

DYPES: Analyzing the 2011 Spanish pension system reform: behavioural versus non-behavioural approach.

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Abstract

This paper presents the results of DyPeS, the first dynamic microsimulation model of the retirement pensions system applied to the Spanish case. We use a model that accounts for individuals' reactions to financial incentives when deciding to retire and compare it with a scenario without behaviour. As expected, when individuals are allowed to react to financial incentives, initial pensions grow and the number of initial pensions reduces -suggesting that individuals delay retirement to obtain higher pensions. The simulation of the reform approved in 2011 shows that only the delay in retirement age (from 65 to 67) would have a significant effect on the number of entry pensions, while other measures changing the computation of the initial pension for new retirees have a limited impact. Paradoxically, it is found that the consideration of more contribution years in the computation of the initial pension amount, combined with the effect of the crisis on wages, has a positive impact on initial pensions level.

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1. Introduction

The pension system is one of the main components of the Spanish welfare state. At present, it is composed of two different types of benefits: non-contributory (or *Beveridgean*) and contributory (or *Bismarckian*). The former can be considered a system of minimums, as it provides, under some conditions, a minimum income to those individuals who cannot access the contributory level. The latter is the main part of the system.¹ It is organized on a pay-as-you-go (PAYGO) basis and includes different kinds of pension benefits - retirement, disability and survival - for those individuals who meet the eligibility requirements regarding age and past contributions to the system.

Clearly, the contributory retirement pension is the most important social expenditure programme. In 2007, it represented over 65% of all contributory pension expenditure, and over 5% of GDP. Moreover, a huge increase in its size can be expected in the face of demographic ageing: retirement pension expenditure will be more than 75% of contributory pension expenditure and almost 12% of GDP in 2060 according to the last projection exercise of the Economic Policy Committee (2009).² Therefore, the concern about the necessary reforms to make it sustainable in the long term is fully justified.

Reform proposals vary from a complete restructuring of the system – like a switch to a true or to a notional capitalization system³ – to marginal adjustments of the legal parameters of the current system. Given the expected increase in the ratio of pensioners to contributors, all of them imply raising contributions and/or reducing pensions. Alternatively, an increase in the retirement age is often proposed, as this might improve sustainability both on the expenditure and on the revenue side. Although the legal retirement age used to be 65 for most workers in most countries, the fact is that average retirement age is clearly lower. Governments in the EU, concerned about the importance of this phenomenon, are interested in incentivizing workers to delay retirement. Though average retirement is quite high in Spain by European standards – according to Eurostat it was 62.6 years in 2008, 1.1 years above the EU15 level -, Spain will be hit by one of the most

¹ The civil servants have their own system.

² This projection is in line with previous projections and also with those done in academic work.

³ The possibility of switching to a funded system is limited by the so-called *transition problem*: the initial gift given to generations who did not contribute and received a pension now needs to be offset by a double burden on current workers, who need to maintain the old PAYGO system and contribute to the new one. Some countries have opted for introducing some kind of notional funding, which is somehow a sophisticated way of introducing a defined contribution system.

pronounced ageing processes starting around 2020, a little later than in other European countries given that the baby boom in Spain occurred later than in other countries. Following the recommendations of the European Council, a reform package was debated and approved in 2011. Apart from the continuation of some of the proposals contained in the Toledo Agreement⁴, it was mainly composed of a delay in retirement age.

The design and evaluation of reform measures requires the availability of analytical tools. Simulation models have been developed, especially in the last decades thank to the availability of an increasing amount and quality of databases and computing tools. In the context we are dealing with, those simulation tools need to take both a macro and a micro perspective. The first is essential if one aims at analyzing in a consistent way the sustainability of pensions or any other welfare state transfer. The second is crucial when considering the adequacy of the benefit level in respect to income redistribution. The EU, in the joint report of the European Policy Committee (EPC) and the Social Policy Committee (SPC), has been recommending to attend to both dimensions in order to maintain the welfare state, one of the main achievements of Europe in the past century.

In this paper we present a simulation model of the contributory retirement pension system in Spain and it is used to analyze the effects of the reform enacted in 2011 and which part of these effects is related to individual's reaction to changes in regulation and then can be subject to policy intervention. To the best of our knowledge it is the first model of this kind developed for the Spanish case, thanks to the availability of the MCVL – an administrative data set published by the Social Security Administration since 2004. The model is based on a sub-sample of the 2007 wave of this data set.⁵

The paper is organized as follows. Section 2 is devoted to the description of the Spanish pension system. Section 3 describes the model structure and the data employed, including the projection rules implemented in the model. Section 4 presents the results and Section 5 makes some final remarks.

⁴ Toledo Agreement arose in 1995 when the main political forces in Spain approved a set of recommendations to drive the necessary reforms of the Social Security System in order to ensure its sustainability.

⁵ The data set is called continuous working life sample (*Muestra Continua de Vidas Laborales*) and the first wave was published for 2004 (MTAS, 2006b).

2. The Spanish pension system

The Spanish Social Security system as such was introduced in 1967. Previously, workers were insured against disability and retirement by mutual societies⁶. Some individuals who belonged to that previous system are still working and, because of that, they still keep some special privileges in acceding to early retirement within the contributory system. Due to this particularity, we will refer to them as Old System (OS) workers henceforth.

