considered the average of new gross pensions, reflecting a wide range of situations in terms of age of retirement, contributive career length and applicable regimes, namely in the transitory period that goes until 2042 in the case of the Social Security system. Regarding CGA the last new pensions should occur around 2045, as this system was closed at the end of 2005.

It can be observed that, as expected, the replacement rates in the CGA regime are significantly higher than in the Social Security regime. The long-term evolution is similar in both systems with a reduction before 2030 reflecting both the less “generous” rules of pension formation and higher increases in wages in line with the productivity projections. However, from 2030 onwards, the average replacement rate is projected to recover to levels similar to the current ones due, essentially, to longer contributive careers of new pensioners. In the specific case of CGA, before the consideration of the recent reform measures, this “average” replacement rate would range from 81 to 76 per cent between 2007 and 2040, as a result of the changeover to the social security rules in the convergence period initiated in 1993 and strengthened in 2005.

The evolution of the replacement rate along with the pension updating formulas reflects on the benefit ratio<sup>13</sup> developments. In the case of CGA, the ratio<sup>14</sup> reaches its peak in the late 2020s and decreases thereafter. This scheme is only relevant until the 2040s. As regards to Social Security, the benefit ratio reduces its value until 2040, recovering afterwards in line with the evolution of the replacement rate.

<sup>13</sup> Computed as the average old-age pension (including early retirement pensions) over the average wage.

<sup>14</sup> In the case of CGA, the average pension includes also disability pensions.

Table 13

**Benefit Ratio**  
(percent)

	2007	2020	2030	2040	2050	2060
<b>Benefit ratio</b>						
CGA	73	74	75	66	-	-
Social security scheme	46	47	43	39	40	42

Source: CGA, MTSS and authors' calculations.

The models used in these projections do not allow for the computation of individual replacement rates, as contributors and pensioners are modelled grouped by age and gender strata. However, taking the economy wages evolution and the rules applicable in each year of the projection horizon it is possible to calculate “theoretical” replacement rates for individuals entitled to a full old-age pension at different points of the earnings distribution (Table 14 A).

As expected, these replacement rates computed for complete contributive careers are higher than the average ones and their evolution mainly reflects the effect of two measures: the introduction of the sustainability factor and the new pension formula that differentiates the accrual rate according to the reference earnings. This leads to a slightly smaller reduction in the replacement rates for lower earners than for higher earners. In these estimates, it is assumed that individuals retire as they fulfil the entitlement conditions and do not postpone retirement. If that is the case, *i.e.*, labour market conditions and individual choices match favourably in postponing retirement, the financial penalty induced by the sustainability factor would be (at least partially) offset according to the rules presented in Table 8.

Excluding the sustainability factor effect, the replacement rates would present a more stable pattern, in particular in the Social Security case (Table 14 B). For CGA, the reduction is more marked as a result of the convergence effect of the pension formation rules to the ones of the Social Security.

### 4.3 Further analysis on the two main measures

#### 4.3.1 Sustainability factor

Recent reform measures have an estimated effect of reducing public pension expenditure by about 4 percentage points of GDP by 2060. More than 50 per cent of this result is explained by the introduction of the sustainability factor that accounts for 2.4 percentage points of GDP (Table 15).

These calculations are somewhat prudent by assuming that CGA contributors postpone retirement proportionally to the evolution of the sustainability factor, not accepting the whole financial penalty associated with retirement at age 65 as in the case of the Social Security beneficiaries. However, CGA new retirees will not be relevant from 2045 on as it is a closed system since 2006. As discussed in Pinheiro and Cunha (2007), if contributors postpone their retirement beyond the legal retirement age, the “saving effect” due to the higher employment rate and the reduction of the period during which individuals receive pensions is higher than the marginal growth of the pension amount due to the increased career.

Table 14

## A) "Theoretical" Gross Replacement Rates

(percent)

## CGA

	2007	2020	2030	2040	2050	2060
<b>Individual Reference Earnings</b>						
50% average earnings	89	78	75	68	-	-
75% average earnings	89	78	75	68	-	-
100% average earnings	89	78	75	67	-	-
200% average earnings	89	77	74	66	-	-
250% average earnings	89	77	73	65	-	-

## Social Security

	2007	2020	2030	2040	2050	2060
<b>Individual Reference Earnings</b>						
50% average earnings	92	75	63	59	58	58
75% average earnings	77	66	63	59	58	58
100% average earnings	77	66	62	59	58	57
200% average earnings	77	65	62	58	57	56
250% average earnings	77	65	62	57	57	56

## B) "Theoretical" Gross Replacement Rates without the Sustainability Factor

(percent)

## CGA

	2007	2020	2030	2040	2050	2060
<b>Individual Reference Earnings</b>						
50% average earnings	89	84	85	81	-	-
75% average earnings	89	84	85	81	-	-
100% average earnings	89	84	85	80	-	-
200% average earnings	89	83	83	78	-	-
250% average earnings	89	83	83	77	-	-

## Social Security

	2007	2020	2030	2040	2050	2060
<b>Individual Reference Earnings</b>						
50% average earnings	92	75	71	70	72	75
75% average earnings	77	71	71	70	72	74
100% average earnings	77	71	71	70	72	74
200% average earnings	77	70	70	69	71	73
250% average earnings	77	70	70	68	70	73

Source: CGA, EPC and authors' calculations.

