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Quantitative reduction in retirement benefits by the 2011 Spanish Social Security reform

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Abstract

El objetivo de este trabajo es analizar el efecto de la reciente reforma de la Seguridad Social en la prestación pública de jubilación. Las principales medidas que han afectado al cálculo de la prestación son: 1) extensión de la edad de jubilación de 65 a 67 años, 2) cambio en el número de bases de cotización requeridas para el cálculo, 3) cambio en el factor de ponderación asociado a los años cotizados en el momento de la jubilación y 4) cambio en las reglas de jubilación anticipada.

El estudio distingue tres grupos de pensionistas y hace una comparativa entre la pensión anterior (pensión de referencia) y la pensión calculada con la nueva legislación. La disminución en la prestación pública de jubilación oscila entre el 0 % y 16 % en función del salario y de los años de cotización en el momento de la jubilación.

Abstract

The aim of this paper is to analyse the effect of the recent Social Security reform on public retirement benefits. The main measures affecting the calculation of pensions are: 1) extension of the retirement age from 65 to 67 years, 2) changes in covered earnings of the retirement pension, 3) changes in the weighting factor associated with the number of years of contributions to the system at date of retirement and 4) changes in the early retirement rules.

The study distinguishes three group of pensioners and compares between previous pension (benchmark pension) and the pension calculated under the new legislation. The reduction in public retirement benefits ranges between 0% and 16% depending on wages and the number of years of contributions at the time of retirement.

Keywords: Public retirement pension, Social Security reforms
JEL: H55, J62

1 Introduction

The Spanish Parliament passed last August a law[1] reforming the country's Social Security system.

The reform is the final outcome of the agreement signed between the Spanish government, representatives of employers and the main unions on February 2^{nd}, 2011. It focuses on parametric changes to the Social Security system. The aim was to ensure the long-term sustainability of the public Social Security system taking into account the demographic challenge: an ageing population, an decreasing rate of fertility, an increasing old-age dependency ratio, and the changing age composition of the population.

Many researchers have made projections about the relationship between pension expenditure and GDP, under different methodologies and making a range of assumptions (see Jimeno, 2000; Alonso-Meseguer and Herce, 2003; Del Brío and González, 2004; Da-Rocha and Lores, 2005; Balmaseda et al., 2006; Gil et al., 2007; Jimeno et al., 2008; Díaz-Giménez and Díaz Saavedra, 2009; Vázquez, 2010; Moral-Arce et al., 2010). They have analysed different parametric measures seeking a sustainable system. Other researchers, however, have advocated the implementation of structural measures (see Vidal-Meliá et al., 2009).

The aim of these papers has been to analyse the system is sustainability. However in this analysis the main actor is the pensioner rather than the global system. In that sense, our aim is closer to that of Sarasa (2008), in a study that seeks to determine the extent to which previous reforms have increased the risk of poverty among the elderly.

We focus our the attention on the consequences for the retirement pensioners of four specific measures: 1) the extension of the retirement age from 65 to 67 years, 2) changes in covered earnings of the retirement pension, 3) changes in the weighting factor associated with the number of years of contributions to the system and 4) changes in the early retirement rules. The study focuses on the General Scheme because it represents 72% of all of Spain's retirement pensions.

We are interested in how the different parametric measures affect income when employees retire. The new pension and the new gross theoretical pen-

[1]Ley 27/2011, de 1 de agosto, sobre actualización, adecuación y modernización del sistema de Seguridad Social (BOE number 184, August 2^{nd}, 2011 and errata in BOE number 240, October 5^{th}).

sion replacement rate[2] are analysed and their reductions are quantified. We introduce a more general concept: the variation in public retirement benefits that reflects the variation in the retirement pension due to the application of the parametric measures plus the loss of two years' pension.

In general, the implementation of a reform is gradual and, therefore, a transitional period is opened up to develop the new measures. However, in this paper we assume the new legislation to be fully developed in order to evaluate its effect.

We have quantified the reduction in public retirement benefits and we conclude that the variation is between 0% to 16% depending on wages, the number of years of contributions at the time of retirement and the retirement age. The reduction is most marked in the pensions of those in the lowest wage bracket and with fewest contribution to the scheme.

The paper is organized as follows. Section 2 describes the benchmark pension obtained under the previous legislation. Section 3 introduces the parametric measures adopted. Section 4 describes the methodology applied. Section 5 quantifies the effect on the retirement pension, on the theoretical replacement rate and on the reduction in the public retirement benefits for the three collectives selected. Section 6 concludes.