The Social Security is organized on a PAYGO basis and under a defined-benefit scheme with a partial *Bismarckian* orientation - the pension received is mainly determined by the past contributions of the worker. Social Security covers other contingencies besides retirement, such as disability and survival, but retirement is clearly the most important of them. Below we outline some legal features relevant to our analysis. For the moment we concentrate on the system prior to the last reform approved in 2011 (27/2011 Act), as it is starting to be applied from 2013, with a long transition period, until 2027. Section 4.b) is devoted to detailing the main changes introduced in this last reform and to simulating their effects in the future. Beneficiaries of retirement pensions are affiliated workers who meet the legally established conditions of i) having the legal age (generally 65) and ii) proving a minimum contribution period of 15 years - 2 of them should be included in the 15 years prior to retirement date.

The initial retirement benefit is determined according to a formula depending on retirement age, the number of contribution years and the amount of past contributions. Since the reform posed by the 24/97 Act, the computation is as follows. First, a basic amount (*BR*) is computed as a mean of the level of contributions made in the 15 years prior to retirement⁷. Second, a percentage depending on the number of years of contributions – $p(n)$ – is applied to the *BR* in this way: 50% for the first 15 years, an increase of 3% for each additional year between the 16th and the 25th, and an increase of 2% for each additional year from the 26th until it reaches 100%, at 35 years of contributions. Furthermore, when retirement age deviates from the legal retirement age a correction coefficient – $cc(n)$ – is applied, depending also on the number of

⁶ This system was called *Seguro Obligatorio de Vejez e Invalidez* (SOVI).

⁷ The legal name is *base reguladora*. In the computation, the contributions are updated from the third year according to the evolution of the consumer price index.

years of contribution. Thus, in general terms, the legal formula to calculate the initial retirement benefit (*IRB*) or entry pension is:

$$IRB = p(n) \cdot BR \cdot cc(n) \quad (1)$$

The coefficient $cc(n)$ will be above (below) one for workers delaying (advancing) their retirement from age 65. In the first case an additional 2% will be applied for each year of delay, or 3% if the worker has 40 or more years of contributions – this premium either acts on $p(n)$ increasing up to 100%, holding $cc(n)$ equal to one, or increasing $cc(n)$ above one if the worker already reached the 35 contribution years. In the second case, if the worker retires before age 65 an annual penalty between 6% and 8% is applied, depending on the years of contribution.⁸ Apart from this general rule, there are also other possibilities to reduce the age of retirement: i) certain professional activities, ii) disabled workers, iii) special retirement at age 64 with no penalty and iv) partial and flexible retirement. In each of them, different correction coefficients are also applied.

There are several ways to access retirement in Spain, some of them depending on the labour status. The pension formula is the same for all of them, except for the value of $cc(n)$. Table 2.1 summarizes all those different possibilities or retirement paths. The ordinary retirement age – 65 – is not compulsorily established by law, but it is agreed in most collective wage settlements. In any case, at the moment 65 is the reference age for retirement rules and incentives. For the first time, the 2011 reform establishes a gradual increase to 67, as explained in Section 4.

⁸ In particular, the 8% affects those that only reach the minimum eligibility requirement of 15 contribution years. This penalty is reduced gradually for those crediting enough years to move to the next contribution years scale: 31-34 (7.5), 35-37 (7), 38-39 (6.5) and 40 plus (6).

Table 2.1 Retirement paths in Spain according to labour status

Labour Status	Retirement path	Eligibility requirements and rules determining benefits (2007)
Disabled	Disability*	At age 65 disability pensions are converted into retirement pensions, but keeping the same benefit level
Unemployed	Back to work (all)	
	Early retirement from age 60 (Old system)	Minimum $n = 30$ 8% penalty per year until age 65 (gradually reduced to 6% if $n \geq 40$)**
	Early retirement from age 61 (New system)	Minimum $n = 30$ 7.5% penalty per year until age 65 (gradually reduced to 6% if $n \geq 40$)**
	Regular retirement at 65	The same conditions as workers (detailed below)
Worker	Special retirement at age 64	No early retirement penalty Substitution contract in the same firm
	Early retirement from age 60 (Old system)	8% penalty per year until age 65
	Regular retirement from age 65 (includes delayed retirement)	<65: Reduced age for special professional activities with no penalty Age 65: Minimum $n=15$ (2 in the last 15) >65: Increases beyond 100% of RB by 2% per year (3% if $n \geq 40$)
	Partial retirement**	From age 60 Minimum $n = 15$ years Part-time work and proportional reduction of pension If age < 65 substituting contract No early retirement penalty
Retired	Flexible retirement	Part-time work and proportional reduction of pension

Notes: n = number of years of contribution; * Only disabled below age 65 might change state back to work; ** 7.5% ($n=30-34$), 7% ($n=35-37$), 6.5% ($n=38,39$), 6% $n \geq 40$; *** In 40/07 Act the minimum n was increased to 30 and 6 years of seniority in the same firm were required.

Early retirement pathways have been developing gradually with this direct purpose, but also with an indirect objective of employment policies, like intending to improve the labour market access for youth. Regarding the latter, special retirement at age 64 and partial retirement were established in 1985 and 1999, respectively.⁹ Regarding the former there are several rules. First, apart from the disabled, for some professional activities – especially those which are dangerous or which imply being away from home – there is a possibility of retiring at a fixed or at a reduced age. Second, early retirement was generally available from

⁹ The former was introduced in 1985 (RD 1994/1985) and the latter in 1999 (RD 144/1999).

age 60 under certain requirements but with some penalty in the old system. Given that this would eventually disappear, in 2002 (35/2002 Act) new rules were established for new system workers, allowing early retirement from age 61 with similar but stronger penalties, and including an explicit requirement of being unemployed. In 2007, some changes in penalties were introduced.

