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# The US actuarial balance model for the pay-as-you-go system and its application to Spain[*].

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### Abstract

The aim of this paper is to formulate an approximation of the US actuarial balance model and apply it to the Spanish public retirement pension system under various scenarios in order to determine a consistent indicator of the system's financial state comparable to those used by the most advanced social security systems. This will enable us to answer the question as to whether there is any justification for reforming the pension system in Spain. This type of actuarial balance uses projections to show future challenges to the financial side of the pension system deriving basically from ageing, the projected increase in longevity and fluctuations in economic activity. If one is compiled periodically it can provide various indicators to help depoliticize the management of the pay-as-you-go system by bringing the planning horizons of politicians and the system itself closer together.

**JEL**: H55, H83, J11, J26.

**Key words**: Actuarial balance, Spain., US, pension reform, transparency,

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## 1.-Introduction

According to Boado-Penas et al (2009) and Vidal-Meliá et al. (2010), the actuarial balance of the pay-as-you-go (PAYG) system is a response to the growing social demand for transparency in the management of public finances, the need to protect the PAYG system from populism in pensions, and the desire to give the system more credibility in the eyes of contributors and pensioners. It also provides a positive incentive to improve the management of the system as it minimizes the traditional differences between the planning horizons of electors, politicians (often only four years at most) and the system itself (between 33 and 100 years).

There are basically two options when it comes to compiling the actuarial balance (AB) for the PAYG system: what are known as the Swedish and US models[1]. Although both models have very different characteristics and strengths[2], the Swedish model can be briefly summed up as showing the actuarial (im)balance in pension systems using comprehensible language in the shape of assets and liabilities without needing to use projections. However, it can only be applied to the pension contingency. The US model, on the other hand, uses projections to highlight future challenges to the financial side deriving basically from ageing, the projected increase in longevity and fluctuations in economic activity.

The underlying methodology on which the US model is based - Aggregate Accounting Models - has been used by various researchers in Spain and other countries[3], although the actuarial balance approach barely makes an appearance in the literature. The paper dealing with Spain that most resembles US actuarial balance philosophy is the one by Doménech & Melguizo (2008), which introduces uncertainty through the use of 27 different scenarios and presents a number of financial sustainability indicators similar to those used by the Social Security Administration (SSA). However, there are also significant differences such as the planning horizon (64 years rather than 75), the level of data aggregation, no detailed model showing the interaction between financial, economic and actuarial aspects, the fact that the indicators refer to GDP and not the system's contribution bases, and the way in which uncertainty is quantified.

In this paper we draw up an approximation of the US actuarial balance model and apply it to the Spanish public retirement pension system under various scenarios in order to determine a consistent indicator of the system's financial health comparable to those used by the most advanced SSAs. This will enable us to answer the question as to whether there is any justification for the unexpected pension reform that was recently introduced in Spain[4]. This reform can be considered unexpected because, according to official MTIN

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[1] For more details see Försäkringskassan (2010) for Sweden and BOT (2010) and OACT (2009) for the US.

[2] See the papers by Boado-Penas et al (2011), Vidal-Meliá & Boado-Penas (2011) and Vidal-Meliá et al. (2010) for the main differences and similarities between both types of AB as regards objectives, information provided, structure, projections, valuation of assets/revenues, discount rate, effects on contributors/pensioners, solvency/sustainability indicators, transparency and applicability.

[3] See the papers by Balmaceda et al (2006), Doménech & Melguizo (2008) or Jiménez-Ridruejo et al. (2009) among others.

[4] At the draft bill stage as at May 2011. The changes are important ones and substantially alter retirement pension expectations for young and middle-aged contributors. The legal retirement age will rise progressively from today's 65 to age 67. This will be applied over a transitory period from 2013 to 2027, and in order to receive 100% pension it will be necessary to have contributed 37 years as opposed to the current 35. A 100% pension will be possible at age 65 with 38.5 years contributions rather than 35 today. Early retirement will be possible from age 63 with 33 years contributions or at age 61 in times of economic crisis. There will be better incentives for extending the working lifetime, the period for calculating the qualifying base will increase from 15 to 25 years, and the percentage of the full pension received by a worker will be proportional to the numbers of years contributed, starting at 50% for 15 working years up to 100% for 37 working years. By

(2008) information issued in October 2008, the forecast was that the Spanish public pension system would have no financial difficulties until at least 2029, when in fact the system already had a current treasury deficit in 2010. In Spain there has always been a difference between what politicians say and what the experts say, as Boado-Penas et al (2011) have pointed out. The government authorities had systematically denied that the pension system had sustainability problems, a situation that was not helped by the absence of an official actuarial balance.

As far as we are aware, there is a large gap in the literature which we are attempting fill with this paper because, until now, this area of study has not been looked at from the perspective of the US actuarial balance, nor with the set of indicators that may be derived from it. We also aim to show the advisability of making it compulsory for an actuarial balance to be compiled for the Spanish public pension system every year in order to improve its transparency and solvency, thereby forming part of the trend seen in certain other countries of introducing a methodology typical of accounting and actuarial analysis into the public management of PAYG systems.

The structure of the paper is as follows. After this brief introduction, Section 2 describes the US-style actuarial balance, how it is usually presented and what methodology it is based on. Section 3 gives details of the data, assumptions and subsequent scenarios. Section 4 analyses the results obtained focusing especially on the best-estimate scenario, while Section 5 gives our conclusions and final comments. The paper ends with the bibliographical references and three appendixes which we briefly develop the approach of the aggregate accounting model, show the actuarial, economic and demographic relationships that enable the model to be formulated and present the results broken down into greater detail.

## 2.-The PAYG actuarial balance: US model

This actuarial balance is aimed at measuring the system's financial sustainability with an n-year time horizon (75 years in the US and Canada, and 95 in Japan[5]). It measures the difference in present value - discounted by the projected yield on trust fund assets - between spending on pensions and income from contributions, expressed as a percentage of the present value of the contribution bases for that time horizon, taking into account that the level of financial reserves (trust fund) at the end of the time horizon reaches a magnitude of one year's expenditure. Both the income and the expenditure are discounted using the projected return on the financial assets in each period. In simplified form, the AB can be expressed as:

$$BA_0 = \underbrace{\left[\frac{\overbrace{TF_0}^{\text{Trust fund (1)}} + \overbrace{\sum_{t=0}^{n} IT_t \prod_{h=1}^{t}\left(1+r_h\right)^{-1}}^{\text{Present value of contributions (2)}}}{\underbrace{\sum_{t=0}^{n} ACB_t \prod_{h=1}^{t}\left(1+r_h\right)^{-1}}_{\text{Present value of payrolls}}}\right]}_{\text{Summarized income rate}} - \underbrace{\left[\frac{\overbrace{\sum_{t=0}^{n} EP_t \prod_{h=1}^{t}\left(1+r_h\right)^{-1}}^{\text{Present value of benefits (3)}} + \overbrace{TF_n \prod_{h=1}^{n}\left(1+r_h\right)^{-1}}^{\text{Trust fund (4)}}}{\underbrace{\sum_{t=0}^{n} ACB_t \prod_{h=1}^{t}\left(1+r_h\right)^{-1}}_{\text{Present value of payrolls}}}\right]}_{\text{Summarized cost rate}} \quad \textbf{[1.]}$$

comparison, the system pre-reform was biased in favour of shorter working lifetimes. Finally, a so-called sustainability factor will be introduced from 2027 based on the evolution of life expectancy for 67-year-olds, although it appears to be more like an automatic balance mechanism as a sustainability factor cannot be based on the evolution of life expectancy alone.

[5] See details in OSFIC (2008) for Canada and AAD (2009) for Japan. The papers by GAD (2010) for the UK and Elo et al (2010) for Finland are also relevant.

which, in a situation of financial equilibrium for the valuation period, should give a zero value where: $TF_0$ : Value of assets (reserve fund) at the beginning of the valuation period; $IT_t$ : Income from contributions plus government transfers if any in year t; $EP_t$ : Expending on pensions in year t; $ACB_t$ : Aggregate contribution base in year t; r : Projected yield on trust fund assets; and $TF_n$ : Value of assets at the end of the valuation period.

The typical way in which the actuarial balance is presented includes the basic elements shown in Table 1, although there is no standard model.

| **Table 1: Elements of the n-year actuarial balance Present value at January of year t. Scenario X.** | |
|---|---|
| **1** | Contributions |
| **2** | Benefits |
| **2-1=3** | Initial deficit |
| **4** | Trust fund assets at start of period |
| **5=3+4** | Open group unfunded obligation |
| **6** | End target trust fund |
| **7=5+6** | Results for the period |
| **8** | Aggregate contribution bases |
| **9=(1+4)/(8)%** | Summarized income rate |
| **10=(2+6)/(10)%** | Summarized cost rate |
| **11=(9-10)%** | Actuarial balance |
| **12** | Year of first deficit |
| **13** | Reserve fund exhausted (year) |
| **Source: Own based on BOT (2010)** | |

The open group unfunded obligation is the present value of the debt that would have to be incurred to fund the payments that have been promised, wiping out all the financial assets. This should not be confused with the system's implicit debt at a particular date. The calculation of the actuarial balance includes the cost of accumulating a target trust fund balance equal to 100% of annual costs by the end of the period.

The way the balance is presented in Table 1, based on cash flow statements, as Jackson (2004) points out, highlights the system's annual "surpluses" and its reserves. This undermines efforts to address social security reform proposals by locating the timing of scheme crisis far off in the future, when the trust fund is expected to be exhausted, especially if the treasury deficit is expected to take a while to appear, and tends to delay the application of solutions.

| **Table 2: The US actuarial balance model as a balance sheet.** | |
|---|---|
| **ASSETS** | **LIABILITIES** |
| Reserve fund at start of period (1) | Present value of benefits (3) |
| Present value of contributions (2) | Present value of end target trust fund (4) |
| Present value of deficit (net) ((3)+(4)-(1)-(2))>0 | Present value of surplus (net) ((1)+(2)-(3)-(4))>0 |
| **Total Assets** | **Total Liabilities** |
| **Source: Own.** | |

Table 2 shows an alternative presentation that may make it easier to understand the system's financial situation. It also provides an immediate solvency indicator in the form of an accounting balance sheet in which the assets are the reserve fund at the start of the period and the present value of contributions, while the liabilities are represented by the present value of benefits and the present value of the target trust fund at the end of the period. The items used to balance the accounts if the elements above do not tally are the present value of the estimated deficit (resources the promoter needs to provide to cover all the scheduled benefits) or, in the opposite case, the present value of the surplus that would eventually manifest itself as an excessively large target reserve fund at the end of the projection horizon.