Table 15

**Impact of the Sustainability Factor in Pension Expenditure Projections**  
(percent of GDP)

	2007	2020	2030	2040	2050	2060	Peak year
<b>Projections after reform (1)</b>							
Public pensions	11.4	12.4	12.6	12.5	13.3	13.4	2053
<b>Projections excluding the sustainability factor (2)</b>							
Public pensions	11.4	12.7	13.4	13.8	15.2	15.9	2060
<b>Difference (1)–(2)</b>							
Public pensions	0.0	–0.4	–0.8	–1.3	–1.9	–2.4	

Source: CGA, MTSS and authors' calculations.

Moreover, with this factor, the uncertainty underlying the demography projections, in particular in the expected life expectancy gains, is strongly minimized in the projections of public expenditure on pensions.

#### 4.3.2 Pension updating rule and dynamic progressivity

According to the pensions update rule, presented in Table 4, the annual update rate decreases with the pension value. For example, assuming a 2 per cent inflation rate and a 2 per cent real GDP growth, pensions below 1.5 IAS are updated 2.5 per cent while pensions above 12 IAS remain unchanged. In dynamic terms, this difference reduces the gap between extreme values of pensions and therefore decreases the inequality in income distribution of pensioners.<sup>15</sup> However, two factors partially offset this effect: on one hand, even the highest pensions will eventually start to be updated in the future and, on the other hand, for the higher pensions, tax system progressivity combined with updating rates lower for pensions than for tax parameters reduces the average tax rate. This turns the net amount of the pension updating higher than before tax in the case of higher pensions.

The first effect is illustrated in the Figure 11. Taking a pension that in the initial period is equivalent to 15 IAS (and therefore not updated in the first period), due to IAS annual updating, it ends up below the 12 IAS threshold after some periods. In that case, for instance, after 15 years it is equal to approximately to 11.3 IAS.

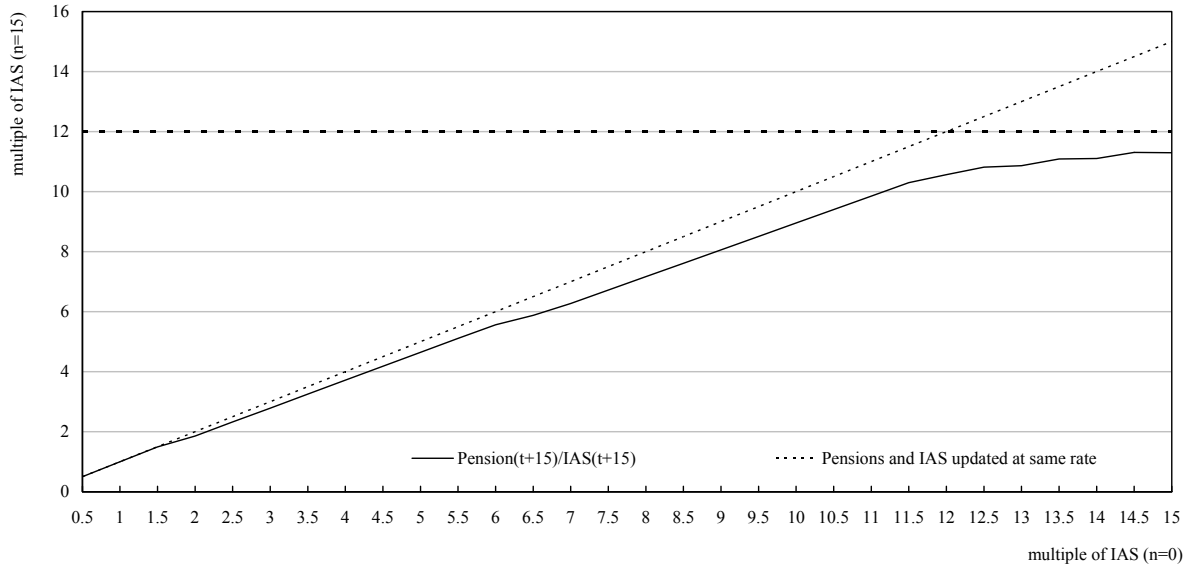
The second effect may be demonstrated through the example of a pension before tax  $p_t^B$  in period  $t$ .

After  $n$  periods (years), the pension after tax is given by:

<sup>15</sup> Whitehouse (2009) discusses the effects of “progressive indexation” in four countries, including Portugal, and finds small redistributive effects on the pensioners' wealth in particular in the cases of Italy and Portugal.