In parallel, and also due to the need to foster sustainability in the face of demographic ageing, some rules were also introduced intending to delay retirement. On the one hand, the possibility of combining work and pension receipts was introduced in 2002 by reformulating partial retirement and introducing flexible retirement (the latter allowing retirees to come back to the labour market as part-time workers). On the other hand, incentives to continue working full-time after age 65 were introduced in the regular retirement path, as detailed above. Finally, there is a possibility to exit the labour market through pre-retirement, i.e. through a special agreement with the firm that leads to private or public subsidies until the age of eligibility.

Table 2.2 Distribution of new entries by pathways (Spain 2002-2007)

Year / Retirement Pathway	2002	2003	2004	2005	2006	2007
From disability	6.86%	5.84%	4.48%	2.33%	1.92%	0.60%
Early retirement	29.42%	33.79%	33.86%	24.02%	28.28%	26.77%
Old system: from age 60 on	25.44%	29.50%	27.95%	19.62%	22.57%	20.24%
From unemployment	12.58%	14.10%	14.18%	10.18%	11.21%	10.76%
From employment	12.86%	15.40%	13.77%	9.44%	11.36%	9.48%
New system: from age 61 and Unemployment	0.51%	0.92%	1.60%	1.47%	1.88%	2.32%
Special retirement at age 64	2.35%	2.19%	3.40%	2.13%	2.57%	3.14%
Collective wage settlements	0.00%	0.05%	0.06%	0.10%	0.23%	0.27%
Pre-retirement	1.12%	1.13%	0.86%	0.70%	1.02%	0.81%
Partial retirement (from employment)	3.45%	5.30%	8.10%	7.78%	11.80%	12.82%
Flexible retirement (from retirement)	0.24%	0.52%	0.30%	0.31%	0.31%	0.20%
Ordinary retirement pensions (Including delayed)	60.04%	54.55%	53.26%	65.56%	57.69%	59.60%
<60	1.14%	1.11%	0.98%	0.81%	1.11%	1.25%
60	0.97%	0.49%	0.49%	0.40%	0.24%	0.20%
61-64	1.83%	1.07%	1.35%	1.09%	1.22%	1.05%
65	44.83%	39.84%	38.25%	43.36%	41.93%	45.43%
>65	11.26%	12.05%	12.19%	19.90%	13.19%	11.66%
Missing age	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
Total	100%	100%	100%	100%	100%	100%

Note: Pre-retirement includes only those which can be identified as receiving public subsidies.

Source: Authors' elaboration from the MCVL.

Table 2.2 shows the distribution of new entries to retirement in Spain over six subsequent years (2002-2007). Clearly, ordinary retirement is the most common and includes both a small share – around 1% – of early retirement at fixed age and a sizeable share – above 10% – of delayed retirement.¹⁰

Interestingly, while the share of pensioners opting for the *OS* early retirement rules is still 20.24%, early retirement at age 61 has not been very attractive. To some extent, this fact is explained by the requirement of being unemployed, but one can think that workers have opted for other less costly ways to access retirement before the legal age, like partial retirement. In some cases they even use the flexible retirement situation to improve their benefits once retired (in 2006 only 12.38% of pensioners in this situation were below age 65).¹¹ Indeed, in practice, some of the measures intending to delay retirement have still been used as a way to improve the pension benefit by early retirees. In 2006, 98.75% of new entries and 87.76% of pensioners in partial retirement situation were below age 65. Flexible retirement has indeed been used to stay longer in the labour market, but its impact is very limited as only 0.20% of new entries in 2007 have chosen this option.

Despite the abovementioned reform efforts, the average retirement age for males has remained quite stable in Spain in recent years. Interestingly, at present females retire later, perhaps due to a joint retirement decision or to the need to complete their shorter contribution histories. This would also explain some of the differences observed between male and female retirement probabilities. Despite the stability of the average retirement age, the evolution of the share of new entries by age and sex has undergone substantial changes which seem to be driven by cyclical movements. In fact, changes in early and delayed retirement move in different directions. The share of those retiring after age 65 is only slightly affected by incentives to delay retirement introduced in the 35/2002 Act. One should bear in mind that most collective wage settlements deny workers the possibility of delaying retirement, so that incentives to work beyond age 65 might become inoperative.

¹⁰ The table classifies new pensions using the variables “type of pension” and “situation of the pension” in the MCVL. A description of the database is provided in Appendix A.

¹¹ With respect to partial retirement, it can be extended beyond age 65. Nevertheless, in 2006 only 6.56% of pensioners were older than 65.

3. The model

This section is devoted to the description of DyPeS, the microsimulation model developed to analyze the Spanish contributory pension system. Subsection a) outlines the model structure, Subsection b) details the data employed, while Subsection c) details the way retirement decision is modelled.

a) Model structure

As said in the introduction, DyPeS is a micro-based model, thanks to the availability of the MCVL. The construction of a microsimulation model involves taking several decisions, mainly affected by the question analyzed and the data set on which the model is based (see Jinjing and O'Donoghue, 2012). In our case, the nature of the pension policy necessarily implied the use of a dynamic model – meaning that it simulates the micro units over time. In this setting, dynamic does not necessarily mean behavioural.¹² Given that our main focus are retirement pensions, behavioural responses in our model are confined to retirement decisions.