The solvency ratio ($RS_t$) indicator used (Table 2) emerges from the balance sheet and is expressed as:

$$RS_t = \frac{\text{Assets}}{\text{Liabilities}} = \frac{\text{Reserve fund (1)} + \text{Present value of contributions (2)}}{\text{Present value of benefits (3)} + \text{Reserve fund (4)}} \qquad \textbf{[2.]}$$

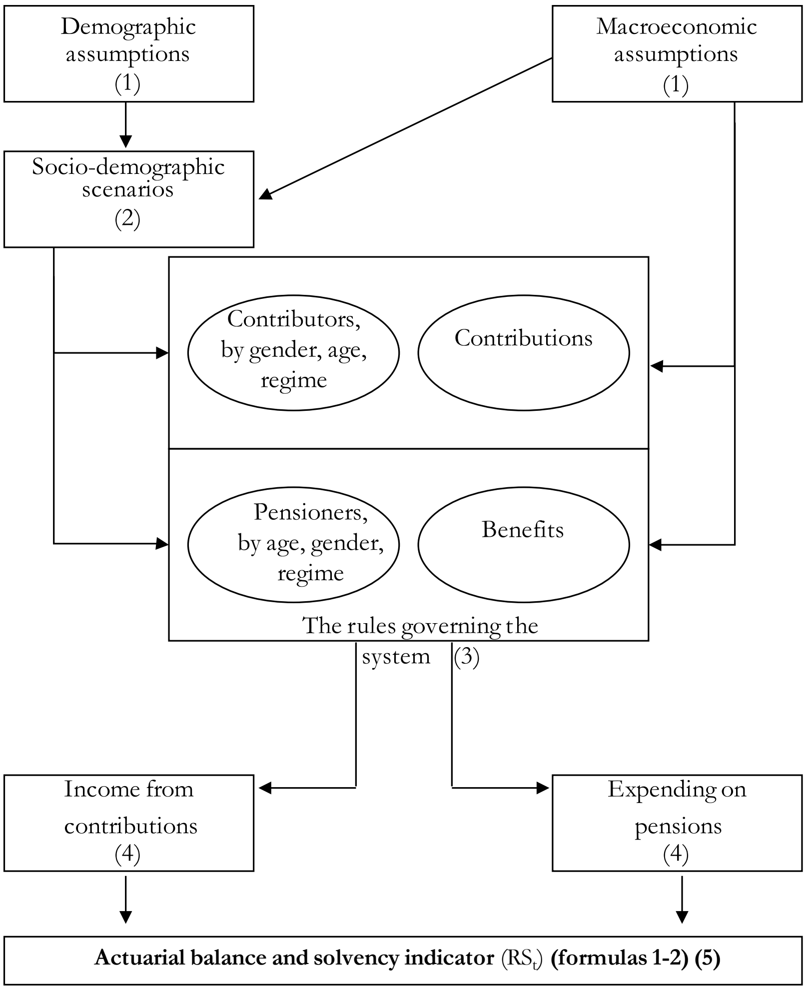


**Figure 1: Aggregate accounting projection model and the US actuarial balance.**

**Source: Boado-Penas et al (2011).**

The main methodology used to compile the US actuarial balance might best be described as an aggregate accounting projection model of spending on pensions (AAM). This approach, as shown in Figure 1, basically relies on making a variety of assumptions regarding the economy as a whole, taking into account future trends in demography (fertility rates, migration flows, life expectancy), economic conditions (participation and employment rates, productivity, wages, interest rates) and the rules governing the pension system (coverage, pension levels).

AAMs are mainly used to make aggregate projections for spending on pensions in relation to GDP - see Equation 4 in Appendix 1 - although SSAs adopt a more financial approach and use it to evaluate the projected social security deficit, usually in relation to the aggregate pensionable earnings (Equation 7 in Appendix 1). This approach is used in Appendix 2 as a basis for developing a detailed model of the main economic, financial and actuarial relations that enable the actuarial balance to be compiled[6].

## 3.-Data, assumptions and socio-demographic scenarios

### 3.1.-Data and assumptions

The formulation of the actuarial balance in this paper is based on the assumption that legislation - the rules governing the system that were in force in 2009 - remains constant throughout the projection period. As far as possible we also apply the principle of verifiable data or transactions at the date the balance was compiled, which means being aware of anything that occurred in the recent past, i.e. the last three or five years depending on the case, and checking against official sources whenever possible. The number of contributors by age and gender, for example, is obtained independently for each regime as the product of the working population and the proportion of them that actually make contributions; an average of 94.25% of the working population made contributions to social security during 2007, 2008 and 2009. This calculation needs to be carried out due to the discrepancy that exists between the figures for working population provided by the quarterly surveys of the labour market carried out by the Instituto Nacional de Estadística (INE - the National Institute of Statistics) and the number of currently working affiliates supplied by the Instituto Nacional de la Seguridad Social (INSS- the National Institute of Social Security).

Official sources are also used for the evolution of the contribution bases for each type of contributor. These are conditional upon the average contribution base, salary scales and the growth rate of the contribution base. The average contribution base for 2009 was obtained from the Ministry of Work and Immigration (Ministerio de Trabajo e Inmigración - MTIN) (2010), while the salary scales have been constructed based on the Continuous Sample of Working Lives (Muestra Continua de Vidas Laborales - MCVL) for 2009[7].

The overall contributions made in the Spanish social security system are not allocated explicitly to different contingencies, and therefore some kind of assumption needs to be made to enable us to find this information. The proportion of the total contributions for common contingencies allocated as income to cover the retirement contingency will be equal to the percentage of total spending on pensions represented by spending on retirement pensions. This calculation has already been carried out by Boado-Penas et al (2008). It is assumed that the contribution rate earmarked for the retirement pension contingency in the general regime is 19.02%, in the self-employed regime 18.48%, household workers19.46%, coal mining 20.49%, sea workers 19.23% and agriculture 12.08%. Apart from the income from contributions, it is assumed that the state provides

[6] It is worth mentioning that the only formula shown in Doménech & Melguizo's (2008) paper to justify the results is equivalent to Equation 4 in Appendix 1. In the paper by Jiménez-Ridruejo et al. (2009), although it includes a number of very detailed aspects such as the evolution of immigration and productivity, the relations of how pensioners and the average pension evolve are carried out using econometric equations unrelated to actuarial methodology, while in AFI (2009) there is no mention of any type of model to justify the results.

[7] According to MTAS (2006), the MCVL is a set of microdata containing the career movements of over a million anonymous people, i.e. it contains the contracts involved in the employment history along with the monthly contributions for each person selected for the sample.

funding to help cover the supplement to the minimum retirement benefits[8]. Following the principle of verifiable data and transactions, it will be assumed that state funding will cover 35.67% of the total supplement to the minimum retirement benefits. We therefore estimate the amount spent on retirement pensions that corresponds to the state contribution to the supplement to the minimum retirement benefits and then add it on as other social security income

The starting point for projecting pension spending is the number of retirement pensioners and their average pension, broken down by age, gender and the social security regime they were registered in at 31 December 2009. We realize that an error is already being committed here at the start due to the fact that the figures cannot be broken down any further - some of the pensioners we take into account will have originally come from a different contingency, i.e. disability, but for administrative reasons they are classified as retirement pensioners once they reach age 65.

New retirees by age, gender, total years contributed and regime are obtained from the product of the new pensions coefficient and the number of people entitled to opt for retirement. The evolution of this variable is determined by demography and rates of employment. The new pensions coefficient itself is assumed to remain constant throughout the projection period in line with the average obtained from the last five years.

The main hypotheses for determining the average amount of new pensions are: 1.- The distribution of new pensions by age and gender remains constant and equal to the average distribution of the last three years; 2.-The recorded number of years contributed when determining the amount of pension also remains constant and equal to the average of the last three years; and 3.-The regulating base will evolve in accordance with Equation 36 in Appendix 2, based on the values recorded for 2009. These three hypotheses have been estimated from the MCVL for 2009.

**3.2 Socio-demographic scenarios**

**Demography**

In January 2010 the National Institute of Statistics (Instituto Nacional de Estadística - INE) (2010) published new estimates as to the future evolution of the population of Spain for the period 2009-2048[9], the main points of which are the following: 1.-Population growth will progressively decrease over the next few decades; 2.-There will be negative population growth from 2020 onwards; and 3.-The population over age 64 will double over the next 40 years and represent over 30% of the total.

In order to recognize the uncertainty surrounding demographic evolution over the projection period, three sets of hypotheses are established that have an effect on the main elements determining the evolution of population, fertility, migration and mortality. Each assumption will determine a particular demographic scenario. The first is designated the "best estimate" or normal scenario and is based on the hypotheses established by the INE up to 2048. The second and third scenarios are designated "favourable" or optimistic and "unfavourable" or pessimistic. After 2048 the various assumptions for each scenario will remain constant at the values reached on that date for the remaining part of the projection period.

[8] The extra amount needed to reach the minimum pension that should be funded through taxes.

[9] The INE projections are based on the component method. This involves making a projection for each population group, by age and gender, using hypotheses regarding the future evolution of fertility, mortality and migration. For more information on this methodology see INE (2009).

The decade from 1998 to 2008 saw an improvement in the different fertility indicators for Spain. The overall fecundity rate[10] (from now on OFR), for instance, rose by 22%, from 1.19 in 1998 to 1.45 in 2008. Continuing with this positive evolution, the INE forecasts a sustained increase in the OFR from 1.44 in 2009 to 1.70 in 2048. Under the favourable scenario it is assumed that there will be an even greater increase in the OFR than in the best estimate scenario, from 1.44 in 2009 to 2.14 in 2048, while in the unfavourable scenario it undergoes a slight increase over the first two decades projected, from 1.44 in 2009 to 1.49 in 2028, but then falls back to the value assumed for 2009.

As far as migration is concerned, the INE assumes a net average migratory flow of 70,000 people a year. The first ten years of the projection take into account the effect of the economic crisis on this variable, which in quantitative terms translates into a significant reduction in the average migratory flow down to an average net migration of around 40,000 people. The optimistic and pessimistic scenarios assume net average migratory flows of 100,000 and 40,000 people respectively during the projection period.

The evolution of mortality assumed by the INE implies that there will be a significant increase in life expectancy both at birth and at age 65. Life expectancy at birth is expected to increase by 6.25 and 5.50 years for men and women respectively, from 78.03 and 84.3 years in 2009 to 84.37 and 89.88 in 2048. Life expectancy at age 65 will increase by 4.07 and 4.33 years for men and women respectively, from 17.82 and 21.81 years in 2009 to 21.89 and 26.14 years in 2048. The increase in life expectancy at birth is mainly due to the increased life expectancy for the elderly. The three demographic scenarios assumed show the same evolution of mortality for the projection period.