2 The benchmark pension

The benchmark pension is calculated under the retirement rules governing since 1985 and the changes introduced by the 1997 reform and 2002, 2007 amendments.

The ordinary retirement pension requires contributions to have been made to the Social Security system for at least 15 years, of which at least two should be within the 15 years prior to retirement.

The monthly pension is the product of three variables:

1. Earnings during the last 180 months before the date of retirement (BR_t).[3]

[2]ISG Report states that theoretical replacement rates provide the possibility to look at individual case studies and evaluate to what extent current and future pension systems ensure that the elderly have the resources to support adequate standards of living.

[3]Known as the *Base Reguladora.*

2. Weighting factor associated with number of years contributing to the system at the date of retirement (β_t). It is given by a piecewise linear function.

3. Early retirement factor at date of retirement (μ_t)[4].

Then, we can state:

$$_{Ret}Pens_t = \beta_t \cdot \mu_t \cdot BR_t \tag{1}$$

where,
t : Date of retirement
$_{Ret}Pens_t$: Monthly retirement pension at t
β_t : Weighting factor associated with number of years contributing to the system at t

$$\beta_t = \begin{cases} 0 & \text{if} \quad C_t < 15 \\ 0.5 + 0.03 \cdot (C_t - 15) & \text{if} \quad 15 \leq C_t < 25 \\ 0.8 + 0.02 \cdot (C_t - 25) & \text{if} \quad 25 \leq C_t < 35 \\ 1 & \text{if} \quad C_t \geq 35 \end{cases} \tag{2}$$

where,
C_t : number of years contributing at t

μ_t : Weighting factor associated with early retirement at t

$$\mu_t = [1 - 0.08 \cdot (x - x^e)]$$

where, (3)
x : ordinary retirement age in years
x^e : early retirement age in years

BR_t : 180 monthly covered earnings before t

$$BR_t = \frac{\sum_{i=1}^{24} BC_i + \sum_{i=25}^{180} BC_i \cdot CA(i,25)}{210} \tag{4}$$

where,

[4]Voluntary early retirement is available from age 60 for people entering the system before 1/1/1967. In this case, the pension is reduced 8% for each year by which the date of retirement is brought forward.

BC_i : Contribution base at month *i-th*, for
$i = \{1, 2, \cdots 180\}$
$CA(i, 25)$: Updating coefficient contribution bases
from month $i - th$ to month $25 - th$

The contribution base, BC_i, is limited yearly depending on the level at which the worker is included in the General Scheme. The contribution base is limited yearly by a maximum contribution level BC_i^{max} and by a minimum level BC_i^{min}.

$$BC_i^{min} \leq BC_i \leq BC_i^{max}$$

The expression (1) is replaced by:

$$_{Ret}Pens_t = \beta_t \cdot \mu_t \cdot \frac{\sum_{i=1}^{24} BC_i + \sum_{i=25}^{180} BC_i \cdot CA(i, 25)}{210} \tag{5}$$

Also, the retirement pension cannot be higher than a limited yearly amount $_{Ret}Pens_t^{max}$ nor can it be lower than a limited yearly amount $_{Ret}Pens_t^{min}$.

$$_{Ret}Pens_t = \begin{cases} {}_{Ret}Pens_t^{min} & \text{if } {}_{Ret}Pens_t <_{Ret} Pens_t^{min} \\ \beta_t \cdot \mu_t \cdot BR_t & \text{if } {}_{Ret}Pens_t^{min} <_{Ret} Pens_t <_{Ret} Pens_t^{max} \\ {}_{Ret}Pens_t^{max} & \text{if } {}_{Ret}Pens_t >_{Ret} Pens_t^{max} \end{cases}$$

The yearly amount is 14 times the monthly pension.

In 2012 the pension is being calculated as the benchmark pension. This will be followed by a transitional period that will be completed at the beginning of 2027.

3 The parametric reform

The main parametric reform of the new law passed last August 2011 is analysed in the following order:

1. Extension of the retirement age from 65 to 67 years.
2. Changes in covered earnings to calculate the retirement pension.

3. Changes in the weighting factor associated with number of years contributing to the system at date of retirement.

4. Changes to the early retirement rules.

3.1 Measure 1: Extension of the ordinary retirement age

The ordinary retirement age before the reform was 65 years ($x = 65$). To keep the ordinary retirement age at 65 years with the application of the new law ($x^m = 65$), the employee must have contributed to the system for at least 38 years and six months on retiring. Otherwise he must wait until he is 67 ($x^m = 67$). This means that there are people who can retire at 65 while others must wait until they are 67.