Figure 11

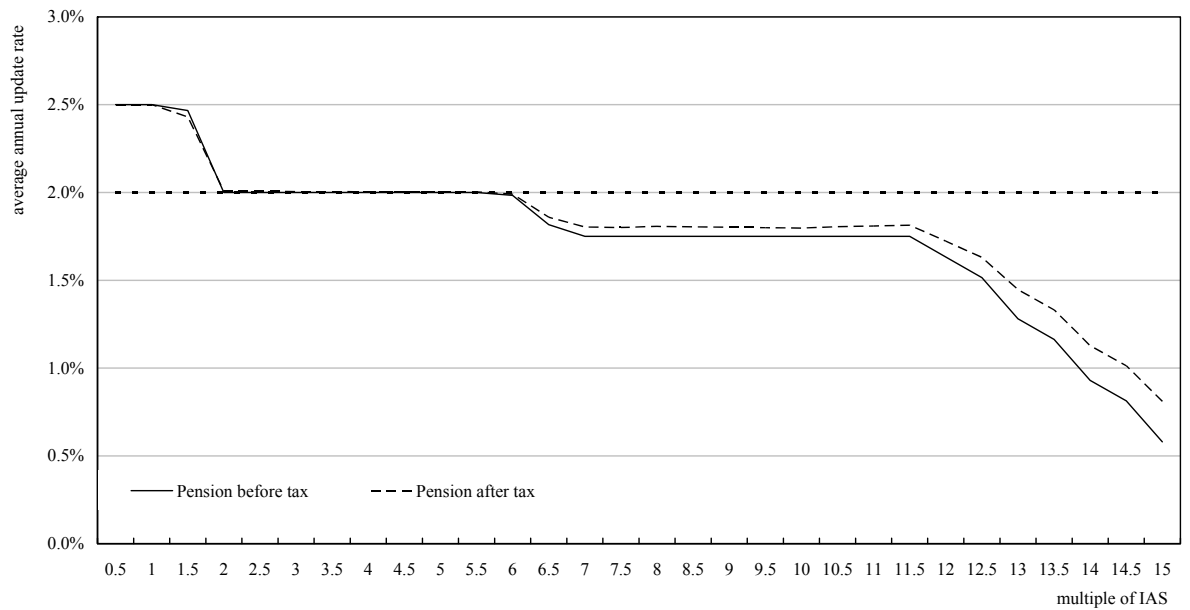
**Pensions Evolution as a Proportion of IAS  
(15-year horizon)**



Note: assumptions – inflation rate of 2%, GDP growth rate of 2% and fiscal parameters annual update of 2%.  
Source: authors' calculations.

Figure 12

**Average Update Rate for Pensions  
(15-year horizon)**



Note: assumptions – inflation rate of 2%, GDP growth rate of 2% and fiscal parameters annual of 2%.  
Source: authors' calculations.



$$p_{t+n}^{Net} = p_t^B (1 + \theta_n)^n - tax_{t+n} \quad (1)$$

where:  $\theta_n$  is the average annual indexation rate after  $n$  periods and  $tax_{t+n}$  is the tax amount.

Annual updating rate, as defined in Table 4, depends on: i) the pension value ( $p$ ), ii) the real GDP growth rate ( $\varphi$ ) and iii) the inflation rate ( $\pi$ ). Therefore:

$$\theta_n = f(p, \varphi, \pi) . \quad (2)$$

Tax amount ( $tax_t$ ) depends, each year, on the pension amount and on the tax parameters.

As the tax regime for personal income is progressive, average tax rate grows with the pension value. However, in dynamic terms, as tax parameters are usually indexed to expected inflation rate, for pensions with annual updating rates lower than expected inflation, the average actual tax rate decreases over time. Therefore, the actual rate for pensions update after tax is higher than before tax (Figure 12).

To evaluate the effect of the indexation rule and taxation in pensioners' distribution of income, the initial pension distribution is compared with the one several periods later. The comparison is made through the evolution of percentile ratios and by using the Gini index. These were computed by using the Personal Income Tax database for 2007 (latest information available), which includes all pensioners that are legally obliged to declare taxable income and allows for simulation modelling.<sup>16</sup>

This database presents, however, some caveats for the purpose we are using it and so they should be mentioned: i) sample representativeness – as the lowest pensions are tax exempt, the sample is biased to higher pensions; ii) pensions aggregation – pensions are reported in an aggregate way, *i.e.*, it is not possible to disentangle the value of each pension for individuals that receive more than one pension, which is not neutral in terms of the indexation rule effects; iii) income aggregation for tax purposes leads to an average tax rate and not necessarily to a specific tax rate on pensions income. We assumed that pensioners do not receive income from other sources, which is somewhat a strong hypothesis.

The parameters updating between 2007 and 2009 took into account the available information on GDP growth, inflation rate, IAS and tax parameters updates. From 2009 onwards, we considered the EPC (2008) assumptions for GDP growth and inflation rate (constant at 2 per cent), assuming tax parameters to be indexed in line with inflation.

The results obtained are presented in Table 16. It provides evidence for the pension update rule's progressivity with both the percentile ratio and the Gini Index decreasing in the time period considered. Before tax, percentile ratios decline 4.3 per cent over a ten year's horizon and 8.9 per cent over twenty years. Also Gini coefficient decreases 2.4 and 5 per cent, respectively. Tax effect reinforces these results except in the case of the percentile ratio over twenty years due to the tax impact (discussed above) on highest pensions.

Another important aspect is related to the fact that average pension update before tax is lower than 2 per cent, the value considered for inflation rate. However, the rates denote a small increase when considering after tax pension values, which reflects a lower growth of tax revenue than the one of the average pension.

<sup>16</sup> It covers around 1.5 millions of pensioners, which account to 83 per cent of total public expenditure on pensions.

## 5 Sensitivity analysis

The results presented above rely strongly on the demography and macroeconomic assumptions considered. In order to assess the robustness of the projections several sensitivity tests were carried out. Each sensitivity scenario was computed in relation to the baseline scenario with the respective parameter change, *ceteris paribus*.