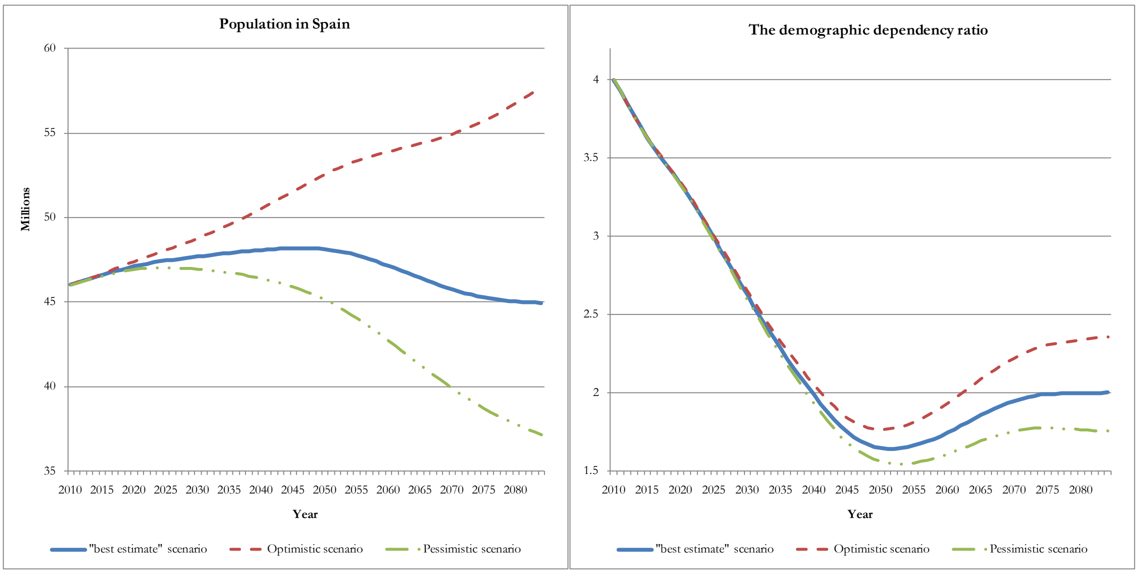


**Figure 2: Evolution of population in Spain and the demographic dependency ratio under various scenarios. Source: Own.**

The evolution of the population over the projection period for the scenarios specified is shown in Figure 2. During the early years the changes manifest themselves slowly, but by the last year of the projection the population may show very different results: under the normal scenario there would be around 45 million inhabitants, while in the optimistic and pessimistic scenarios there would be 58 and 37 million respectively.

[10] The overall fecundity rate can be defined as the average number of children that will be born to one woman from a hypothetical cohort of women of childbearing years who were not exposed to mortality risk from birth until the end of their fertile period.

As regards the demographic dependency ratio - defined as the population aged between 16 and 64 divided by the population aged 65 and over - shown in the second part of Figure 2, over the three scenarios it will drop sharply over the next four decades, from 4.06 in 2009 to 1.67, 1.78 and 1.59 in 2048 for the central, favourable and unfavourable scenarios respectively. At the end of the projection period a slight improvement can be seen in comparison with the situation in 2048: 2, 2.37 and 1.76 respectively in 2084.

**Macroeconomy**

As with the demographic aspect, three scenarios are also constructed with regard to the macroeconomic aspect. Their general outlines are as follows:

1.-Central or "best estimate" scenario: This assumes that in 2048 the labour force participation rate and the employment rate of the Spanish economy will converge with the average rates recorded for the EU-15 during 2008[11]. This scenario assumes average annual accumulated growth in productivity of 0.95%[12].

2.-Optimistic scenario: This assumes that in 2048 the labour force participation and employment rates of the Spanish economy will converge with the rates recorded in Germany during 2008. This scenario assumes average annual accumulated growth in productivity of 1.25%.

3.-Pessimistic scenario: This assumes that in 2048 the labour force participation and employment rates of the Spanish economy will converge with the rates recorded in Spain during 2008. This scenario assumes average annual accumulated growth in productivity of 0.66%.

For the first two years of the projection, 2009 and 2010, the hypotheses used for the average rates of labour force participation, employment and productivity under the three scenarios are the rates actually recorded for those years, while for 2011 it will be the rates recorded in the first quarter of that year.

The combination of demographic and macroeconomic scenarios therefore determine 9 possible socio-demographic scenarios, as shown in Table 3:

**Table 3: Socio-demographic scenarios.**

| **Scenarios** | **Macroeconomy Optimistic (2)** | **Demography Normal (1)** | **Demography Pessimistic (3)** |
|---|---|---|---|
| **Macroeconomy Optimistic (2)** | D-E (2,2) | D-E (1,2) | D-E (3,2) |
| **Demography Normal (1)** | D-E (2,2) | **D-E (1,1) "best estímate"[13]** | D-E (3,1) |
| **Macroeconomy Pessimistic (3)** | D-E (2,3) | D-E (1,3) | D-E (3,3) |

[11] The EU-15 comprises Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

[12] The productivity hypothesis for 2011-2050 under the favourable scenario is the same as the productivity path assumed by the European Commission in the 2009 Ageing Report (2008).

[13] According to standard actuarial terminology, the "best-estimate" scenario is that obtained under "best-estimate assumptions". These assumptions reflect the best judgment of the experts as to future demographic and economic conditions that will probably affect the long-term financial viability of the system.

Figure 3 below shows the effect of various scenarios on the evolution of real GDP in base 100 for the whole projection period. In the case of extreme scenarios D-E (2,2) and D-E (3,3), the GDP in base 100 for the last year of the projection is 68% greater and 40% lower respectively than in central scenario D-E (1,1), or to put it another way, the GDP under the most favourable scenario is 2.79 times greater than in the least favourable. Figure 3 also aims to show the effect the variations of the economic scenarios have on the normal demographic scenario and vice versa. It can be seen that the economic effects have a faster and greater impact on GDP, productivity, the participation rate and the employment rate than the demographic variations. At the end of the projection period, the real value of GDP under scenario D-E (1,2) is 1.76 times greater than under scenario D-E (1,3), while the relationship between scenarios D-E (2,1) and D-E (3,1) is 1.58 times greater.

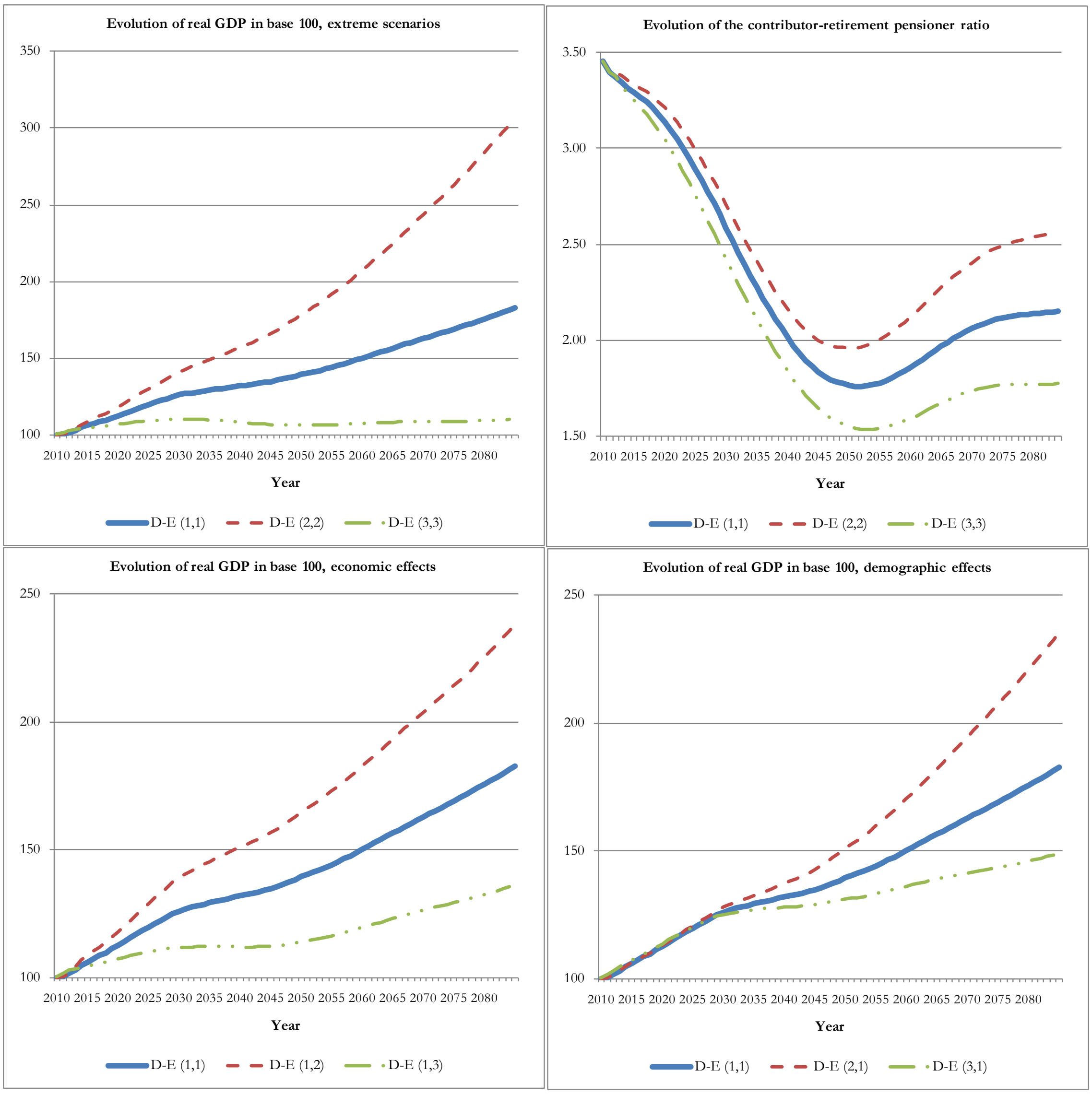


**Figure 3: Evolution of real GDP in base 100, extreme scenarios, demographic and economic effects, and evolution of the contributor-retirement pensioner ratio under the normal and two most extreme scenarios. Source: Own.**

Finally, Figure 3 shows the estimated evolution of the contributor-pensioner ratio, which is the most important aspect for the authority that administers the pension system. It can be seen under any scenario that this is projected to deteriorate drastically over the coming years basically because of population ageing. In the most likely scenario, D-E (1,1), it drops from 3.46 in 2010 to 1.75 in 2052 and then recovers to 2.15 in the last year of the projection. In the extreme scenarios, the results predicted for 2052 are 1.96 and 1.54 respectively for D-E (2,2) and D-E (3,3), while for the last year of the projection they are 2.56 and 1.77.

**4.-Main results**

Tables 4 and 5 below show the aggregate results for all regimes and scenarios for some of the elements included in the actuarial balance over two projection periods: 75 years and 50 years respectively. The disaggregated results for the general regime and the rest are shown in Appendix 3.

The results are unequivocal in so far as the system's financial health is far more delicate than it may appear. Even under what could be termed the most optimistic scenarios the results are very poor for both the 50 and the 75-year projection horizon.