3.2 Measure 2: Changes to the BR_t to calculate the pension

The change in the formula means having to increase the number of monthly contribution bases from 180 to 300. Therefore (4) is replaced by:

$$BR_t^m = \frac{\sum_{i=1}^{24} BC_i + \sum_{i=25}^{300} BC_i \cdot CA(i,25)}{350} \tag{6}$$

where,

BR_t^m : Covered earnings in the last 300 months before the date of retirement

BC_i : Contribution base at month *i-th* $\quad \forall\, i = \{1, 2, \cdots 300\}$

$CA(i, 25)$: Updating coefficient contribution bases from month *i-th* to month *25-th*

3.3 Measure 3: Changes to β_t associated with period of contributions

The weighting factor associated with the number of years contributing to the system on retirement in expression (2) is modified. The pension will increase 0.19% for each additional month to 15 years contributed during 247 months.

The increment in the $248-th$ additional month will be 0.18% in order to obtain 100% of the pension. Therefore expression (2) is replaced by:

$$\beta_t^m = \begin{cases} 0 & \text{if} \quad C_t^m < 180 \\ 0.5 + 0.0019 \cdot (C_t^m - 180) & \text{if} \quad 180 \leq C_t^m < 428 \\ 0.9712 + 0.0018 \cdot (C_t^m - 428) & \text{if} \quad 428 \leq C_t^m < 444 \\ 1 & \text{if} \quad C_t^m \geq 444 \end{cases} \tag{7}$$

where,

β_t^m : Modified weighting factor associated with number of months contributing at t

C_t^m : Number of months contributing at t

The comparative plot of expressions (2) and (7) is:

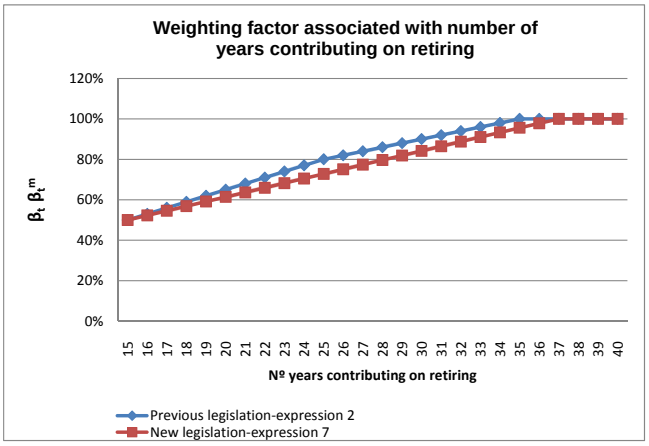

Figure 1: Differences between β_t and β_t^m

As we can observe Figure 1, if the number of years spent contributing is less than 37, the modified weighting factor is always below the one under the previous legislation.

3.4 Measure 4: Changes to μ_t associated with voluntary early retirement

The new requirements for voluntary retirement are: a) being at least 63 years old and b) having contributed to the system for at least 33 years. The reduction in the pension will be based on the quarters that remain to reach the legal retirement age. Expression (3) is modified by:

$$\mu_t^m = \begin{cases} (1 - 0.01875 \cdot T) & \text{if} \quad \frac{C_t^m}{12} < 38.5 \\ \\ (1 - 0.01625 \cdot T) & \text{if} \quad \frac{C_t^m}{12} \geq 38.5 \end{cases} \tag{8}$$

where,

μ_t^m : Modified early retirement factor at t

C_t^m : Contributed months at time t

T : Number of quarters that remain to reach the legal retirement age

There is a limit in the pension defined by:

$$_{Ret}Pens_t = \begin{cases} {}_{Ret}Pens_t^{min} & \text{if} \quad {}_{Ret}Pens_t^m <_{Ret} Pens_t^{min} \\ \beta_t^m \cdot \mu_t^m \cdot BR_t^m & \text{if} \quad {}_{Ret}Pens_t^{min} <_{Ret} Pens_t^m <_{Ret} Pens_t^{max} \\ {}_{Ret}Pens_t^{max} \cdot (1 - 0.0025 \cdot T) & \text{if} \quad {}_{Ret}Pens_t^m >_{Ret} Pens_t^{max} \cdot (1 - 0.0025 \cdot T) \end{cases}$$