An increase in the employment rate of 1 percentage point does not change the results significantly, while a higher labour productivity scenario of 0.25 percentage points induces a decrease in total pension expenditure by 0.7 percentage points in 2060, as pension updating is no longer linked to wage increases (and productivity gains).

In relation to demography, we tested both the impact of an increase in life expectancy of one year by 2060 and the extreme assumption of zero migration. A one year increase in life expectancy leads to a rise in the pension expenditure ratio of 0.4 percentage points by 2060. This moderate increase reflects the counter

Table 16

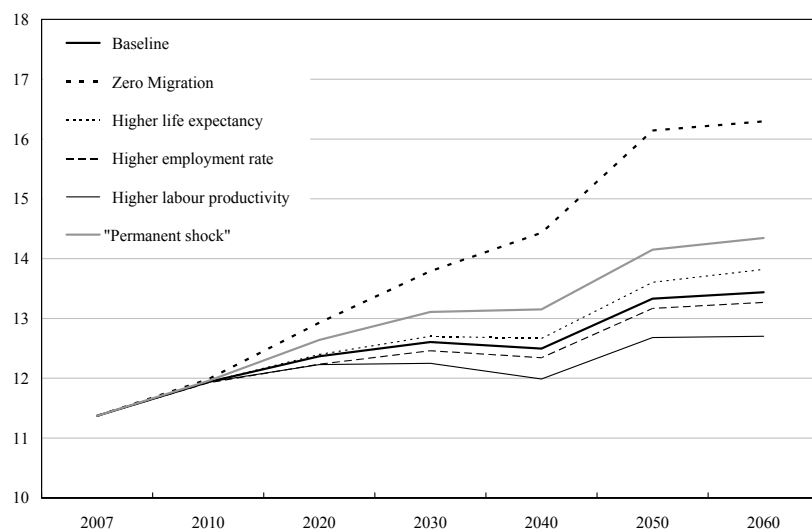
**Pension Distribution Effects**  
(unit: average growth rates, percent)

	Number of Years	
	10	20
IAS update	2.31	2.36
Pensions update		
Before tax	1.90	1.97
After tax	1.93	2.00
Distribution of pensions*		
Before tax		
Percentile ratio (P75/P25)	-4.3	-8.9
Gini coefficient	-2.4	-5.0
After tax		
Percentile ratio (P75/P25)	-4.3	-8.7
Gini coefficient	-2.6	-5.2

Note: \* End-of-period growth rates.  
Source: authors' calculations.

Figure 13

**Pension Expenditure under Different Scenarios**  
(percent of GDP)



Source: CGA, MTSS and authors' calculations.

Table 17

**Effects of a Permanent Economic Downturn**

	2007	2020	2030	2040	2050	2060
Public pension spending						
Baseline scenario	11.4	12.4	12.6	12.5	13.3	13.4
“Permanent shock” effect	0.0	0.3	0.5	0.7	0.8	0.9
Public employees' pension spending						
Baseline scenario	4.1	4.0	3.9	3.1	2.4	2.2
“Permanent shock” effect	0.0	0.0	0.1	0.1	0.2	0.2

Source: CGA, MTSS and authors' calculations.

effect of the sustainability factor, minimizing the pension expenditure exposure to the uncertainty of the evolution of life expectancy. The assumption of zero migration is by far the most extreme one, leading to an increase of the pension expenditure ratio by almost 3 percentage points in 2060 when compared with the baseline scenario. This assumption is associated to a reduction of employment and economic growth and, therefore, the GDP “denominator effect” exceeds the “numerator effect” of lower pension expenditure in the long term.

Given the more recent economic developments, which were not incorporated in the macroeconomic assumptions underlying the baseline scenario,<sup>17</sup> additional tests were made in order to evaluate the impact of the current economic downturn in the long term projections. At this juncture, it can be considered that the economic downturn is temporary and there will be a convergence to the baseline trend or, alternatively, that there will be a “permanent shock” in the terms of productivity growth and employment rate.

Even considering the “permanent” effects of the economic downturn, assuming a reduction of 0.25 percentage points in the productivity rate and an increase of 1 per cent in the unemployment rate, the projected expenditure for public pensions would rise by 0.9 percentage points of GDP in 2060 (Table 17). Considering only the public employees pension expenditure, the increase would be of 0.2 percentage points of GDP.

In case of a temporary shock, the effects on the pension spending projections would be minor, in particular in the long run. According to the modelling assumptions used, relatively lower productivity (and wages) in the short run would result in relatively lower pensions in the future but due to the “denominator effect”, the pension expenditure as a share of GDP should still be higher than in the baseline scenario.

On the basis of the sensitivity tests' results, changes in the demography scenario may have larger effects on the pensions' projections than different macroeconomic assumptions (not considering second-order effects on demography). Pension expenditure revealed particular sensitivity to migration flows assumptions.

<sup>17</sup> The long-term macroeconomic projections were based on the European Commission Spring 2008 prospects for 2008-10.

## 6 Public Finance Sustainability

Before the introduction of the most recent pension reform package (2006-08), the projected increase in the age-related public expenditure was extremely high, reaching 10.1 percentage points of GDP between 2004 and 2050. Out of this, 9.7 percentage points related to pension spending.<sup>18</sup> In its analysis of the long-term sustainability of public finances in the EU, the European Commission had classified Portugal as a high risk country in 2006. This assessment depends on the initial budgetary position of the Member State (*i.e.*, in the years considered by the annual updates of the national stability or convergence programmes), on the long-term projections on age-related expenditure, and on a wide range of other quantitative and qualitative indicators, as well.