The rest of events are modelled in the simplest way given data availability. The following are the main events experienced by agents. Agents experience first birth and second entry in the labour market. Third, other labour market transitions, including changes in the qualification level and unemployment events, are derived based on transitions observed in the data set. Wages grow according to an econometric model -a version of the traditional Mincer model- estimated outside the microsimulation model by the authors. We employ a huge data set elaborated from the MCVL that includes information on wages, firm characteristics, and personal characteristics comprising the period 1997 to 2010.

Fourth, once agents attain the eligible retirement age (fixed from 59 to 75), they start computing their expected pensions in each of the available pathways depending on their labour market status and, eventually, retire according to the survival times estimated by our retirement model (see section c) . Finally, agents die according to exogenous age and gender specific mortality rates evolving in line with those used in

¹² The term dynamic has been mixed up with the term behavioural for some time, especially in static microsimulation models. See Dekers et al., (2008) and Jinjing and O'Donoghue (2012) for a survey on dynamic microsimulation models.

the standard population projections. The projection routine of the model starts in 2008. Hence, for events occurring before – affecting agents alive in 2007 - the observed date is taken from the data set.

Regarding the programming strategy, DyPeS is a case-based model – one case is simulated after another -, as opposed to time-based – where all cases are simulated in each period. It is an open model, in the sense that new agents are introduced, apart from those in the initial sample; and population-based, instead of cohort-based. It is programmed in continuous time, though some of the events happen only once a year. DyPeS has been developed using ModGen, a generic dynamic microsimulation programming language developed and maintained by Statistics Canada and widely used in social science microsimulation.¹³

b) Data employed

DyPeS starts from a subsample of individuals registered with the Social Security in 2007 extracted for the 2007 wave of the MCVL. The year 2007 is chosen as the base year and the reference point for most data. This way the data employed for transitions are not distorted by the effects of the crisis. Certainly, future waves of the MCVL will improve perspectives to measure the effect of the crisis. For the moment, we start in 2007 and simulate the effect of the crisis in a stylized way, as described in Section 4.¹⁴ At this first stage we stick to information given in the MCVL and no alignments to external data are made, unless strictly necessary. Below, the main decisions taken regarding the MCVL data set and information used from external sources are summarized.

Table 3.1 Initial sample from the 2007 MCVL

	The youngest in the labour market in 2007	Start retiring (age 59)	Finish retiring (age 75)	Maximum age 100
Birth year	1991	1948	1932	1907
Age in 2007	16	59	75	100
Start retiring (age 59)	2050	2007	1991	1966
Finish retiring (age 75)	2066	2023	2007	1982

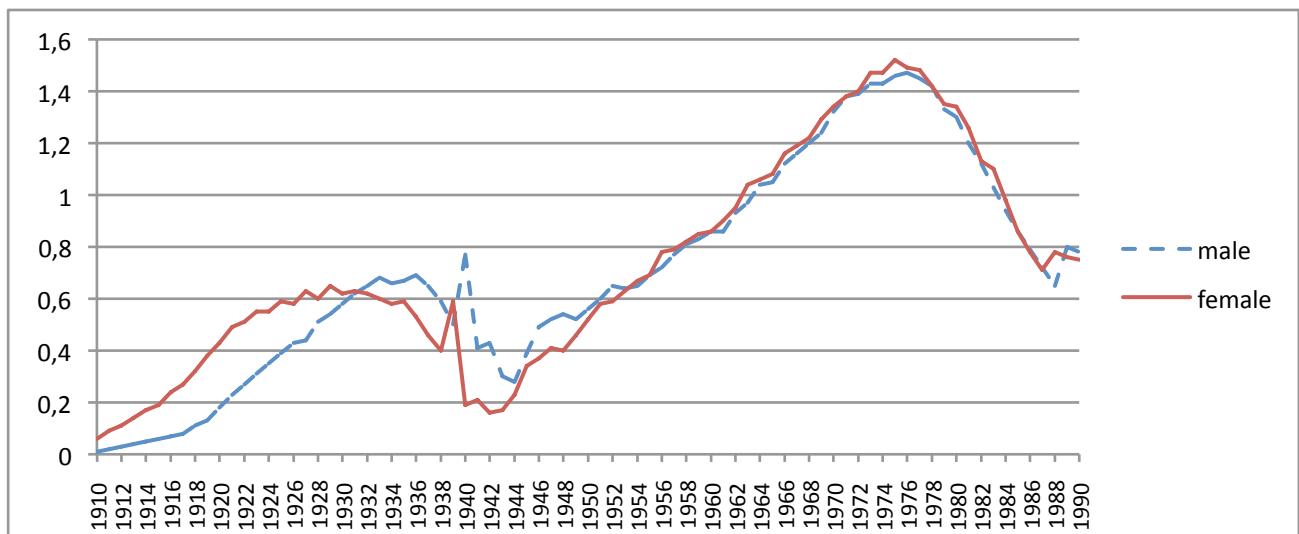
¹³ Modgen supports the creation, maintenance and documentation of most dynamic microsimulation model types, including both continuous and discrete time, case and time-based models as well as interacting and non-interacting populations. It is freely available at the Statistics Canada web site.

¹⁴ The last complete wave – including fiscal data - available at the moment is for year 2009.

Source: Authors' elaboration

Table 3.1 describes the initial sample. Basically, individuals present in the 2007 wave of the MCVL are taken. The MCVL extracts 4% of the population who have some relation with Social Security administration. Then, all past information on their working careers and contributions is added. Nevertheless, the quality of data worsens for the past. A cleansing process was needed in order to keep those workers whose contributions were well recoded (see Appendix A for details). The sample includes both pensioners and contributors born from 1907 to 1991. Hence, in order to project future expenditure and revenue, new entries in the labour market from 2008 on and new births from 1991 need to be added to the model. In order to add newborns, we compare the number of people in the 2007 population and in the 2007 MCVL wave. Figure 3.1 below shows this relation for males and females.