If the "best estimate" - scenario D-E (1,1) - is taken as a benchmark, in the 75-year balance it can be seen that the first deficit already makes an appearance in 2010[14]. According to this scenario, the reserve fund will be exhausted in 2019, while under the best, D-E (2,2), and worst, D-E (3,3), scenarios it runs out in 2020 and 2018 respectively. This result is logical seeing that the early years of the projection assume that changes come about slowly and do not veer away significantly from the trends shown under the central scenario, as can be seen in Figures 2 and 3 in the previous section.

The result of the actuarial balance is -13.90%, i.e. the contribution rate would have to be increased by 13.90% from the very start and for the entire projection horizon in order to cover all the scheduled pensions. The increase in the income rate for the period would be 70%. The results for the best and worst scenarios considered are -10.34% and -18.1% respectively. The result for the 50-year actuarial balance is -12.39%, slightly better than the result for the 75-year balance but not much better because the projected effect of ageing is very intense during the first 30 years of the projection period. However, this is expected to at least partially reverse in the last 25 years of the projection period, as shown in Figures 1 and 2.

The result for the solvency ratio in the best estimate is barely 0.5957 on average, as seen using Formula 2, which compares the system's assets and liabilities for the entire projection horizon. If no additional resources are injected, it will not be possible to pay approximately 41.43% of scheduled pensions[15]. The solvency index does not significantly improve under the most optimistic scenario, 0.6539, i.e. although the demographic and economic aspects are much better than predicted, on average and without additional resources 34.61% of scheduled pensions would be unpaid or not covered.

The solvency index for the 50-year actuarial balance is slightly better, though not much for the same reason that we mentioned earlier: the demographic aspects will start to work in the system's favour from 2052.

[14] It should be pointed out that the official results for social security in Spain show a treasury surplus because they include the return on the reserve fund, but if this were not taken into account there would be a deficit.

[15] If the assumption that the minimum pension were financed in its entirety had been adopted, as is usual in official projections, the solvency index would rise to 0.631 under the most likely scenario.

| Table 5: Elements of the 75-year actuarial balance 2010-2084.<br>Present value at January 2010 in thousands of millions of euros. Consolidated for all regimes. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **D-E (1,1) B-B** | D-E (1,2) B-O | D-E (1,3) B-P | D-E (2,1) O-B | **D-E (2,2) O-O** | D-E (2,3) O-P | D-E (3,1) P-B | D-E (3,2) P-O | **D-E (3,3) P-P** |
| **Income from contributions and government transfers [20]** | 3,694.79 | 4,259.97 | 3,166.97 | 3,735.85 | 4,650.60 | 3,413.18 | 3,474.92 | 3,987.44 | 2,993.81 |
| **Spending on pensions** | 6,307.51 | 6,887.26 | 5,877.17 | 6,333.29 | 7,079.21 | 6,013.34 | 6,183.07 | 6,737.86 | 5,770.19 |
| **Initial deficit** | -2,612.72 | -2,627.29 | -2,710.20 | -2,597.44 | -2,428.61 | -2,600.15 | -2,708.15 | -2,750.43 | -2,776.37 |
| **Trust fund assets at start of period[21]** | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 |
| **Open group unfunded obligation** | -2,572.58 | -2,587.16 | -2,670.07 | -2,557.30 | -2,388.47 | -2,560.02 | -2,668.02 | -2,710.29 | -2,736.24 |
| **Ending target trust fund[22]** | 68.82 | 84.98 | 57.49 | 70.01 | 94.27 | 63.53 | 63.18 | 77.95 | 52.83 |
| **Results for the period** | -2,641.40 | -2,672.14 | -2,727.56 | -2,627.31 | -2,482.75 | -2,623.55 | -2,731.20 | -2,788.24 | -2,789.07 |
| **Aggregate contribution bases** | 18,999.23 | 2,1956.10 | 16,229.42 | 19,229.89 | 2,4017.70 | 17,526.34 | 17,840.92 | 20,520.21 | 15,318.54 |
| **Summarized income rate** | 19.66 | 19.58 | 19.76 | 19.64 | 19.53 | 19.70 | 19.70 | 19.63 | 19.81 |
| **Summarized cost rate** | 33.56 | 31.76 | 36.57 | 33.30 | 29.87 | 34.67 | 35.01 | 33.22 | 38.01 |
| **Actuarial balance** | **-13.90** | **-12.17** | **-16.81** | **-13.66** | **-10.34** | **-14.97** | **-15.31** | **-13.59** | **-18.21** |
| **Year of first deficit** | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 |
| **Reserve fund exhausted (year)** | **2019** | **2020** | **2018** | **2019** | **2020** | **2018** | **2018** | **2019** | **2018** |
| **Solvency Index** | **0.5857** | **0.6167** | **0.5404** | **0.5897** | **0.6539** | **0.5683** | **0.5627** | **0.5909** | **0.5210** |
| **Results for the period as % share of GDP in 2010** | 250.63 | 253.54 | 258.80 | 249.29 | 235.57 | 248.93 | 259.15 | 264.56 | 264.64 |
| **Results for the period as % of present value of GDPs for the period** | 4.15 | 3.65 | 5.03 | 3.81 | 3.10 | 4.49 | 4.57 | 4.06 | 5.45 |

[20] A single annual rate of interest of 1.5% in real terms is used for discounting income and expenditure.

[21] At 31 December 2009 the social security reserve fund had accumulated a total of 60,022 million euros. As there is no separation by contingency, it is assumed that the reserve fund is disaggregated following the same criterion as the contribution rate. Therefore the amount accumulated by the reserve fund at the start of the projection period totalled 40,133 million euros.

[22] A target reserve fund equal to predicted expenditure for the last year of the projection is considered, a standard hypothesis for this type of actuarial balance. On this subject see BOT (2010), OSFIC (2008) and AAD (2009).

| Table 6: Elements of the 50-year actuarial balance 2010-2059.<br>Present value at January 2010 in thousands of millions of euros. Consolidated for all regimes. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **D-E (1,1) B-B** | D-E (1,2) B-O | D-E (1,3) B-P | D-E (2,1) O-B | **D-E (2,2) O-O** | D-E (2,3) O-P | D-E (3,1) P-B | D-E (3,2) P-O | **D-E (3,3) P-P** |
| **Income from contributions and government transfers** | 2,682.34 | 2,984.15 | 2,384.23 | 2,783.63 | 3,103.75 | 2,467.78 | 2,566.16 | 2,843.98 | 2,291.58 |
| **Spending on pensions** | 4,339.96 | 4,565.91 | 4,166.76 | 4,373.41 | 4,603.55 | 4,196.75 | 4,155.20 | 4,368.60 | 3,993.26 |
| **Initial deficit** | -1,657.61 | -1,581.76 | -1,782.54 | -1,589.78 | -1,499.80 | -1,728.96 | -1,589.03 | -1,524.62 | -1,701.68 |
| **Trust fund assets at start of period** | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 |
| **Open group unfunded obligation** | -1,617.48 | -1,541.63 | -1,742.40 | -1,549.64 | -1,459.66 | -1,688.83 | -1,548.90 | -1,484.49 | -1,661.54 |
| **Ending target trust fund** | 93.97 | 105.82 | 85.01 | 96.69 | 108.97 | 87.37 | 88.72 | 99.74 | 80.47 |
| **Results for the period** | -1,711.45 | -1,647.45 | -1,827.41 | -1,646.33 | -1,568.63 | -1,776.20 | -1,637.62 | -1,584.23 | -1,742.01 |
| **Aggregate contribution bases** | 13,813.82 | 15,401.10 | 12,242.00 | 14,349.72 | 16,034.40 | 12,683.79 | 13,226.11 | 14,672.52 | 11,792.68 |
| **Summarized income rate** | 19.71 | 19.64 | 19.80 | 19.68 | 19.61 | 19.77 | 19.71 | 19.66 | 19.77 |
| **Summarized cost rate** | 32.10 | 30.33 | 34.73 | 31.15 | 29.39 | 33.78 | 32.09 | 30.45 | 34.54 |
| **Actuarial balance** | **-12.39** | **-10.70** | **-14.93** | **-11.47** | **-9.78** | **-14.00** | **-12.38** | **-10.80** | **-14.77** |
| **Year of first deficit** | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 |
| **Reserve fund exhausted (year)** | **2019** | **2020** | **2018** | **2019** | **2020** | **2018** | **2018** | **2019** | **2018** |
| **Solvency Index** | **0.6140** | **0.6474** | **0.5702** | **0.6317** | **0.6671** | **0.5854** | **0.6141** | **0.6455** | **0.5724** |
| **Results for the period as % share of GDP in 2010** | 162.39 | 156.32 | 173.39 | 156.21 | 148.84 | 168.53 | 155.38 | 150.32 | 165.29 |
| **Results for the period as % of present value of GDPs for the period** | 3.70 | 3.20 | 4.47 | 3.43 | 2.93 | 4.19 | 3.64 | 3.17 | 4.37 |

In terms of GDP - the last two rows in Tables 4 and 5 - the results are even more striking. If the aim were to "ensure" payment of estimated pensions for the next 75 years, the initial financial contribution that would have to be added to the initial reserve fund under the "best estimate" - scenario D-E (1,1) - would be 250.6% of GDP for the base year, or "paid in instalments" at the rate of 4.15% of GDP for each year. If the benchmark were the contribution base for the base year, 8.39 times that contribution base would need to be injected to "ensure" benefits because the tax base ratio is stable and approximately 0.299 of GDP. The best scenario, D-E (2,2), slightly reduces the initial injection needed to 235.57% of GDP, though the reduction is greater if paid in instalments: 3.10% of GDP for each year.

A wide variety of indicators deriving from the model developed can be extracted, two of which are shown in Figure 4: the amount of pensions that could be paid between 2018 and 2020 depending on scenario using only the available resources, i.e. on the assumption that no explicit debt can be accumulated once the reserve fund is exhausted; and the contribution rate necessary to finance all the scheduled benefits from year to year. As far as the first is concerned, it can be seen that under scenario D-E (1,1) the minimum to be paid will be reached in 2051, this being 44.92% of scheduled benefits if the contribution rate is not increased or if the system does not accumulate explicit debt to finance successive deficits. In the last year of the projection period the system will only be able to fund 53.49% of scheduled benefits without help. Under the optimistic scenario, D-E (2,2), the minimum level of funding will also be reached in the same year, but in this case 52.37% of the benefits can be financed, while in the last year of the projection period this could reach 65.55%.