One of these indicators is the sustainability gap S2, which measures the size of a permanent budgetary adjustment that allows fulfilling the inter-temporal budget constraint over an infinite horizon. This indicator may be decomposed into the impact of the initial budgetary position gap to debt stabilizing the primary balance (IBP) and the impact of the long-term change in the primary balance (LTC), which provides the additional adjustment required to finance the increase in public expenditure over an infinite horizon. It is usually computed for two scenarios: the baseline scenario, which takes the programme's first year structural primary balance into account, and the programme scenario that assumes that the medium-term programme objectives for the structural balances are achieved.

In the October 2006 Report, the sustainability gap S2 in the programme scenario was 5.2 percentage points of GDP, significantly above the EU average (1.6 percentage points), reflecting the high value of the LTC component (Table 18). Considering the effect of the recent reform measures, the value of this component halved, allowing a significant reduction in the sustainability gap S2 to 2.0 percentage points of GDP.

The latest sustainability evaluation was based on the January 2009 update of the Portuguese stability programme. It presents a deterioration of the structural balance to be achieved in 2011 vis-à-vis the previous years' programme, since it was updated due to the economic downturn and the fiscal stimulus package introduced in 2008/2009. However, it still considers the same long-term projections and the LTC component remains basically unchanged and S2 increases slightly to 2.3 per cent of GDP.

**Table 18**

**Sustainability indicator S2  
Programme Scenario**

	<b>IBP</b>	<b>LTC</b>	<b>S2</b>
	<b>(1)</b>	<b>(2)</b>	<b>(3) = (1) + (2)</b>
October 2006 (2005-2009)	-1.5	6.7	5.2
March 2008 (2007-2011)	-1.2	3.2	2.0
March 2009 (2008-2011)	-0.9	3.2	2.3

Source: European Commission.

<sup>18</sup> DGEFCIN (2006).

With the consideration of the 2008 demography and macroeconomic assumptions, the projected trend for pension expenditure as a share of GDP is even more contained (+2.1 percentage points of GDP between 2007 and 2060), which should allow a reduction in the sustainability gaps and to improve the sustainability of the Portuguese public finances, *ceteris paribus*.

## **7 Conclusion**

In 2006, the projected increase of 10.1 percentage points of GDP in the age-related public expenditure between 2004 and 2050 was unsustainable. The need to foster a deep reform of the Social Security system and, in particular, of the CGA system, where the underlying conditions to determine and update pensions were much more generous, became quite stringent. The reform that was implemented relied on a set of structural changes of which we analyze the two most important ones: the implementation of a sustainability factor that links the pension value to the evolution of life expectancy at 65 years old and a new rule for updating pensions.

These reform measures have an estimated effect of reducing public pension expenditure by about 4 percentage points of GDP by 2060. More than 50 per cent of this result is explained by the introduction of the sustainability factor that accounts for 2.4 percentage points of GDP. Equally important is the fact that this sustainability factor significantly reduced the systems vulnerability to changes in the demographic scenario as increases in life expectancy have a minor impact on future pension expenditure.

We also analyze the distributive impact of the new rule for updating pensions and conclude that a significant reduction of the gap between pensions can be forecasted, which may contribute to the system stability but have an undetermined effect on the decision of high wage contributors to postpone their retirement age: either they prefer an initial higher pension or more “generous” future updates.

The importance of this issue and the more demanding macroeconomic environment require further analysis of the impact of the reform measures implemented in 2006. An unexplored dimension of the reform is modelling the agents' reaction to the new system of financial incentives related to the decision of whether or not to postpone the retirement age. In reality, while the bonus for each year of contributions to the system may lead agents to postpone retirement, the sustainability factor may have the opposite effect. Understanding under which conditions each one of them prevails should be of interest to both academics and policy makers.

**ANNEX A**  
**THE EVOLUTION OF THE PORTUGUESE PUBLIC PENSION SYSTEM**

End XIX century	First institutions of social protection for the elderly (state industry employees followed by other public and private corporations employees)
1919	Introduction of mandatory social insurance (first attempt) for employees (some sectors) with low income
<b>1929</b>	<b>Creation of the public employees old-age pension scheme (Decree No. 16669 of 27 March)</b> <b>Maximum retirement age: 70 years old</b>
<b>1934</b>	<b>Introduction of survivors pensions for public employees (Decree-Law No. 24046 of 21 June)</b>
1935	Definition of the general framework of social insurance Old-age and disability pensions financed on a funded basis
1962	Social Security reform (Law no. 2115 of 15 June and others) with enlargement of social protection for industry, trade and services employees and financed on mixed basis (funded and PAYG)
1972	Definition of the pensions scheme for agricultural workers (Decree-Law No. 391/72 of 13 October)
<b>1972</b>	<b>Creation of <i>Estatuto da Aposentação</i> (Decree-Law No. 498/72 of 9 December), integrated legal framework of public employees retirement regime:</b> <b>i) wider coverage of the scheme, including contributors aged 55 or older</b> <b>ii) pension entitlement with 15 years of contributions to public employees scheme or private employees</b> <b>iii) contributory rate: 6 per cent employees</b> <b>iv) retirement conditions: aged 60 and contributory career 40 years (full pension)</b> <b>v) pension amount: last net wage (or average last 10 years if higher) or in the proportion of the contributive career if less than 40 years</b> <b>vi) more favourable conditions for military personnel</b> <b>vii) pensions update on a discretionary basis but in practice following public sector wages</b>
1973	Minimum entitlement contributory period: 5 years for disability pensions and 10 years for old age pensions
1974	Transition for a unified system of Social Security (Decree-Law No. 203/74 of 15 May) Introduction of social pension for disabled (above 65) Introduction of 13 <sup>th</sup> month for all pensioners