The comparative plot of expressions (3) and (8) is:

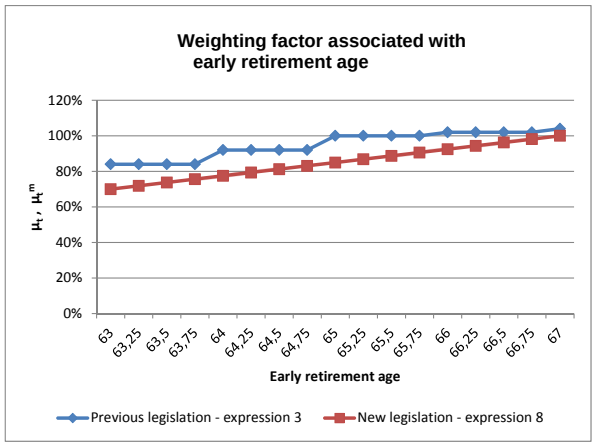

Figure 2: Differences between μ_t and μ_t^m

Until now we have considered the effect of each of the four measures adopted in the new law separately. Now, the combination of these measures transforms expression (1) into:

$$_{Ret}Pens_t^m = \beta_t^m \cdot \mu_t^m \cdot BR_t^m \tag{9}$$

4 Methodology applied to quantify the effect of the reform

In order to quantify the combined effect of all the measures that constitute in the reformed retirement law, we follow four steps:

1. Three collectives are distinguished depending on the time that they have contributed to the system at retirement date.

2. New pension and new gross theoretical pension replacement rate are calculated in order to be compared with the previous legislation.

3. The variation of the public retirement pension, in relative terms, is analysed. At this point, we introduce a more general concept, namely the variation in the public retirement benefits.

4. The new rules regarding early retirement are used to maintain the retirement age at 65 years under certain constraints.

STEP 1: We divide the collective into three groups depending on the length of time spent contributing to the system:

a) Collective 1: Employees with $C_t \geq 38.5$ years at 65.

b) Collective 2: Employees with $35 \leq C_t < 38.5$ years at 65.

c) Collective 3: Employees with $25 \leq C_t < 35$ years at 65.

Collective 1: People who have contributed to the system for at least 38 years and 6 months when they reach 65 years. The retirement age for this group is 65 years under both laws ($x = x^m = 65$). No reduction coefficient is applied in the formula for contributions to the retirement years ($\beta_t = \beta_t^m = 1$) and the factor associated with early retirement is not involved ($\mu_t = \mu_t^m = 1$). The only difference lies in the determination of the BR_t^m ($BR_t^m \neq BR_t$).

- Sub-collective 1.1: Not affected by maximum pension
- Sub-collective 1.2: Affected by maximum pension

Measure 2 affects Collective 1.

Collective 2: People who have contributed to the system for more than 35 years and less than 38 years and 6 months when they reach 65 years. The new pension of this second group is different in two aspects to the benchmark pension: first, the ordinary retirement age at 67 years ($x^m = 67$) and, second, the formula for calculating the BR_t^m ($BR_t^m \neq BR_t$).

The fact of increasing the retirement age to 67 years has the collateral effect of increasing the contributions to the system to 37 years ($\beta_t^m = \beta_t = 1$). Moreover, until now the factor associated with early retirement has not been involved($\mu_t^m = \mu_t = 1$).

- Sub-collective 2.1: Not affected by maximum pension

- Sub-collective 2.2: Affected by maximum pension

Measures 1 and 2 affect Collective 2.

However, this collective can retire at 65 if they fulfil the requirements established for early retirement (at least 63 years of age and 33 years contributing to the system) and described in the previous section.

In this case, measure 2 ($BR_t^m \neq BR_t$), measure 3 ($\beta_t^m \neq \beta_t$; $\beta_t^m < 1$) and measure 4 ($\mu_t^m \neq \mu_t$; $\mu_t^m < 1$) affect Collective 2.

Collective 3: People who have contributed to the system for more than 25 years and less than 35 years when they reach 65 years. The differences between the two pensions are due to all three factors: new retirement age ($x^m = 67$), the formula for calculating the BR_t^m ($BR_t^m \neq BR_t$), and the factor associated with the contributions to the system at the age retirement age ($\beta_t^m \neq \beta_t$; $\beta_t^m < 1$)

- Sub-collective 3.1: Not affected by maximum pension
- Sub-collective 3.2: Affected by maximum pension

Measures 1, 2 and 3 affect Collective 3.