Figure 3.1 Number of people in the MCVL to Total Population, by birth year (year 2007).



Source: Authors' elaboration

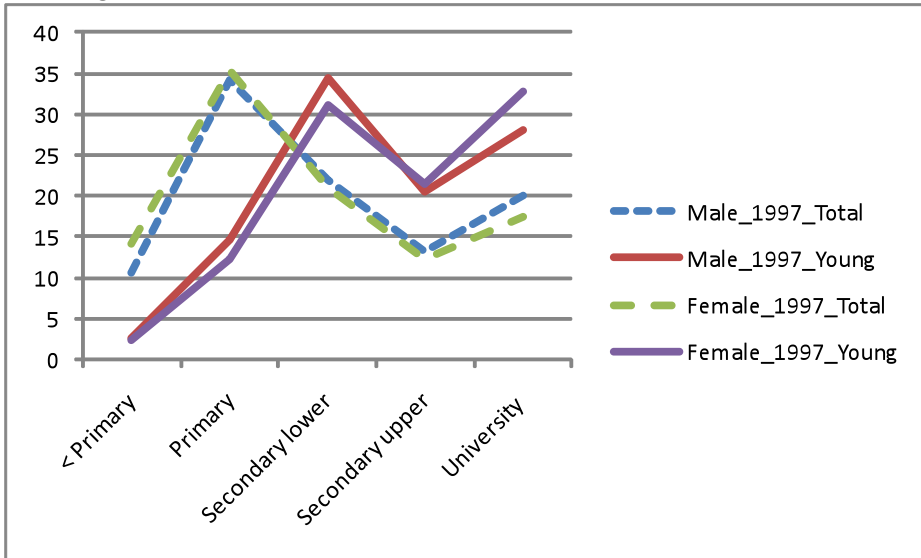
Females overcome males for cohorts born before 1930 due to the higher life expectancy of females. For the rest of cohorts, the pattern of both sexes is quite similar.

The data employed to simulate each of the events are described below. The first step is to assign an education level. Decisions on education level are minimized and simplified as much as possible. The MCVL

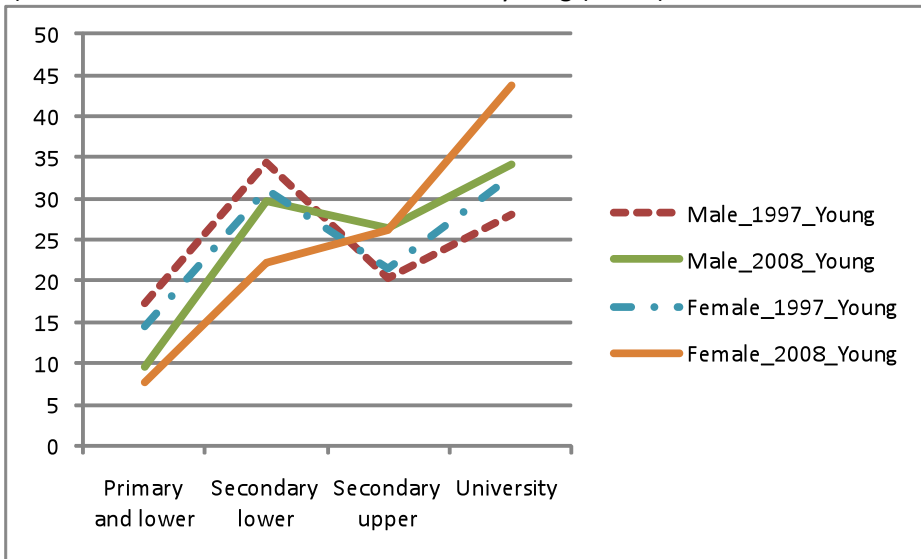
contains information about the education level of the individuals. Nevertheless, this variable is collected from a different data set that is not updated very frequently. As a result, the education level is frequently missing or underestimated. For individuals registered in the MCVL we keep the value reported and correct it up in case there is an inconsistency between the value of education and the contribution group. For “future” individuals, born from 1991 on, the final education level is assigned randomly so as to reproduce the educational distribution observed for the Spanish population by MEC (2010). According to this publication, the education level has grown substantially. In 1997 – Figure 3.2, panel a) - one can already observe that the young population was more educated than the total population. The improvement in the education level continues until 2008, as one can see by looking at panel b) in the same Figure: the education level increases for both young males and females from 1997 to 2008. Interestingly, the education level is currently higher for young females than for males, inverting the initial situation. Note that we are assigning the final educational attainment without any attention to transitions from one education level to the next one, given the data constraints and the focus of our analysis.

Figure 3.2 Distribution of population according to education level in Spain (%)

a) Young (25-34) versus total (25-64) in 1997



b) Evolution of the education level of the young (25-34) from 1997 to 2008



Source: Authors' elaboration from MEC (2010).

In a second step, once the main characteristics of the individuals are assigned and they reach the age of 16, they are exposed to the risk of entering the labour market by age, gender, education and initial qualification level. This is obtained from the observation of the entry path of the last cohort, which had completed their incorporation to the labour market – those aged 36-40 in 2007 (see Table 3.2.). As shown below, most entrances are in the 5th contribution group (composed of part-time workers) except for the most educated –

more than ¼ of them enter once they obtain their degree. The pattern is similar for females, with slight differences.