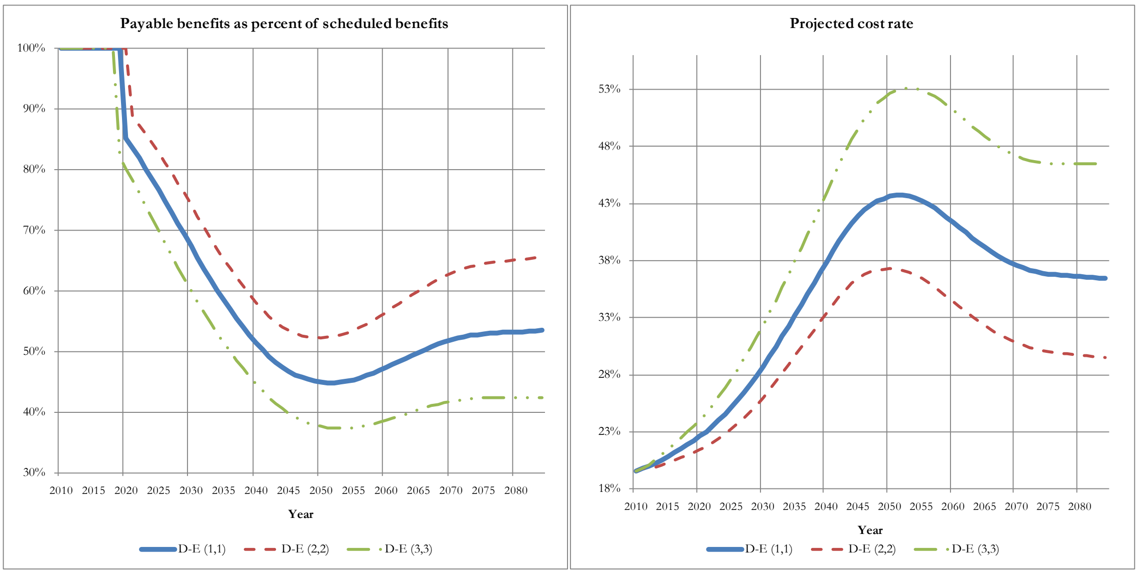


**Figure 4: Evolution of payable benefits as a percentage of scheduled benefits and the projected cost rate. Source: Own.**

As regards the projected cost rate - which could also be disaggregated following Equation 7 in Appendix 1 - under the normal scenario the maximum will be reached in 2051 with 43.74% in the contribution rate needed to cover the scheduled payments. From then on the rate will decrease until it reaches 36.44% in the last year of the projection period. The most optimistic scenario reaches its maximum of a 37.27% increase in 2050, dropping to 29.51% by the last year of the projection period.

Appendix 3 shows the disaggregated results for both projection horizons, distinguishing between the general regime and the rest, which includes the self-employed, agriculture, sea workers, coal mining and household workers regimes along with the SOVI[23]. The general regime is seen to be the one that would have the fewest treasury problems if it were completely independent, see Table 7, with the first treasury deficit not appearing until 2017 and the reserve fund still having resources until 2027 under the most likely scenario. Under the most optimistic scenario, D-E (2,2), the deficit could take an extra two years to appear and the reserve fund would not be exhausted until 2030. In the rest of the regimes the treasury deficit is already a fact and if they were independent there would be no trace of a reserve fund either. As far as the solvency index in the central scenario is concerned, the reading for the general regime at 0.6082 is very different from the one for the rest at 0.4897, and in any case far from what it should be in a solvent pension system. In the most optimistic scenario the indices rise to 0.6767 and 0.5531 respectively for the general regime and the rest, which is still a very long way from solvency.

Finally a brief comparison is made of the results in an area of great concern to many researchers and institutions: the evolution of projected pension spending as a proportion of GDP, especially for the retirement contingency. We include data from papers by EC (2008), Gil et al (2007) and Jiménez-Ridruejo et al. (2009) for the comparison, and the results are shown in the following table.

**Table 6: Spending on retirement benefits as a proportion of GDP.**

| Paper | Initial year | Year 2050 |
|---|---|---|
| **EC (2008)** | 5.6% (2007) | 12,3% |
| **Gil et al (2007)** | 5% (2005) | 12% |
| **Jiménez-Ridruejo et al (2009)** | 5% (2005) | 11,3% |
| **Our model, scenario D-E (1.1)** | 5.86% (2009) | 13% |

As the table shows, there is a significant increase in pension spending as a proportion of GDP - more than double - in all the papers considered. We can use Equation 4 in Appendix 1 to briefly analyse what factors lie behind the difference between our result and the others. Demographic factors as represented in the demographic dependency rate show no significant differences between one paper and another, although it is true that this paper has assumed that the demographic dependency ratio will be worse than in the projections made by the other papers. As far as economic factors are concerned, it should be noted that we have taken into account how they have been affected by the economic crisis.

The main point of divergence between this paper and the others is the institutional factor. The papers by Gil et al (2007) and Jiménez-Ridruejo et al (2009) show a sustained increase in the take-up ratio, rising from 64% to 70% and 77% respectively in 2050, while the take-up ratios observed by this paper go down from 65% in 2010 to 60%. This decrease can be explained by the extinction of the SOVI from 2050 and the fact that we have applied the principle of verifiable data and transactions at the effective date of the balance. This means that even though an increase in cover is expected, it will only be incorporated into the projection year by year once it can be verified. Finally, as regards the system's generosity rate, i.e. the quotient between the average pension and GDP per worker, the results presented in this paper show that there is an increase from 21.85% in 2009 to 24.48% in 2050, whereas in the other papers analysed it either remains unchanged or decreases slightly.

[23] The former Compulsory Old-Age and Permanent Disability Insurance regime (SOVI: Seguro Obligatorio de Vejez e Invalidez).

## 5.-Final remarks and future research

Compiling an actuarial balance of the pay-as-you-go system at set times is a practice found in Social Security Administrations in the most advanced countries. It is normally carried out by prestigious independent organizations, for example the Office of the Chief Actuary or equivalent in the US, Canada and the UK. The balance is usually audited and is aimed at depoliticizing the management of the system by bringing the planning horizon of the politicians closer to that of the system itself, revealing the pension system's true situation of solvency or sustainability, and quantifying the impact of any reforms to be carried out.

In this paper we have formulated an approximation of the US actuarial balance for the public retirement pension system in Spain for a set of credible scenarios in order to determine a consistent indicator of the system's financial health and enable us to answer the question as to whether there is any justification for reforming the pension system. This is an important point since only a short while ago the government authorities in Spain were systematically denying the existence of sustainability problems, MTIN (2008).

The results leave little room for doubt that parametric reform would be justified. Even under the most optimistic scenarios, the results of the solvency index and the actuarial balance itself are very negative. This begs the question as to whether the reform - without entering into a discussion about its being the most suitable one - should have been carried out earlier. It is likely that if there had been some sort of official, independent instrument produced from time to time, such as the actuarial balance compiled in this paper, the reform would indeed have been introduced earlier because, although the system's treasury situation enabled benefit payments to be made, the system's solvency, due to problems of actuarial imbalance caused by the lack of adjustment to the system's parameters and the projected effect of ageing, was already in a perilous state even though the impression it conveyed was the opposite. Taking into account the way the system has been affected by the economic crisis, i.e. fewer contributors and more pensioners, makes the solvency indicator deteriorate even faster.

A question closely linked to the previous one concerns what the impact of the pension reform would be. If an instrument such as that described had been in place, it would have been possible to show transparently what the benefits of the changes introduced into the system would be. It would also enable an assessment to be made to discover whether the reform is actually a solution to sustainability problems or whether it is simply a stopgap to defer treasury problems that will make it necessary to introduce more reforms in the not too distant future. Clearly this area needs to be investigated further and will be the subject of a future paper.

Finally, as other researchers such as Boado-Penas et al (2008) and Vidal-Meliá et al (2009) have recommended, it would certainly be advisable to incorporate into the Spanish public pension system the obligation to compile an actuarial balance every year in order to improve its transparency and solvency and to enable any reforms introduced into the system to be assessed. This would bring the system into line with the trend seen in other countries which aims to introduce methodology typical of accounting and actuarial analysis into the public management of pay-as-you-go systems.

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**Appendix 1: The aggregate accounting projection model (AAM) of spending on pensions.**

AAMs are often referred to by some authors as actuarial models, although paradoxically they take a more financial than actuarial approach since they are based on determining a succession of cash flow statements rather than focusing on the actuarial commitments taken on by the system. According to TEPC (2007) and Lefevbre (2007), they are also often used by public administrations and organizations. The Ageing Working Group, the technical working group of the economic policy committee of the European Union responsible for projecting expenditure, follows this basically deterministic approach, although not all countries apply it. The World Bank uses what is known as the PROST (Pension Reform Options Simulation Toolkit) model, which is based on this methodology, along with the International Labour Organization, which has its own model called the ILO Pension Model.

If we start from this simple identity:

$$EP_t \equiv L_t^p \cdot AP_t \qquad \textbf{[3.]}$$

where: $EP_t$ is expenditure on pensions in year t, $L_t^p$ is the number of pensioners during year t, and $AP_t$ is the average pension for year t. Following García-García (2009), the above identity can be developed as much as desired, in such a way that the typical form in which it is presented is:

$$\frac{EP_t}{GDP_t} = \overbrace{\underbrace{\frac{L_t^{+z}}{L_t^{e-z}}}_{\text{Old-age dependency ratio}}}^{\text{Demographic factors}} \cdot \overbrace{\underbrace{\frac{L_t^{e-z}}{L_t^{a}}}_{\text{Inverse of the participation rate}} \cdot \underbrace{\frac{L_t^{a}}{L_t^{e}}}_{\text{Inverse of the employment rate}}}^{\text{Economic factors}} \cdot \overbrace{\underbrace{\frac{L_t^{p}}{L_t^{+z}}}_{\text{Take up ratio}} \cdot \underbrace{\frac{AP_t}{\underbrace{\frac{GDP_t}{L_t^{e}}}_{\text{Average labor productivity}}}}_{\text{Benefit ratio}}}^{\text{Rules of the system and Economy}} \qquad \textbf{[4.]}$$

$L_t^{+z}$ is the population older than z years (the normal age of retirement, or the effective age of retirement) during year t, $L_t^{e-z}$ is the population aged between e years (minimum legal age to join the labour market) and z years during year t, $L_t^{a}$ is the active population in year t, $L_t^{e}$ is the employed population in year t, and $GDP_t$ is the Gross Domestic Product for year t at current year t prices.

In this case it can be seen that spending on pensions as a proportion of GDP can be broken down into the product of five factors:

1) $\frac{L_t^{+z}}{L_t^{e-z}}$ is the old-age dependency ratio, defined as the population aged over z years as a proportion of the working age population.

2) $\frac{L_t^{e-z}}{L_t^{a}}$ is the inverse of the participation rate, defined as the active population as a proportion of the working age population.

3) $\frac{L_t^{a}}{L_t^{e}}$ is the inverse of the employment rate, defined as the number of people working as a proportion of the active population.

4) $\frac{L_t^{p}}{L_t^{+z}}$ is the take-up ratio or the coverage of the pension system, defined as pensioners as a proportion of the population aged over z years.

5) $\frac{AP_t}{GDP_t/L_t^e}$ is the benefit ratio, defined as the ratio between the average pension and average work productivity.