Part of this collective can retire at 65 age too if they fulfil the requirements established at early retirement (only if they have contributed to the system for 33 or 34 years). In this case all the measures affect the collective: measure 1, measure 2, measure 3 and measure 4. For this collective we focus on workers that have to wait until they are 67.

STEP 2: We project the monthly pension at the age of retirement according to expressions (1) and (9) for different annual wage levels today and considering different numbers of years contributing to the Social Security system.

The retirement date occurs after the transitional period has terminated and the new legislation is fully developed.

The annual wage levels today analysed in the present study are related with:

a) Inter-professional minimum wage[5].

[5] 9,000 euros for 2011.

b) Spanish average wage[6].

c) Maximum retirement pension[7].

d) Maximum contribution base[8].

e) A wage above the maximum contribution base[9].

A set of hypotheses are necessary to project the pensions. We highlight the following:

1. The contribution base is taken to be the total wage. It is limited yearly by a maximum contribution level BC_i^{max} and by a minimum level BC_i^{min}.
2. Consumer price index (cpi) is estimated to be 2%. It is necessary to project growth in pensions, maximum contribution bases, etc.
3. Growth in wages (w) is estimated to be 3%.
4. Interest discount rate (i) is estimated to be 4%.
5. Mortality table used is that of the Social Security to calculate retirement capital cost.[10]

The projected monthly pension is calculated according to the previous legislation ($_{Ret}Pens_t$) and to the new one ($_{Ret}Pens_t^m$). We take into account the maximum and minimum annual pension amounts in this calculation. In the case of the minimum pension, the Spanish legislation considers two cases depending on whether the pensioner has a spouse with earnings or not. We have taken the first case.

Other important information is the gross theoretical pension replacement rate in both cases. This variable is defined as the level of public pension as a percentage of previous individual earnings at the moment of taking up the pension for a hypothetical worker. It measures the variation in living standards when a typical worker retires.

[6]National Statistics Institute. Spanish Statistical Office reports of 22,500 euros for 2009. We have worked with 25,000 euros for 2011.

[7]35,000 euros for 2011.

[8]38,000 euros for 2011.

[9]60,000 euros for 2011.

[10]Orden TAS/4045/2005 of 27th December 2005. BOE 310.(28/12/2005).

The gross theoretical pension replacement rate is expressed as $TPRR_t = \frac{{}_{Ret}Pens_t}{W_t}$ if it is calculated with the benchmark pension and as $TPRR_t^m = \frac{{}_{Ret}Pens_t^m}{W_t}$ when calculated with the new pension. W_t is the last monthly salary before retirement date.

STEP 3: In a first stage, we take the pension variation in absolute terms:

$$\triangle_{{}_{ret}Pens_t} = {}_{Ret}\, Pens_t - {}_{Ret}\, Pens_t^m$$

At this point, it should be noted that at certain times we compare the pension calculated at 65 (for example, the benchmark pension) and the pension calculated at 67 years. To make this possible from a financial point of view, we estimate the pension calculated at 65, two years later using the estimated *cpi*.

To compare the effect, we express the pension variation in relative terms:

$$\frac{\triangle_{{}_{ret}Pens_t}}{{}_{Ret}Pens_t} \tag{10}$$

In a second stage, we consider that, in the case of retirement at 67 years instead of 65, the employee extends his employment life by two years while his life as a pensioner is reduced by two years with the same life expectancy. This loss of pension income during two years is not considered in the previous variable and for this reason we introduce a more general concept, the variation in public retirement benefits ($\triangle_{PRB_t}$).

This new variable reflects the variation in retirement pensions due to the application of parametric measures plus the loss of two years' pension. The actuarial value at 65 years of the two streams of pension payments is used to quantify the variable.