1975	<p>First regulation of the State participation in the financing of the Social Security pensions system</p> <p>Introduction of survivors pensions for agricultural scheme</p>
1977	<p>New organics of Social Security (Decree-Law No. 549/77)</p> <p>Inclusion of self-employed and housewives (or -men)</p> <p>Introduction of means-tested social pension for all above 65</p> <p>Reduction in the minimum entitlement contributory period: 3 years for disability pensions and 5 years for old pensions</p>
<b>1979</b>	<b>Reduces the full pension condition to 36 contributive years and minimum period for pension entitlement to 5 years (Decree-Law No. 191-A/79 of 25 June)</b>
1980	<p>Definition of the non-contributory regime of social security (Decree-Law No. 160/80 of 27 May)</p>
1982	<p>Enlargement of the minimum entitlement contributory period: 5 years for disability pensions and 10 years for old age pensions</p>
1984	<p>First Social Security Framework Law (Law No. 28/84 of 14 August)</p> <p>System PAYG: contributive regime financed by employees and employers contributions and non-contributive regime financed by State transfers</p> <p>Pensions updates taking into account consumer prices prospects</p>
<b>1985</b>	<b>Increases the contributory rate of public employees to CGA to 6.5 per cent (Decree-Law No. 40-A/85 of 11 February)</b> <b>The rate for survivors pensions is 1.5 per cent</b>
1986	<p>Determines a standard contributory rate for the general regime of Social Security: 24 per cent for employers and 11 per cent for employees (lower rates for special regimes)</p>
<b>1988</b>	<b>Extends the CGA coverage to private schools teachers (Decree-Law No. 321/88 of 22 September)</b>
1990	<p>Introduction of 14<sup>th</sup> month for all pensioners (Ordinance No. 470/90 of 23 June)</p>
<b>1993</b>	<b>Revision of <i>Estatuto da Aposentação</i> (Decree-Law No. 277/93 of 10 August and others): from September on, the pension scheme of new public employees became subject to the rules of the private sector system (Social Security General Regime)</b>

1993	<p>Reform of the Social Security general regime (Decree-Law No. 329/93 of 25 September):</p> <p>Enlargement of the minimum entitlement contributory period: from 10 to 15 years for old age pensions</p> <p>Gradual increase of legal retirement age of women from 62 to 65 years (the same as men)</p> <p>Revision of the contributory rate of Social Security to 35.5 per cent</p>
<b>1994</b>	<b>Increases the contributory rate of public employees to CGA old-age pensions to 7.5 per cent and to survivors pensions to 2.5 per cent, similar to Social Security contributors (Decree-Law No. 78/94 of 9 March)</b>
1995	Reduction of the standard contributory rate of Social Security by 0.75 percentage points to 34.75 (increase of the VAT standard rate by 1 percentage point earmarked to Social Security)
1999	Decomposition of the contributory rate of Social Security (34.75 per cent) (Decree-Law No. 200/99 of 8 June)
2002	<p>New Framework Law for Social Security (Law No. 32/2002 of 20 December)</p> <p>Convergence of earnings-related minimum pensions to national minimum wage</p> <p>Revision of new pension formula: transitory period for new rules taking into account the whole contributive career from 2017 on (Decree-Law No. 35/2002)</p>
<b>2002</b>	<b>Early retirement (old-age) pension is possible with 36 contributive years and a penalty of 4.5 per cent per year earlier than 60 years old (Law No. 32-B/2002 of 30 December)</b>
<b>2005</b>	<p><b>Revision of <i>Estatuto da Aposentação</i> (Law No. 60-B/2005 of 29 December) – further convergence of CGA and Social Security pension regimes:</b></p> <p><b>i) from 2006 on, new public employees are enrolled in Social Security System</b></p> <p><b>ii) progressive increase in legal retirement age to 65 years old (until 2015) for all public employees and of career length to 40 years (until 2013)</b></p> <p><b>iii) convergence of new pensions formula for contributors enrolled in CGA until August 1993</b></p>
2007	Reform of the Social Security pension regime (revision of the Framework Law – Law No. 4/2007 of January 16 and Decree Law No. 87/2007 of May 10)
<b>2007</b>	<b>Transposition of Social Security reform measures to CGA from 2008 on, with a transitory period until 2015 (Law No. 52/2007 of 31 August)</b>
<b>2008</b>	<b>Convergence (until 2015) of the minimum contributive career from 36 to 15 years to be entitled to a early retirement pension (Law No. 11/2008 of 20 February)</b>

Note: text in bold refers specifically to CGA.

Source: CGA and Ministry of Labour and Social Solidarity.