With such a level of disaggregation it is easy to distinguish the three groups of factors that define the evolution of pension spending as a proportion of GDP (demographic, economic and and the rules governing the pension system (coverage, pension levels).). It should be pointed out that, in line with Boado-Penas and Vidal-Meliá (2011), from the point of view of the authority governing a particular pension system, it is better to relate all the magnitudes indexed to the system's contribution base in year t, and that is how it appears in reports compiled by long-established Social Security Administrations. In fact, if it is taken into account that the salary income that forms part of the GDP in any particular year $W_t$ can be expressed as the product of the average salary of the working population in the economy as a whole, $\overline{W}_t^e$ and working population $L_t^e$:

$$W_t = \overline{W}_t^e \cdot L_t^e \qquad \textbf{[5.]}$$

and if we consider that the number of contributors in year t $C_t = \beta_t \cdot L_t^e$, is a proportion $\beta_t$ of the working population obliged to contribute, and the average salary of the contributors during year t, $\overline{W}_t^{Cot}$, is $\overline{W}_t^{Cot} = \delta_t.\overline{W}_t^e$ is a proportion $\delta_t$ of the average salary of the working population of the economy as a whole, the aggregate contribution base for year t at year t current prices, $ACB_t$, will be:

$$ACB_t = \overbrace{\beta_t \cdot L_t^e}^{C_t}.\underbrace{\delta_t.\overline{W}_t^e}_{\overline{W}_t^{Cot}} = \beta_t.\delta_t.W_t \qquad \textbf{[6.]}$$

which, if substituted by the previous expression in 4,

$$\frac{EP_t}{ACB_t} = \overbrace{\underbrace{\frac{L_t^{+r}}{L_t^{e-r}}}_{\text{Old-age dependency ratio}}}^{\text{Demography}} \cdot \overbrace{\underbrace{\frac{L_t^{e-r}}{L_t^{a}}}_{\text{Inverse of the participation rate}} \cdot \beta_t \underbrace{\frac{L_t^{a}}{L_t^{e}}}_{\text{Inverse of the modified employment rate}}}^{\text{Economy}} \cdot \overbrace{\underbrace{\frac{L_t^{p}}{L_t^{+r}}}_{\text{Coverage rate}} \cdot \underbrace{\frac{AP_t}{\overline{W}_t^{Cot}}}_{\text{Financial ratio}}}^{\text{Pension system}} = \theta_t^{*} \quad \textbf{[7.]}$$

There remains an expression in which the financial ratio appears explicitly, which according to Plamondon et al (2002) is much more useful from the point of view of the authority that administers the system, and the inverse of the employment rate corrected by those who work and effectively contribute. It seems clear that the value of the quotient in equation 7 is the theoretical contribution rate $\theta_t^{*}$ which would have to be applied in that year in order for the system's income to be coincident with the benefits to be paid in that year, i.e. the contribution rate that maintains year-to-year financial equilibrium.

Income from contributions, like expenditure, can be broken down into the product of the number of contributors and the average contribution:

$$IC_t \equiv C_t \cdot \overbrace{\theta_t \cdot \overline{W}_t^{Cot}}^{AC_t} = \theta_t \cdot ACB_t \quad \textbf{[8.]}$$

where $IC_t$ is the income from contributions during year t, and $AC_t$ is the average contribution during year t.

Income from contributions as a proportion of GDP can be broken down into:

$$\frac{IC_t}{GDP_t} \equiv \frac{\overbrace{\theta_t \cdot \delta_t \cdot \beta_t \cdot \overbrace{\overline{W}_t^{e} \cdot L_t^{e}}^{W_t}}^{ACB_t}}{GDP_t} \quad \textbf{[9.]}$$

which according to the aggregate contribution base, naturally, is the contribution rate for each year: $\frac{IC_t}{ACB_t} \equiv \theta_t$

**Appendix 2: Brief description of the economic, financial and actuarial relations.**

This appendix gives a brief description of the program developed in Mahtlab®[24] which enables the results shown in Section 4 to be obtained.

A set of labour force participation rates for the population are assumed, distinguishing by age, gender and professional category for each period t equal to $LF(X,t,s)$. The labour force participation rate is understood by the following expression:

$$LF(X,t,s) = \frac{\overbrace{L^a(X,t,s)}^{\text{Active population}}}{\underbrace{L(X,t,s)}_{\text{Population}}} \quad \textbf{[10.]}$$

$$X = e, e+1, ..., z-1, z; \; t = 1,2,...T; s = 0,1$$

where z represents the maximum age an individual stays in the labour market.

[24] Mahtlab® is a high-level language and interactive environment that enables intensive skills to be performed computationally faster than with traditional programming languages such as C, C++ and Fortran.

The total active population for each period t is determined by aggregating the active population by age, gender and type $L_t^a = \sum_{X=e}^{z}\sum_{s=0}^{1} L^a(X,t,s)$. Afterwards the labour force participation rate for the economy as a whole can be obtained: $LF_t = \frac{L_t^a}{L_t^{e-z}}$

If a set of employment rates is assumed by $ER(X,t,s)$, distinguishing by gender and age too, for each period t the working population is defined by the following equation:

$$L_t^e(X,t,s) = ER_t(X,s) \cdot L_t^a(X,s)$$

**[11.]**

$$X = e, e+1, ..., z-1, z; \; t = 1,2,...T; \; s = 0,1$$

In the same way as for the total active population, the total working population is obtained by aggregating the population, $L_t^e = \sum_{X=e}^{z}\sum_{s=0}^{1} L_t^e(X,s)$.

The rate of variation (increase or decrease) in the working population can be obtained:

$$\Delta L_t^e = \frac{L_{t+1}^e - L_t^e}{L_t^e} \quad \textbf{[12.]}$$

If we add the assumption of the rate of variation in average work productivity $\Delta lp_t$, using the following accounting identity the rate of variation in GDP in real terms is obtained:

$$\Delta gdp_t = \Delta L_t^e + \Delta lp_t + \Delta L_t^e \cdot \Delta\Delta l_t \quad \textbf{[13.]}$$

The process continues determining the number of contributors and the average contributions. The contributors to social security will be divided up according to the regime in which they are registered:

$$C_t(X,s,r) = Cov_t(X,s,r) \cdot L^e{}_t(X,s) \quad \textbf{[14.]}$$

where $C_t(X,s,r)$ is the number of contributors of age X and gender S registered in regime r as working during year t, which in the start year is derived directly from SS data; and $Cov_t(X,s,r)$ is the proportion of workers that, having the obligation to contribute, actually do so.

Once the number of contributors has been projected, a projection has to be made for the average contribution. The first step for this is to obtain the contribution bases. Following Plamodom et al (2002), the contribution base for each contributor will vary in accordance with the following expression:

$$W_t(X,s,r) = SS(X,s,r) \cdot (1 + \Delta TW_t) \cdot \left[\frac{\overline{W}_{t-1}}{\overline{SS}_t}\right] \quad \textbf{[15.]}$$

where $W_t(X,s,r)$ is the contribution base of a contributor of age X, gender s and regime r during period t, $\Delta TW_t$ is the rate of annual variation in the accumulated tax base, $SS(X,s,r)$ is the salary scale of an individual of age X, gender s and regime r. The latter element is the one that, starting with the average contribution base, enables us to obtain heterogeneity as regards age, gender and regime.

The average salary scale weighted by the number of contributors is determined by:

$$\overline{SS}_t = \sum_{r=1}^{R}\sum_{s=0}^{1}\sum_{X=e}^{z}\left(\frac{SS(X,s,r)\cdot C_t(X,s,r)}{C_t}\right) \quad \textbf{[16.]}$$

where $C_t$ is the total number of contributors. Once the above variables have been obtained, they need to be filtered in order for the contribution bases to remain within their maximum and minimum limits.

$$CB_t(X,s,r) = \begin{cases} CB_t^d(r) & \text{si } \overline{W}_t^N(X,s,r) < CB_t^d(r) \\ W^E{}_t(X,s,r) & \text{si } CB_t^d(r) \le \overline{W}_t^N(X,s,r) < CB_t^u(r) \\ CB_t^u(r) & \text{si } \overline{W}_t^N(X,s,r) \ge CB_t^u(r) \end{cases} \quad \textbf{[17.]}$$

with $CB_t^d(r)$ and $CB_t^u(r)$ being the minimum and maximum contribution bases in force during period t.

Once the effective contribution base has been obtained, the effective contribution for each affiliate to the system can be calculated. This contribution will be the product of the effective contribution base and the contribution rate for the retirement contingency, $\theta$. Therefore the total income from contributions from affiliates of age X, gender s and regime r in period t, $IC_t(X,s,r)$, will be:

$$IC_t(X,s,r) = \underbrace{\theta_t \cdot CB_t(X,s,r)}_{\text{Income from contribution}} \cdot \underbrace{C_t(X,s,r)}_{\text{Number of contributors}} \quad \textbf{[18.]}$$

The contributions that each affiliate makes can be disaggregated according to the contingencies covered. Thus the income from contributions will be:

$$IC_t(X,s,r) = \sum_{i=1}^{I}\theta_t^i \cdot CB_t(X,s,r)\cdot C_t(X,s,r) = \sum_{i=1}^{I} IC_t^i(X,s,r) \quad \textbf{[19.]}$$

with $\theta_t^i$ being the contribution rate by contingency. Therefore the sum of the contribution rates by contingency should be equal to the total contribution rate[25] $\theta_t = \sum_{i=1}^{I}\theta_t^i$ y $IC_t^i(X,s,r)$, the income from contributions from affiliates of age X and gender s registered in regime r to cover contingency i[26].

The total income from contributions will be:

$$IC_t = \sum_{r=1}^{R}\sum_{s=0}^{1}\sum_{X=e}^{z}\sum_{i=1}^{I} IC_t(X,s,r) \quad \textbf{[20.]}$$

Finally, if we add to the previous result the contributions made by the state to cover items in connection with the supplement to the minimum retirement benefits or explicit redistribution, $OI_t$, the total income will be obtained:

[25] In the Spanish social security system there is no separation of contribution rates by contingency, and this naturally makes the accounts less clear and prevents us from compiling an actuarial income statement by contingency.

[26] In this paper is only considered the retirement contingency.

$$IT_t = IC_t + OI_t \quad [21.]$$

**Retirement pensions**.

The retirement pensions are projected first, and within them the pensioners already existing at 31/12/2009. Hence the evolution of the number of pensioners at the end of the year will be[27]:

$$L_t^B(X+1,s,r) = L_{t-1}^B(X,s,r) - DR_t^B(X,s,r) \quad [22.]$$

$$NL_t^B(X+1,s,r) = L_t^B(X+1,s,r) + 0{,}5DR_t^B(X,s,r) \quad [23.]$$

where $L_t^B(X,s,r)$: Number of pensioners of age X and gender s registered in regime r, already existing at 31/12 in year t-1 who continue as pensioners at 31/12 of year t (and therefore are one year older), and $DR_t^B(X,s,r)$: Number of decrements of age X and gender s registered in regime r. In the case of retirement, the only decrements considered are those due to death, which occur between 31/12 of year t-1 and 31/12 of year t. The number of deaths is determined by the projected mortality tables for each year t:

$$DR_t^B(X,s,r) = L_{t-1}^B(X,s,r) \cdot q_t(X,s) \quad [24.]$$

where $q_t(X,s)$: Mortality rate of an individual of age X and gender s for year t, i.e. the probability that an individual of age x and gender s will not live another year in year t.