Actuarial value at t of the annual stream of pension payments under previous legislation is expressed as:

$$PRB_t = \sum_{j=0}^{h-x} {}_{Ret}Pens_{t+j} \cdot 14 \cdot (1+i)^{-j} \cdot {}_j\, p_x$$

where:

$t:$	Date of retirement
${}_{Ret}Pens_{t+j} \cdot 14:$	Annual retirement pension at $t+j$ under the previous legislation
$h:$	Limiting age of mortality table
$x:$	Retirement age under the previous legislation
$i:$	Interest discount rate
${}_jp_x:$	Probability of surviving j years at age x obtained from Social Security mortality table

Expression of actuarial value at t of the annual stream of pension payments under the new legislation is:

$$PRB_t^m = \sum_{j=0}^{h-x^m} {}_{Ret}Pens_{t+j}^m \cdot 14 \cdot (1+i)^{-j} \cdot {}_j\, p_{x^m}$$

where:

$t:$	Date of retirement
${}_{Ret}Pens_{t+j}^m \cdot 14:$	Annual retirement pension at $t+j$ under the new legislation
$h:$	Limiting age of mortality table
$x^m:$	Retirement age under the new legislation
$i:$	Interest discount rate
${}_jp_{x^m}:$	Probability of surviving j years at age x^m obtained from Social Security mortality table

We take the variation in public retirement benefits in absolute terms at 65 years:

$$\triangle_{PRB_t} = PRB_t - PRB_t^m \cdot (1+i)^{-(x^m-x)} \cdot {}_{x^m-x}\, p_x$$

To compare the effect, we express the variation in public retirement benefits relative terms:

$$\frac{\triangle_{PRB_t}}{PRB_t} \tag{11}$$

STEP 4: We calculate expressions (1) and (9) to evaluate the effect of maintaining the retirement age under the new conditions of voluntary early retirement. The new rules are based on the number of years contributing to the system at the time of application and the quarters remaining until ordinary retirement.

5 Results

Collective 1:

This group is affected only by changes to the expression that calculates the BR_t of the benchmark pension. The pension is reducing effect is due to the increase from 15 to 25 years of contributions in the formula and BR_t is replaced by BR_t^m (measure 2).

The change to the gross theoretical pension replacement rate and the variation in public retirement pension in relative terms and for different salaries are summarised in Table 1.

Table 1: Collective 1. Ordinary retirement age: 65 years

$Collective$	W_{2011} $Annual$	$TPRR_t \rightarrow TPRR_t^m$	$\frac{\triangle_{ret}Pens_t}{_{ret}Pens_t}$
1.1.	9,000	90.72% → 86.46%	−4.70%
1.1.	22,500	90.72% → 86.46%	−4.70%
1.1.	25,000	90.72% → 86.46%	−4.70%
1.2.	35,000	83.82% → 83.82%	0%
1.2.	38,000	77.21% → 77.21%	0%
1.2.	60,000	48.90% → 48.90%	0%

The gross theoretical pension replacement rate calculated for the average wage and lower (sub-collective 1.1) is around 91%[11]. However, as we can see in the table, for employees affected by limited contribution bases (sub-collective 1.2), the replacement rate decreases as the wage increases. The difference is between 77% and 49%. In these cases, employees must complement their retirement pension with private products in order to maintain their standard of living.

With the application of measure 2, we see that the public pension falls 4.7%, while the effect of applying the legislative reform is void for wages above the maximum retirement pension.

[11] According to the percentage reported for the Spanish Case in the annex to the ISG report on theoretical replacement rates (2009).

Collective 2:

This group is affected by the change to the BR_t too. BR_t is replaced by BR_t^m as in collective 1 (measure 2). In collective 2 we can distinguish cases where employees must delay retirement by two years ($x^m = 67$) (measure 1) and cases in which the retirement age is maintained at 65 years ($x^m = 65$) since the conditions for early retirement are satisfied (measure 4).

In Table 2 are shown the results in the case of a delay to the retirement.

Table 2: Collective 2. Ordinary retirement age: 67 years

$Collective$	W_{2011} $Annual$	$TPRR_t \rightarrow TPRR_t^m$	$\frac{\triangle_{ret}Pens_t}{_{ret}Pens_t}$
2.1.	$9,000$	$88.97\% \rightarrow 86.45\%$	-2.83%
2.1.	$22,500$	$88.97\% \rightarrow 86.45\%$	-2.83%
2.1.	$25,000$	$88.97\% \rightarrow 86.45\%$	-2.83%
2.2.	$35,000$	$82.20\% \rightarrow 82.20\%$	0%
2.2.	$38,000$	$75.71\% \rightarrow 75.71\%$	0%
2.2.	$60,000$	$47.95\% \rightarrow 47.95\%$	0%

For this collective, the gross theoretical pension replacement rate calculated with the benchmark pension decreases slightly with respect to collective 1. On the other hand, the amount of pension at 67 years is higher than two years earlier, thus counteracting part of the decrease generated by the number of years contributing to the system required in the BR_t^m formula. This is why the decrease in sub-collective 2.1 is less than that in sub-collective 1.1. However, sub-collective 2.2 is not affected, as was also the case of sub-collective 1.2.