**ANNEX B**  
**MAIN ASSUMPTIONS UNDERLYING THE LONG-TERM PROJECTIONS**

**Demography**

	2008	2020	2030	2040	2050	2060
Life expectancy						
at birth	78.7	80.6	82.0	83.4	84.7	85.9
males	75.5	77.6	79.3	80.8	82.3	83.6
females	82.1	83.7	84.9	86.1	87.3	88.3
at 65 years old	18.2	19.6	20.7	21.9	23.1	24.1
males	16.3	17.6	18.7	19.7	20.7	21.6
females	19.9	21.1	22.1	23.0	23.9	24.8
Population (10 <sup>9</sup> )	10.599	11.080	11.299	11.443	11.458	11.289
Dependency ratio (DR) ( <i>percent</i> )						
young DR –15/15-64	22.8	22.1	20.9	21.6	22.9	22.7
old-age DR +65/15-64	25.9	30.7	36.6	44.6	53.0	54.8

Source: Eurostat (EUROPOP2008).

**Macroeconomic Scenario**

	2008	2020	2030	2040	2050	2060
Labour productivity growth (hours worked) ( <i>percent</i> )	1.2	1.8	2.7	2.2	1.7	1.7
Labour input growth (15-71)	0.3	0.3	-0.1	-0.4	-0.5	-0.3
GDP growth (real)	1.5	2.1	2.5	1.8	1.2	1.4
Employment rate (15-64)	68.4	71.4	71.6	71.7	71.8	71.6
Unemployment rate (15-64)	8.2	6.2	6.2	6.2	6.2	6.2

Source: EPC (2008).

## ANNEX C CGA MODEL

The pension model used for the CGA projections is an accounting/actuarial model that allows a detailed parameterization of the system, including the simulation of different demography or macroeconomic assumptions and changes in the reform parameters. However, as it is not a general equilibrium model it does not permit endogenous analysis of the changes in supply and demand and in the consumption and investment decisions of economic agents stemming from their adjustment, for example, to the reforms in social security that were enacted.

### 1 Assumptions and methodology

The model has four main modules: the first one relates to input data (including macroeconomic and demography data), the second one comprises the dynamics for contributors and number of pensions, the third one refers to the dynamics of contributions and pensions and the last one provides the outputs. Modules two and three are structured by age and gender strata in order to allow more precise results.

### 2 Module for contributors and pensioners dynamics

Due to the fact of CGA being a closed system, the *dynamics of contributors* is quite simple: the number of contributors decreases each year due to mortality and to other motives like moving to the private sector or exoneration. The number of CGA contributors at the end of year is given by:

$$C_{t,a,g} = C_{t-1,a-1,g} \times (1 - \mu_{t,a,g} - \pi_{t,a,g}) - np_{t,a,g} \quad (6)$$

where:

$C_{t,a,g}$  : Number of CGA contributors in year  $t$ , for age  $a$  and gender  $g$

$\mu_{t,a,g}$  : Mortality rate in year  $t$ , for age  $a$  (for those who would complete age  $a$  during year  $t$ ) and gender  $g$

$\pi_{t,a,g}$  : Contributors rate of exoneration in year  $t$ , for age  $a$  and gender  $g$

$np_{t,a,g}$  : Number of new pensioners (includes old-age pensioners and disability pensioners) in year  $t$ , for age  $a$  and gender  $g$ .

In the “open system” variant, the dynamics of contributors was slightly changed in order to include entrants from each year. The end-2007 stock was adjusted by the new public employees enrolled in 2006 and 2007, and between 2008 and 2011 it was assumed that the number of new public employees was around half of the new retirees in each year. The age and gender distribution was assumed to be the same as the distribution of new public employees in 2005. From 2012 on it was considered that the entries in the public sector were such that allowed to keep the share of public in total employment (around 12 per cent).

The *dynamics of pensioners*<sup>19</sup> is calculated for old age and disability pensioners together and for survivors separately. The stock of pensioners increases with new pensioners and decreases

<sup>19</sup> More precisely, available data refer to the number of pensions and not the number of pensioners.

according to pensioners' mortality. In this model, survivor pensioners also depend on a "depreciation rate" that applies mainly to when descendants conclude their studies.

### 2.1 Old age and disability pensioners

New pensioners (and pensions) are computed according to the legal regime that applies to each type of contributors: regime of *Estatuto de Aposentação* (that applies to public employees registered in the CGA until August 1993) and the social security regime that applies to public employees registered in the CGA between September 1993 and December 2005. For each legal regime, new pensioners are projected with a breakdown by motive: disability, old age (including early retirement) or age limit (at 70 years old).

New pensioners are computed by using "retirement probabilities". The later are defined as the base year ratios of new pensioners over contributors, for those who are aged less than 70. This means that new pensions are not determined only as a function of the legal criteria.

Number of new old-age pensioners:

$$op_{t,a,g} = op_{t-1,g,a-1} \times \frac{C_{t-1,g,a-1}}{C_{t-2,g,a-1}} \quad (7)$$

where:  $op_{g,a}(t)$ : Number of new old-age pensioners during year  $t$  for age  $a$  and gender  $g$ .

In the case of old age, including early pensioners, the above mentioned ratios move along legal retirement age (LRA).<sup>20</sup> It should be recalled that the LRA for CGA contributors is increasing from 60 years old in 2005 to 65 years old in 2015, at a pace of 6 months per year, in order to achieve convergence to the private sector regime.