Finally, $NL_t^B(X+1,s,r)$ is the average number of pensioners for the retirement contingency during period t, who at the beginning of the period were of age X and gender s registered in regime r. In other words, those that are alive at the end of the year $L_t^B(X+1,s,r)$ are distinguished from the average number for the year $NL_t^B(X+1,s,r)$, to which those who started to receive a pension that same year will need to be added.

For each period t of the projection, the annual pension already in payment in the base year to a retirement pensioner of age X and gender s registered in regime r, $P_t^B(X,s,r)$, will be determined according to the indexation rule:

$$P_t^B(X,s,r) = \text{Max}\left[\text{Min}\left[P_0^B(X,s,r) \cdot \prod_{i=1}^{t}(1+\pi(i)), P(r)_t^{Max}\right], P(r)_t^{Min}\right] \quad [25.]$$

where $\pi(i)$ is the projected value in year t of the variable by which the pensions are indexed, and $P_t^{MIN}(r)$ y $P_t^{MAX}(r)$ are the minimum and maximum retirement pensions for year t in regime r.

The spending on retirement pensions for pensioners already receiving pension will be determined by the product of that average pension and the number of pensioners by year:

$$EP_t^B(X,s,r) = NL_t^B(X,s,r) \cdot P_t^B(X,s,r) \quad [26.]$$

[27] Similar approaches to the evolution of the number of retirement pensioners can be found in TEPC (2007), Gil et al (2007) and Moral-Arce et al (2008), although no distinction is made between pre-existing pensioners and those “created” by the model.

with $EP_t^B(X,s,r)$ being the spending on retirement pensions for pensioners already receiving pension in the base year, of age X and gender s registered in regime r during period t.

The total spending on retirement pensions already in payment at the valuation date for each period t will be:

$$EP_t^B = \sum_{r=1}^{R}\sum_{s=1}^{S}\sum_{X=X_1^i}^{w-1} EP_t^B(X,s,r) \qquad \textbf{[27.]}$$

The number of new retirement pension recipients per age and gender during period t, $NR_t(X,s,r)$, will be obtained according to the following expression[28]:

$$NR_t(X,s,r) = Npc_t(X,s,r)\cdot PPR_t(X,s,r) \qquad \textbf{[28.]}$$

$$X = X_j^e,\dots,X_j^f \quad s = 1,2 \quad r = 1,..,R$$

with $Npc_t(X,s,r)$ being the new pensioner coefficient, i.e. the percentage of new entries of age X, gender s and regime r during year t out of the population that could potentially be entitled to that pension. $PPR_t(X,s,r)$ is the population of age X and gender s that could "potentially" be entitled to retirement pension during period t.

This variable, the proxy variable for the number of affiliates whether in employment or not, is obtained as the product of the average labour force participation rate of the generation born in year H (H = t - X), $\overline{LF}_t^H$ and the total population $L_t(X,s)$.

Once the number of new pensioners by age and gender has been obtained, they need to be distributed by years contributed towards retirement. This distribution will be carried out following this expression:

$$NR_t(X,k,s,r)) = NR_t(X,s,r)\cdot d(X,k,s,r) \qquad \textbf{[29.]}$$

$$X = X_j^e,\dots,X_j^f \qquad k = 1,\dots,K$$

where $NR(X,k,s,t)$ is the number of new pensioners from affiliates of age X, gender s and accumulated years contributed k during period t, and $d(X,s,k)$ is the coefficient enabling the new entries to be distributed according to the accumulated number of years contributed:

$$\sum_{k=1}^{K} d(X,k,s) = 1 \quad X = X_j^e,\dots,X_j^f \;\; s = 1,2 \qquad \textbf{[30.]}$$

Pensioners for the retirement contingency are divided according to age, gender, when they retired, the number of years contributed when they retired and regime. The number of pensioners can be calculated with the following expressions:

If $X = h$

$$\overbrace{L_t^P(h+1,s,h,a,k,r) = NR_t(h,s,k,r)}^{\text{Number of pensioners at the end of year t}} \qquad \textbf{[31.]}$$

[28] Based on ideas from the paper by Blanco et al. (2001), revisited by López-García (2008).

$$\overbrace{NL_t^P(h+1,s,h,k,r) = 0{,}5NR_t(h,s,k,r)}^{\text{Average number of pensioners in year t}} \quad \textbf{[32.]}$$

If $X > h$

$$L_t^P(X+1,s,h,k,r) = L_{t-1}^P(X,s,h,k,r) - DR_t^P(X,s,h,k,r) \quad \textbf{[33.]}$$

$$NL_t^P(X+1,s,h,k,r) = L_t^P(X+1,s,h,k,r) + 0{,}5DR_t^P(X,s,h,k,r) \quad \textbf{[34.]}$$

with $DR_t^P(X,s,h,k,r)$ being the number of deaths of pensioners of age x, gender s, who started to receive their pension when they were aged h years and accumulated k years of contributions in regime r. In this contingency their dynamic is determined by the mortality tables for that year, $DR_t^P(X,s,h,k,r) = L_{t-1}^P(X,s,h,k,r) \cdot q_t(X,s)$. $L_t^P(X+1,s,h,k,r)$ is the number of pensioners of age x, gender s, who started to receive their pension when they were aged h years and accumulated k years of contributions in regime r, who were already pensioners at the start of the year and continued being pensioners at the end of it. They will also be determined by the mortality tables for each year. $NL_t^P(X+1,s,h,k,r)$ is the average number of pensioners for the retirement contingency during period t, who at the start of the period were aged X, gender s, and who started to receive their pension when they were h years and accumulated k years of contributions, registered in regime r.

The average pension that each type of representative pensioner will receive will depend on the initial average pension and the successive indexations that come about. The initial average pension will be calculated according to the legislation in force, the number of years contributed, age at time of retirement, and the regulating base:

$$P_t^{1,P}(h,s,h,k,r) = \mathrm{Min}\left[\mathrm{Max}\left[\lambda_r^1(h) \cdot \alpha_r^1(AC_t(h,s,k,r)) \cdot BR_t^1(h,s,k,r), P_t^{1,MIN}(r)\right], P_t^{1,MAX}(r)\right]$$

**[35.]**

where $P_t^{1,P}(h,s,h,k,r)$: Initial pension for a retirement contingency pensioner of age h, with k years contributed and of gender s, registered in regime r; $\lambda_r^1(h)$: Percentage according to age that is applied to the regulating base to calculate the retirement pension; $AC_t(h,s,k,r)$: Average number of accumulated years contributed by an affiliate of age X; $\alpha_r^1(AC_t(h,s,k,r))$: Percentage according to the number of years contributed by the pensioner that is applied to the regulating base to calculate the retirement pension; $BR_t^1(h,s,k,r)$: Regulating base of an affiliate who starts to receive retirement pension at age h, with k years contributed, of gender s and registered in regime r. This variable will be determined by the following expression:

$$BR_{t+1}(h,s\,k,r) = BR_t(h,s,k,r) * (1 + tBR_t(X,s,r)) \quad \textbf{[36.]}$$

where $tBR_t(X,s,r)$ is the annual rate of variation of the regulating base. This variable will be obtained as a weighted average of the growth rate of the contribution bases for the 15 years previous to the year the regulation base is determined.

The evolution of the pension at dates later than the period in which it was awarded is determined by the rule of indexation in force:

$$P_{t'}^{1,P}(X,s,h,k,r) = \mathrm{Min}\left[\mathrm{Max}\left[P_t^{1,P}(h,s,h,k,r) \cdot \prod_{i=1}^{t}(1+\pi(i)), P_{t'}^{1,MIN}\right], P_{t'}^{1,MAX}\right] \quad \textbf{[37.]}$$

where $P_{t'}^{1,P}(X,s,h,k,r)$: Retirement pension in period t of a pensioner of age X and gender s registered in regime r who started to receive the pension at age h having contributed k years; and $t' = t + (X - h)$: Number of periods that have passed since the pensioner started to receive the pension.

Therefore spending on pensions for the all the affiliates of age X, gender S, regime r who started to receive retirement pension at age h is:

$$EP_t^P(X,s,h,k,r) = P_t^P(X,s,h,k,r) \cdot NL_t^P(X,s,h,k,r) \quad \textbf{[38.]}$$

The total spending on retirement pensions generated by the model can be expressed as:

$$EP_t^P = \sum_{r=1}^{R} \sum_{s=0}^{1} \sum_{h=X_1^I}^{X_1^F} \sum_{X \geq h}^{w-1} \sum_{k=1}^{K} EP_t^P(X,s,h,k,r) \quad \textbf{[39.]}$$

and the total spending on pensions:

$$EP_t = EP_t^B + EP_t^P \quad \textbf{[40.]}$$

**Surplus/Deficit and reserve fund of the pension system.**

The current treasury deficit or surplus (R) for period t is obtained as the difference between the total income from contributions and the total spending by the pension system:

$$R_t = IT_t - ET_t \quad \textbf{[41.]}$$

and therefore the evolution of the reserve fund is:

$$TF_t = TF_{t-1}(1+r) + bR_t \quad \textbf{[42.]}$$

where $TF_t$: Reserve fund for year t; b: Proportion of the result for year t which is allocated to make up the reserve fund, and r: the projected yield of the reserve fund.