Under this scenario, we observe that the pension decrease and the change in gross theoretical pension replacement obtained in Table 2 do not reflect the fact that the pensioner is receiving two years less retirement pension. At this point, we introduce the variation in public retirement benefits in relative terms ($\frac{\triangle_{PRB_t}}{PRB_t}$). Each stream finishes at the limiting age in the mortality table. The results obtained are shown in Table 3.

Table 3: Collective 2. Ordinary retirement age: 67 years

$Collective$	W_{2011} $Annual$	$\frac{\triangle_{PRB_t}}{PRB_t}$
2.1.	$9,000$	-12.02%
2.1.	$22,500$	-12.02%
2.1.	$25,000$	-12.02%
2.2.	$35,000$	-9.45%
2.2.	$38,000$	-9.45%
2.2.	$60,000$	-9.45%

Under this new scenario, sub-collective 2.1 and sub-collective 2.2 are affected by the new law. The effect of the application of parametric measures plus the loss of two years' pension is a reduction in public retirement benefits for the pensioner. As we can appreciate, the percentage of decrease is considerable in both cases.

Finally, for collective 2, we study the effect on the retirement pension if the employee decides to retire at 65 years under the early retirement conditions aware that they are highly exacting. In this case, Table 2 is replaced by Table 4.

Table 4: Collective 2. Early retirement age: 65 years

$Collective$	W_{2011}	$TPRR_t \rightarrow TPRR_t^m$	$\frac{\triangle_{ret}Pens_t}{_{ret}Pens_t}$
2.1.	$9,000$	$90.72\% \rightarrow 77.45\%$	$-14.62\%^*$
2.1.	$22,500$	$90.72\% \rightarrow 76.19\%$	-16.02%
2.1.	$25,000$	$90.72\% \rightarrow 76.19\%$	-16.02%
2.2.	$35,000$	$83.82\% \rightarrow 75.19\%$	-10.30%
2.2.	$38,000$	$77.21\% \rightarrow 72.16\%$	-6.54%
2.2.	$60,000$	$48.90\% \rightarrow 46.43\%$	-5.04%

(*) Minimum pension is applied in this case.

As we can appreciate, maintaining the retirement age, if the employee is eligible for early retirement, punishes the pensioner with the receipt of a

lesser amount of retirement pension. In this scenario sub-collective 2.1 and sub-collective 2.2 are affected. The difference, if we compare with Table 2, is substantial.

In the following table, we summarize the effect of the new law on the public retirement benefit of a employee that belongs to collective 2 when the retirement age is: $x^m = 67$ and $x^m = 65$.

Table 5: Collective 2. Reduction in public retirement benefits

W_{2011}	$Collective$	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x^m = 67$ $ordinary$	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x^m = 65$ $early$
2.1	$9,000$	-12.02%	-14.62%
2.1	$22,500$	-12.02%	-16.02%
2.1	$25,000$	-12.02%	-16.02%
2.2	$35,000$	-9.55%	-10.30%
2.2	$38,000$	-9.45%	-6.54%
2.2.	$60,000$	-9.45%	-5.04%

Collective 3:

This group is affected by the change in the BR_t formula, which is replaced by BR_t^m (measure 2), by the change in the ordinary retirement age x, which is replaced by x^m (measure 1) and finally, by the change in the weighting factor associated with the period of contribution at t β_t which is replaced by β_t^m(measure 3).

Most cases have no possibility of accessing early retirement at 65 years since they have not contributed for 33 years. For this reason, we focus on employees that have to wait until 67 years.

As the number of years contributed to the system increases, the effect of the reduction in measure 3 weakens. In order to evaluate the effect of measure 3, in the next table we include two cases. The first is when the number of years contributed at 67 is 27 and the second is when the number of years contributed at 67 is 36. The range of variation is between -6.04% and -2.99% for yearly salaries below 35,000 euros and between 5.98% and 0% for wages with a limited contribution base.

The weighting factor associated with period of contribution at t (β_t^m) plays an important role when we calculate the gross theoretical pension replacement rate for collective 3. We note a sizeable difference for the same salary between the gross theoretical pension replacement rate calculated with 27 years of contribution and with 36 years of contributions.

Sub-collective 3.1 is affected by the application of the three measures, while pensions are not modified for part of sub-collective 3.2, namely those that have contributed for more than 34 years on retiring.