Table 3.2 Entrance in the labour market by education and qualification level (CG)

		Initial qualification level (CG)					
		1	2	3	4	5	
Education level	Males					Total	
	1	2	3	4	5		
1	0.83%	0.37%	0.72%	10.10%	87.98%	100%	
2	6.95%	4.21%	3.77%	31.08%	53.98%	100%	
3	25.17%	11.25%	9.98%	33.41%	20.19%	100%	
		Females					
1	2	3	4	5	Total		
1	1.28%	0.94%	0.65%	26.93%	70.19%	100%	
2	7.32%	7.54%	1.98%	53.14%	30.02%	100%	
3	20.89%	15.53%	4.34%	43.72%	15.53%	100%	

Source: Authors' elaboration

In a third step, once individuals enter the labour market, they are exposed to the labour market transitions. The hazards observed are extracted from the MCVL. In particular, transitions between qualification levels within employment and transitions between employment and unemployment are obtained by age and gender and qualification level when necessary. To that effect, the 13 contribution groups in the general regime of the Spanish Social Security are grouped in five subgroups – those subject to the same contribution limits (thresholds). As the transition hazards among the different qualification levels are quite stable during the period observed (2002-2007), the value of the last transition observed before the economic crisis (2006 to 2007) is taken, and it is held constant for the future (see Appendix B for details). In Section 4.a), an explanation is given of how these hazards are altered during the crisis.

Regarding earnings, some decisions need to be taken. On the one hand, the initial value of wages for future workers needs to be decided. On the other hand, it is necessary to decide how wages are to be projected to the future both for 2007 workers and for those entering the labour market afterwards. First, regarding initial wages, for those working or contributing in 2007, the initial value of wages in 2007 is taken from the fiscal module of the MCVL. In case this value is missing, the contribution basis is taken. For future contributors, the final education level attained determines the contribution group, entry age and wage, as shown above. Similarly, the error term observed in each cell is also used to ensure variability of initial wage.

Second, wages grow according to a model based on the traditional Mincer equation (see estimation results in the appendix E) :

for the period t

$$w_{it} = \bar{w}_t \left(\frac{\beta_0^*}{w_t} + \frac{\beta_1^*}{w_t} w_{i,t-1} + \frac{\alpha^*}{w_t} X_{it} \right) \quad (2)$$

then we obtain:

$$\beta_0^* = \frac{\beta_0}{w_t} \quad \text{and} \quad \beta_1^* = \frac{\beta_1}{w_t} w_{i,t-1} \quad (3)$$

For $t+1$ and the following periods:

$$w_{i,t+1} = \bar{w}_{t+1} \left(\beta_0^* + \beta_1^* w_{i,t}, \alpha^* X_{i,t+1} \right) \quad (4)$$

where w_{it} is the yearly wage of the individual i , \bar{w}_t is the average wage of the economy and β_0 and β_1 are the parameters of interest that we wish to estimate. The set of explanatory variables, X_{it} , includes: previous wage (only one period is considered), personal characteristics -age, age squared and migrant status-, productivity indicators -education, qualification group and experience-, business cycle indicators -unemployment rate- and cohort effects that are supposed, for simplicity, to be linear (see detailed results in the appendix). We use a data set that covers the period 1997-2010 and have been elaborated using information from the MCVL and information on macroeconomic indicators provided by the Spanish National Institute of Statistics (INE).

During the simulation, earnings (and contribution bases) are updated on a continuous time basis. For that purpose, both a current value and an accumulated value are maintained and updated in the following cases. First, earnings are updated at the beginning of the year, according to equation 2 and 4. At the same moment, contribution bases are also updated. Second, whenever a labour status transition occurs – both among contribution groups within employment status, and between unemployment and employment status

–, a change in wage is applied depending on gender and the original and final states. For that purpose, the average change in wage observed is used.

Finally, each time one of the abovementioned changes occurs, total earnings (and contribution bases) functions are updated. This also happens at the end of the year, so that the annual flow of earnings and contribution bases can be recovered and stored.

Once agents reach retirement age, the retirement module – detailed below – produces the retirement event. Finally, an exogenous age, gender and time-specific mortality rate, coherent with demographic projection, is applied.

c) The retirement decision: a hazard rate model

In this section, we describe in more detail the way the retirement decision is modelled. The retirement module determines whether an eligible individual actually retires according to two alternative criteria. First, individuals are assumed to claim their pension benefit according to a survival model that only include personal characteristics and business cycle indicators, but not financial incentives: age, age squared, educational level, last wage, a dummy variable that takes value 1 during the first year that the person is eligible and 0 otherwise, and unemployment rate. These set of variables try to capture all the factors involved in any retirement decision and under any regulatory framework: age and, therefore, time of benefit from pension, productivity issues and individual's perform in the labour market, time preferences and business cycle considerations. To summarize, this non-behavioural criterion depicts the scenario not affected by changes in regulations.

Second, we define the behavioural scenario that we use as baseline. We model retirement behaviour by introducing financial incentives using again a survival framework. The survival estimates highlight the key role played by the economic incentives to retirement implicit in the pension scheme, in line with previous research for the United States (Gruber and Wise, 2004; Coile and Gruber, 2000; Baker et al., 2003). Including

this retirement behavioural equation in our microsimulation model allows us to define an ‘optimal time of retirement’ scenario coherent with current regulation to be compared with the ‘non-behavioural’ one. Our set of variables include: age, age squared, educational level, qualification level (contribution group), labour status (employed/unemployed), an indicator for receiving unemployment benefits, an indicator that takes the value 1 during the first year that the person can retire, last wage, difference between the pension obtained today and the maximum pension, time to obtain the maximum pension, age when reaching the maximum pension, replacement rate, an indicator for receiving the minimum pension and time counter.