It was assumed that the retirement probabilities for disabled do not change with the above-mentioned increase in the LRA.

The number of CGA new disability pensioners is given by:

$$dp_{t,a,g} = dp_{t-1,a,g} \times \frac{C_{t-1,a-1,g}}{C_{t-2,a-1,g}} \quad (8)$$

where:  $dp_{t,a,g}$ : Number of new disability pensioners in year  $t$ , for age  $a$  and gender  $g$ .

The dynamics for the number of old-age and disability pensioners at the end of year  $t$  is given by:

$$Op_{t,a,g} = Op_{t-1,a-1,g} \times (1 - \mu_{t,a,g}) + op_{t,a,g} + dp_{t,a,g} \quad (9)$$

where:  $Op_{t,a,g}$ : Number of old-age and disability pensioners at the end of year  $t$  for age  $a$  and gender  $g$ .

### 2.2 Survivor pensioners

New pensioners are a function of old age and disability pensioner's mortality. In the past, on average, 80 per cent of pensioners who died had a survivor entitled to a pension, but this

<sup>20</sup> For pensioners aged between LRA-10 and 70 (age limit).

percentage is expected to decrease (to near 60 per cent), as spouses beneficiaries tend to have their own wage/ pension and would not be eligible to a survivor pension and the number of children tend to decrease as well. Having the estimate for total new survivors' pensioners, the age and gender distribution is the same of base year.

It is also considered that the stock of survivor pensioners depend on a "depreciation rate" that applies mainly to descendants when conclude their studies. So it is necessary to divide the age strata into the following:

- $18 < a < 27$

$$Sp_{t,a,g} = Sp_{t-1,a-1,g} \times (1 - \mu_{t,a,g} - \chi_{t,a,g}) + sp_{t,a,g} \quad (10)$$

- Other  $a$

$$Sp_{t,a,g} = Sp_{t-1,a-1,g} \times (1 - \mu_{t,a,g}) + sp_{t,a,g} \quad (11)$$

where:

$Sp_{t,a,g}$  : Number of survivor pensioners in year  $t$ , for age  $a$  and gender  $g$

$sp_{t,a,g}$  : Number of new survivor pensioners in year  $t$ , for age  $a$  and gender  $g$

$\chi_{t,a,g}$  : Depreciation rate of the survivor pensioners stock, unrelated to the death of the beneficiary in year  $t$ , for age  $a$  and gender  $g$

### 3 Module for contributions and pensions' dynamics

Contributions to CGA are a fixed percentage of employees' remuneration (10 per cent supported by employees and 13.1 per cent by the employer).<sup>21</sup> Therefore, the contributions dynamics depends on the remunerations evolution. The data available for 2007 contained average values for remunerations of the subscribers by age and gender strata. The actualized and adjusted average remuneration is:

$$W_{t,a,g} = \max(W_{t-1,a,g} \times (1 + \gamma_t), W_{t-1,a-1,g} \times (1 + \gamma_t)) \quad (12)$$

where:  $\gamma_t$  is the annual update rate for public sector wage scale.

Contributions in each year are given by:

$$Cont_{t,a,g} = \tau_t \times W_{t,a,g} \times C_{t,a,g} \quad (13)$$

where:  $\tau_t$  is the CGA's contributory rate.

The average old-age pension is determined by:

$$Pens_{t,a,g} = \frac{[(Op_{t,a,g} - op_{t,a,g}) \times Pens_{t-1,a-1,g} \times (1 + \alpha_t) + op_{t,a,g} \times npens_{t,a,g}]}{Op_{t,a,g}} \quad (14)$$

<sup>21</sup> In practice, only some general government subsectors employers actually contribute to CGA, while in the case of State it makes an annual transfer to CGA. However, the contributory rate of 13.1 per cent was considered to all employers (as an imputed one, in the case of State) by analogy with the contributory rate to Social Security general regime of new public employees.

where:  $\alpha_t$  represents annual pension update and  $npens_{t,a,g}$  is the new old-age pension in year  $t$ , for age  $a$  and gender  $g$ .

$npens_{t,a,g}$  is calculated according to the rules presented in Table 6 for the *Estatuto da Aposentação* contributors and for other public employees (rule B) separately. It is assumed that public employees hired between September 1993 and 2001 will not retire before 2017.

Total old-age and disability pensions expenditure is given by:

$$TE_{t,a,g} = pens_{t,a,g} \times (Op_{t,a,g}) \quad (15)$$

The dynamics of survivor's pensions follows the old-age pension's one:

$$SurvPens_{t,a,g} = \frac{[(Sp_{t,a,g} - sp_{t,a,g}) \times SurvPens_{t-1,a-1,g} \times (1 + \alpha_t) + sp_{t,a,g} \times nsurvpens_{t,a,g}]}{Sp_{t,a,g}} \quad (16)$$

where  $\alpha_t$  represents annual pension update (the same of old age pensions) and  $nsurvpens_{t,a,g}$  is the new survivors pension in year  $t$ , for age  $a$  and gender  $g$ .

Each new survivor's pension, according to the law, is equivalent to 50 per cent of the old age pension that originate it. In the model, it was assumed the average new survivors pensions to be around 40 per cent of the average old age pensions.

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