Table 6: Collective 3. Ordinary retirement age: 67 years

Collective	W_{2011}	$TPRR_t \to TPRR_t^m$ $C_{67} = 27$	$\frac{\triangle_{ret}Pens_t}{_{ret}Pens_t}$ $C_{67} = 27$	$TPRR_t \to TPRR_t^m$ $C_{67} = 36$	$\frac{\triangle_{ret}Pens_t}{_{ret}Pens_t}$ $C_{67} = 36$
3.1.	9,000	73.00% → 73.00%	0%*	87.18% → 84.58%	−2.99%
3.1.	22,500	71.17% → 66.87%	−6.04%	87.18% → 84.58%	−2.99%
3.1.	25,000	71.17% → 66.87%	−6.04%	87.18% → 84.58%	−2.99%
3.2.	35,000	69.67% → 65.50%	−5.98%	82.20% → 82.20%	0%
3.2.	38,000	65.19% → 62.45%	−4.21%	75.71% → 75.71%	0%
3.2.	60,000	41.29% → 39.95%	−3.25%	47.95% → 47.85%	0%

(*) Minimum pension is applied in this case.

As with collective 2, we calculate the reduction in public retirement benefits. We add the reduction in the pensions of Table 6 and the effect of a two-year loss of pension.

Table 7: Collective 3. Reduction in public retirement benefits

Collective	W_{2011}	$\frac{\triangle_{PRB_t}}{PRB_t}$ $C_{67} = 27$	$\frac{\triangle_{PRB_t}}{PRB_t}$ $C_{67} = 33$
3.1.	9,000	−9.04%	−11.76%
3.1.	22,500	−14.54%	−11.76%
3.1.	25,000	−14.54%	−11.76%
3.2.	35,000	−14.48%	−9.04%
3.2.	38,000	−12.87%	−9.04%
3.2.	60,000	−12.00%	−9.04%

We conclude with a table that summarizes the decrease in the public benefits attributable to the reform of the Social Security system for the three collectives.

Table 8: Reduction in public retirement benefits following the reform of the Social Security system

W_{2011}	Col	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x=65$	Col	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x=67$ $C_{67}\geq 37$	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x=65$ $C_{65}\geq 35$	Col	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x=67$ $C_{67}=27$	$\frac{\triangle_{PRB_t}}{PRB_t}$ $x=67$ $C_{67}=36$
$9,000$	1.1	-4.7%	2.1	-12.02%	-14.62%	3.1	-9.04%	-11.76%
$22,500$	1.1	-4.7%	2.1	-12.02%	-16.02%	3.1	-14.54%	-11.76%
$25,000$	1.1	-4.7%	2.1	-12.02%	-16.02%	3.1	-14.48%	-11.76%
$35,000$	1.2	0%	2.2	-9.55%	-10.30%	3.2	-12.87%	-9.04%
$38,000$	1.2	0%	2.2	-9.45%	-6.54%	3.2	-12.00%	-9.04%
$60,000$	1.2.	0%	2.2.	-9.45%	-5.04%	3.2	-10.55%	-9.04%

6 Conclusions

The main conclusions that we draw from the study can be summarised as follows:

With the new legislation, the number of years contributing to the Social Security system acquires greater importance because it affects not only β_t but also determines the age at which a employee can retire. We distinguish three types of group and within each we differentiate if they are affected by a maximum contribution or not.

The variables used to quantify the effect of the reform are the pension variation in relative terms and the variation in public retirement benefits in relative terms. This second variable reflects the decrease in the retirement pension due to the application of parametric measures plus the loss of two years of pension. We quantify the difference between the actuarial value at t of the annual stream of benchmark pension payments and the actuarial value at t of the annual stream of pension payments under the new legislation.

Our aim was to analyse how the reform affect pensioners. We have quantified the reduction in public retirement benefits and we conclude that the

variation is between 0% to 16% depending on wages, years of contributions at the time of retirement and retirement age. The reduction is more marked in the pensions of those in the lowest wage bracket and with fewest contributions to the system. The results are summarized in Table 8.

The only employees not affected by the implementation of new legislation are those that can still retire at 65, whose factor of contribution remains at 100% and, who finally, will have contributed to the system an amount that exceeds the maximum contribution each year for at least 38 years and six months. The remaining employees will be affected to a greater or lesser extent. In general, the severity is higher for wages lower or equal to the Spanish average wage. The impact is larger for smaller wages.

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