In both cases, we estimate a piece-wise constant exponential model. These kind of semi-parametrics models are commonly used in a continuous time framework (like ours) to avoid the strong assumptions about the shape of the hazard function implied by the parametric models. The hazard is assumed constant within pre-specified survival time intervals. Then, the exponential model can be defined by:

$$hi(t) = h0.\lambda_i, \text{ where } \lambda_i \equiv \exp(\beta'Xi), \text{ or}$$

$$\log[hi(t)] = \log(h0) + \beta'Xi$$

since, in this case $h0(t) = h0$, a constant.

We can generalise this specification to have a constant hazard within each of K intervals along the survival time axis:

$$\log[hi(t)] = \log(h01) + \beta'Xi, t \in (0, \tau1]$$

$$\log[hi(t)] = \log(h02) + \beta'Xi, t \in (\tau1, \tau2]$$

...

$$\log[hi(t)] = \log(h0K) + \beta'Xi, t \in (\tauK-1, \tauK]$$

For both estimations -behavioural and non-behavioural- we use a monthly panel data set covering the period 2005-2010 elaborated from the MCVL. It includes all individuals that are eligible for retirement during this period, excluding those that retired due to collective agreements or forced by regulation (unemployed that reach the minimum retirement age).

Ideally, a behavioural model should take into account a simultaneous consideration of the decision both of the firm and the individual. This is rarely possible, given the lack of data on the position of the firm, and most studies focus on the perspective of the individual. Along this line, structural models of retirement behaviour take into account utility maximization along the life cycle and, hence, the whole set of contribution and pension receipts from the pension system. Nevertheless, due to constraints in availability of longitudinal data sets, it has become common using reduced form estimations of retirement decision. This estimation strategy is not exempt of problems related to the identification of the incentives to delay retirement. These are usually measured as the increase in the so-called social security wealth – the present net value of net benefits received from the pension system. However, this variable might be endogenous and it might not be possible to separate the effect of financial incentives and the taste for work – both interacting with age. The MCVL certainly opens the way for this kind of analysis. There is some work on this field applied to Spain. This showed a poor effect of retirement incentives on retirement decision, indicating that age was the main determinant.¹⁵ This work was based on a preliminary experimental version of MCVL. Recently, this work has been extended (García-Pérez et al. 2013) using the MCVL and the results show that, when incentives are properly defined and problems like individual heterogeneity are taken into account, incentives have a strong impact on labour market decisions and particularly on retirement decisions. It worth mentioning here that this results are only partially comparable with the work we present here. The fact that our retirement model has to be inserted in a more complex microsimulation model -meaning that all variables included in the retirement model have to be replicated for future periods- imposes an obvious imperative of simplicity.

4. Results of the simulation model

¹⁵ See Boldrin et al. (2004) and Jimenez-Martin (2006), mainly focused on employed individuals, while the alternative pathways to retirement - long-term unemployment benefits and disability - were included using exogenous age and gender-specific probabilities. The first study is the chapter devoted to Spain in an international comparative study edited by Gruber and Wise (2004). Although incentive measures turn out to be significant for most countries, results for Spain seemed to be an example of the identification problem. See also Argimón et al. (2007 and 2009). In the former, retirement incentives are not considered among the explanatory variables. In the latter, retirement incentives are included, but there is no clear way of controlling the alternative pathways to retirement.

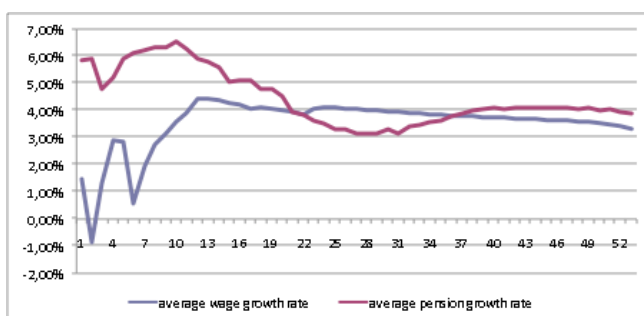
This Section is devoted to showing the first results of DyPeS. First (Subsection a), the baseline situation is characterized, explaining how the effects of the crisis are simulated. Second (Subsection b), the impact of the reform of the Spanish pension system approved in 2011 is analyzed. In order to interpret the results, it is important to bear in mind that we are keeping the retirement hazards observed by age, not allowing for a behavioural response in the retirement age decision. This implies that the burden of the adjustment will be mostly on the level of pensions. If we observe changes in the time path of the number of pensions, they will be mainly due to direct policy changes in retirement age.

a) The baseline situation and the effects of the crisis

Our baseline scenario incorporates both behaviour in the retirement decision and the effects of the 2011 reform. It tries to reproduce the "real" situation in the sense that the 2011 have been already undertaken when our projections are done and the behavioural model is the one that we suppose to better replicate the retirement decision. In this sense, other scenarios -without behaviour, without reform- act as counterfactuals.

Figure 4.1 shows the evolution of wages and pensions during the last decades and the projected wage growth and pensions growth. The average growth rate during the period 1995-2008 have been 3.49% and the projected growth is 3.55%. Pensions have grown, on average, by 4.7% during the period 1995-2008. This is exactly the same average growth rate that we obtain from our projections for the period 2008-2060. It worth mentioning here the fact that, historically, pensions have grown to a higher rate than wages.