**Appendix 3: Breakdown of main results by regime**

| Table 7: Elements of the 75-year actuarial balance 2010-2084. Present value at January 2010 in thousands of millions of euros. General regime. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **D-E (1,1) B-B** | D-E (1,2) B-O | D-E (1,3) B-P | D-E (2,1) O-B | **D-E (2,2) O-O** | D-E (2,3) O-P | D-E (3,1) P-B | D-E (3,2) P-O | **D-E (3,3) P-P** |
| **Income from contributions and government transfers** | 3,113.69 | 3,595.81 | 2,664.52 | 3,386.93 | 3,935.90 | 2,878.51 | 2,923.25 | 3,359.91 | 2,514.63 |
| **Spending on pensions** | 5,128.69 | 5,634.64 | 4,766.33 | 5,263.25 | 5,797.11 | 4,881.30 | 5,024.54 | 5,509.25 | 4,677.02 |
| **Initial deficit** | -2,015.01 | -2,038.83 | -2,101.81 | -1,876.32 | -1,861.22 | -2,002.80 | -2,101.29 | -2,149.34 | -2,162.38 |
| **Trust fund assets at start of period** | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 |
| **Open group unfunded obligation** | -1,974.87 | -1,998.69 | -2,061.67 | -1,836.18 | -1,821.08 | -1,962.66 | -2,061.16 | -2,109.21 | -2,122.25 |
| **Ending target trust fund** | 56.97 | 71.05 | 47.45 | 63.20 | 78.93 | 52.56 | 52.25 | 65.08 | 43.56 |
| **Results for the period** | -2,031.85 | -2,069.74 | -2,109.12 | -1,899.38 | -1,900.02 | -2,015.22 | -2,113.40 | -2,174.29 | -2,165.81 |
| **Aggregate contribution bases** | 15,993.08 | 18,490.68 | 13,658.23 | 17,419.81 | 20,266.76 | 14,774.80 | 14,999.49 | 17,259.62 | 12,876.73 |
| **Summarized income rate** | 19.72 | 19.66 | 19.80 | 19.67 | 19.62 | 19.75 | 19.76 | 19.70 | 19.84 |
| **Summarized cost rate** | 32.42 | 30.86 | 35.24 | 30.58 | 28.99 | 33.39 | 33.85 | 32.30 | 36.66 |
| **Actuarial balance** | **-12.70** | **-11.19** | **-15.44** | **-10.90** | **-9.38** | **-13.64** | **-14.09** | **-12.60** | **-16.82** |
| **Year of first deficit** | 2017 | 2019 | 2016 | 2017 | 2019 | 2016 | 2017 | 2019 | 2016 |
| **Reserve fund exhausted (year)** | 2027 | 2030 | 2025 | 2027 | 2030 | 2025 | 2027 | 2029 | 2025 |
| **Solvency index** | **0.6082** | **0.6372** | **0.5619** | **0.6434** | **0.6767** | **0.5916** | **0.5837** | **0.6099** | **0.5412** |
| **Results for the period as % share of GDP in 2010** | 192.79 | 196.39 | 200.12 | 180.22 | 180.28 | 191.21 | 200.53 | 206.31 | 205.50 |
| **Results for the period as % of present value of GDPs for the period** | 3.19 | 2.82 | 3.89 | 2.75 | 2.37 | 3.45 | 3.53 | 3.17 | 4.23 |

| Table 8: Elements of the 75-year actuarial balance 2010-2084.<br>Present value at January 2010 in thousands of millions of euros. Other regimes. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Items** | **D-E (1,1) B-B** | D-E (1,2) B-O | D-E (1,3) B-P | D-E (2,1) O-B | **D-E (2,2) O-O** | D-E (2,3) O-P | D-E (3,1) P-B | D-E (3,2) P-O | **D-E (3,3) P-P** |
| **Income from contributions and government transfers** | 581.11 | 664.16 | 502.45 | 622.16 | 714.71 | 534.68 | 551.67 | 627.53 | 479.18 |
| **Spending on pensions** | 1,178.82 | 1,252.62 | 1,110.84 | 1,204.59 | 1,282.10 | 1,132.04 | 1,158.54 | 1,228.62 | 10,93.17 |
| **Initial deficit** | -597.71 | -588.47 | -608.39 | -582.43 | -567.39 | -597.36 | -606.86 | -601.09 | -613.99 |
| **Trust fund assets at start of period** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Open group unfunded obligation** | -597.71 | -588.47 | -608.39 | -582.43 | -567.39 | -597.36 | -606.86 | -601.09 | -613.99 |
| **Ending target trust fund** | 7.84 | 9.22 | 6.65 | 8.62 | 10.16 | 7.31 | 7.23 | 8.50 | 6.14 |
| **Results for the period** | -605.55 | -597.69 | -615.05 | -591.05 | -577.55 | -604.67 | -614.09 | -609.59 | -620.13 |
| **Aggregate contribution bases** | 3,006.15 | 3,465.43 | 2,571.19 | 3,236.81 | 3,750.94 | 2,751.54 | 2,841.43 | 3,260.59 | 2,441.81 |
| **Summarized income rate** | 19.33 | 19.17 | 19.54 | 19.22 | 19.05 | 19.43 | 19.42 | 19.25 | 19.62 |
| **Summarized cost rate** | 39.47 | 36.41 | 43.46 | 37.48 | 34.45 | 41.41 | 41.03 | 37.94 | 45.02 |
| **Actuarial balance** | **-20.14** | **-17.25** | **-23.92** | **-18.26** | **-15.40** | **-21.98** | **-21.61** | **-18.70** | **-25.40** |
| **Year of first deficit** | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 |
| **Reserve fund exhausted (year)** | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 |
| **Solvency index** | **0.4897** | **0.5263** | **0.4496** | **0.5128** | **0.5531** | **0.4693** | **0.4732** | **0.5073** | **0.4359** |
| **Results for the period as % share of GDP in 2010** | 57.46 | 56.71 | 58.36 | 56.08 | 54.80 | 57.37 | 58.27 | 57.84 | 58.84 |
| **Results for the period as % of present value of GDPs for the period** | 0.95 | 0.82 | 1.13 | 0.86 | 0.72 | 1.03 | 1.03 | 0.89 | 1.21 |

| Table 9: Elements of the 50-year actuarial balance 2010-2059. Present value at January 2010 in thousands of millions of euros. General regime. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Items** | **D-E (1,1) B-B** | D-E (1,2) B-O | D-E (1,3) B-P | D-E (2,1) O-B | **D-E (2,2) O-O** | D-E (2,3) O-P | D-E (3,1) P-B | D-E (3,2) P-O | **D-E (3,3) P-P** |
| **Income from contributions and government transfers** | 2,258.17 | 2,515.62 | 2,004.48 | 2,346.35 | 2,619.90 | 2,077.21 | 2,192.46 | 2,438.19 | 1,950.08 |
| **Spending on pensions** | 3,504.29 | 3,701.41 | 3,358.33 | 3,532.30 | 3,733.14 | 3,383.60 | 3,482.34 | 3,676.62 | 3,338.48 |
| **Initial deficit** | -1,246.12 | -1,185.80 | -1,353.85 | -1,185.95 | -1,113.24 | -1,306.39 | -1,289.88 | -1,238.44 | -1,388.40 |
| **Trust fund assets at start of period** | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 | 40.13 |
| **Open group unfunded obligation** | -1,205.98 | -1,145.66 | -1,313.72 | -1,145.82 | -1,073.11 | -1,266.26 | -1,249.74 | -1,198.30 | -1,348.26 |
| **Ending target trust fund** | 77.22 | 87.55 | 69.68 | 79.50 | 90.21 | 71.68 | 75.45 | 85.48 | 68.12 |
| **Results for the period** | -1,283.20 | -1,233.21 | -1,383.40 | -1,225.32 | -1,163.32 | -1,337.94 | -1,325.19 | -1,283.78 | -1,416.39 |
| **Aggregate contribution bases** | 11,614.66 | 12,953.72 | 10,291.60 | 12,076.23 | 13,499.64 | 10,672.12 | 11,270.82 | 12,548.45 | 10,007.07 |
| **Summarized income rate** | 19.79 | 19.73 | 19.87 | 19.76 | 19.70 | 19.84 | 19.81 | 19.75 | 19.89 |
| **Summarized cost rate** | 30.84 | 29.25 | 33.31 | 29.91 | 28.32 | 32.38 | 31.57 | 29.98 | 34.04 |
| **Actuarial balance** | **-11.05** | **-9.52** | **-13.44** | **-10.15** | **-8.62** | **-12.54** | **-11.76** | **-10.23** | **-14.15** |
| **Year of first deficit** | 2017 | 2019 | 2016 | 2017 | 2019 | 2016 | 2017 | 2019 | 2016 |
| **Reserve fund exhausted (year)** | 2027 | 2030 | 2025 | 2027 | 2030 | 2025 | 2027 | 2029 | 2025 |
| **Solvency index** | **0.6417** | **0.6745** | **0.5964** | **0.6607** | **0.6957** | **0.6128** | **0.6275** | **0.6588** | **0.5842** |
| **Results for the period as % share of GDP in 2010** | 121.76 | 117.01 | 131.26 | 116.26 | 110.38 | 126.95 | 125.74 | 121.81 | 134.39 |
| **Results for the period as % of present value of GDPs for the period** | 2.77 | 2.40 | 3.38 | 2.55 | 2.17 | 3.16 | 2.95 | 2.57 | 3.56 |

| **Table 10: Elements of the 50-year actuarial balance 2010-2059.<br>Present value at January 2010 in thousands of millions of euros. Other regimes.** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Items** | **D-E (1,1) B-B** | D-E (1,2) B-O | D-E (1,3) B-P | D-E (2,1) O-B | **D-E (2,2) O-O** | D-E (2,3) O-P | D-E (3,1) P-B | D-E (3,2) P-O | **D-E (3,3) P-P** |
| **Income from contributions and government transfers** | 424.17 | 468.53 | 379.75 | 437.28 | 483.85 | 390.58 | 373.70 | 405.79 | 341.49 |
| **Spending on pensions** | 835.67 | 864.50 | 808.43 | 841.11 | 870.41 | 813.15 | 672.86 | 691.98 | 654.77 |
| **Initial deficit** | -411.50 | -395.96 | -428.68 | -403.83 | -386.56 | -422.57 | -299.16 | -286.19 | -313.28 |
| **Trust fund assets at start of period** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Open group unfunded obligation** | -411.50 | -395.96 | -428.68 | -403.83 | -386.56 | -422.57 | -299.16 | -286.19 | -313.28 |
| **Ending target trust fund** | 16.75 | 18.27 | 15.33 | 17.19 | 18.76 | 15.69 | 13.28 | 14.27 | 12.34 |
| **Results for the period** | -428.25 | -414.24 | -444.01 | -421.02 | -405.32 | -438.26 | -312.43 | -300.45 | -325.62 |
| **Aggregate contribution bases** | 2,199.16 | 2,447.39 | 1,950.39 | 2,273.49 | 2,534.76 | 2,011.67 | 1,955.28 | 2,124.07 | 1785.61 |
| **Summarized income rate** | 19.29 | 19.14 | 19.47 | 19.23 | 19.09 | 19.42 | 19.11 | 19.10 | 19.12 |
| **Summarized cost rate** | 38.76 | 36.07 | 42.24 | 37.75 | 35.08 | 41.20 | 35.09 | 33.25 | 37.36 |
| **Actuarial balance** | **-19.47** | **-16.93** | **-22.77** | **-18.52** | **-15.99** | **-21.79** | **-15.98** | **-14.15** | **-18.24** |
| **Year of first deficit** | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 |
| **Reserve fund exhausted (year)** | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 | 2010 |
| **Solvency index** | **0.4976** | **0.5308** | **0.4610** | **0.5095** | **0.5442** | **0.4712** | **0.5446** | **0.5746** | **0.5119** |
| **Results for the period as % share of GDP in 2010** | 40.63 | 39.30 | 42.13 | 39.95 | 38.46 | 41.58 | 29.65 | 28.51 | 30.90 |
| **Results for the period as % of present value of GDPs for the period** | 0.93 | 0.80 | 1.09 | 0.88 | 0.76 | 1.03 | 0.69 | 0.60 | 0.82 |