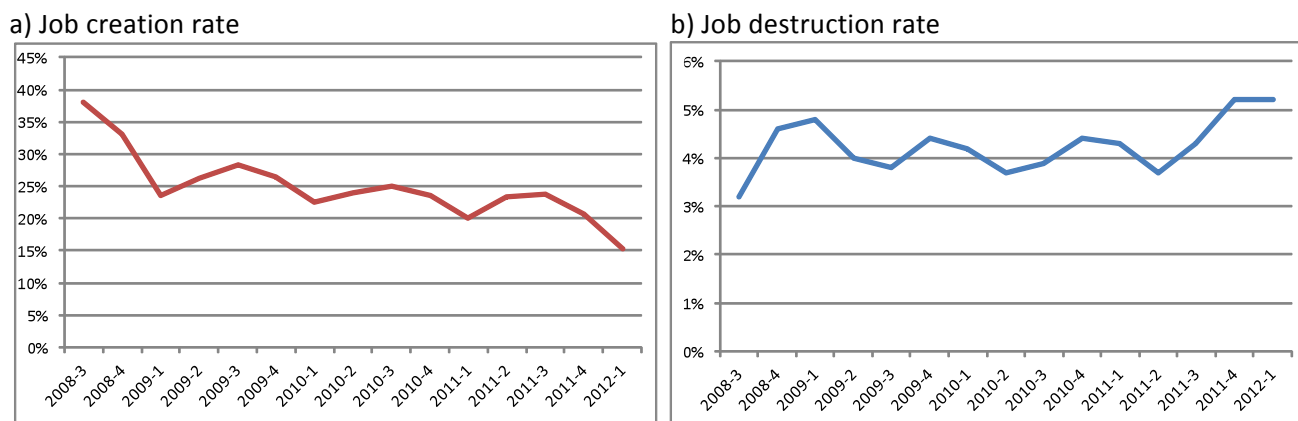
4.1 Wages and pension growth. 1995-2060



Source (1995-2008): Annual Economic Data Base. European Commission and Spanish Social Security. Authors' elaboratio (2008-2060).

As said above, the year 2007 is chosen as the base year to prevent the projections from being permanently affected by the current crisis. At the same time it is necessary to take into account the effect of the crisis. Hence we opt for a simplifying *ad hoc* simulation of a temporary increase (decrease) in the job destruction (creation) rate, in line with the evolution observed in the first years of the crisis, shown in Figure 4.1. Given the uncertainty of the duration of the current crisis, we assume a slow recovery ending in 2018. The change observed in job destruction and job creation rates during the crisis (Figure 4.1) is applied to the transition hazard rates observed in the MCVL (see Figures B.1-3 in Appendix B) from 2008 to 2018.

Figure 4.1 Evolution of the job creation and destruction rates (2008-2011)



Note: Job creation rate: share of unemployed who get a job in the next trimester; Job destruction rate: share of workers who lose their job in the next trimester.

Source: Observatorio laboral de la crisis, (www.fedea.es/observatorio)

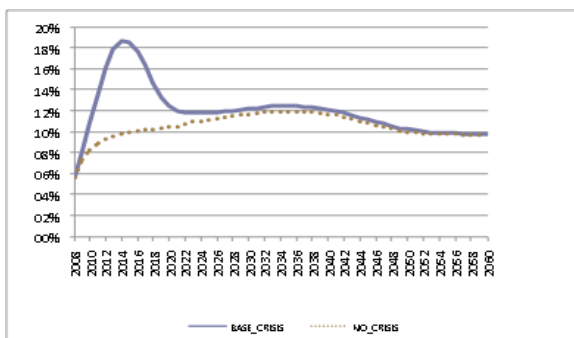
As a result, the unemployment rate doubles, as panel a) in Figure 4.2 illustrates.¹⁶ This increase in unemployment probably understates the long-term impact of the current crisis, but is enough to take into account the effect of the crisis and it illustrates the potentialities of the model. Panel c) and d) in Figure 4.2 show the effect of the current crisis on entry pensions (both number and level). The main driving force of the changes observed is the decrease in the pension level, due to poorer working careers. This effect is relatively small, reaching 2.14% for the cohort retiring in 2017. Being the amount of past years' contributions

¹⁶ Note that the unemployment rate (Figure 4.2 panel a) increases during the retirement of baby boomers. This is a composition effect due to the fact that unemployment rates are higher for older workers might be compensated in reality by the relative scarcity of labour supply. A general equilibrium setting would be necessary to account for this.

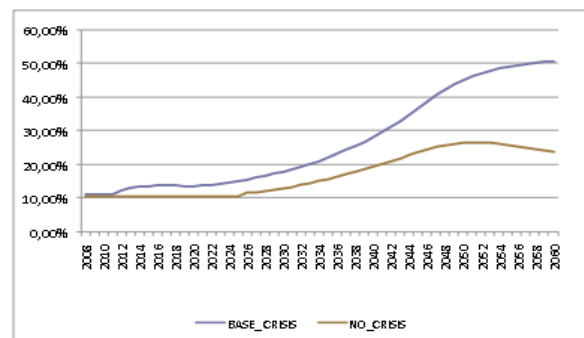
considered to compute the basic pension amount – BR – between 15 and 25, it is obvious that this cohort is the most affected by the cut in wages associated to the crisis. There is also an impact on the time path of the number of entry pensions. The number of new entries reduces between 2013 and 2022 approximately, and grows slightly afterwards. It shows that there is a reaction on retirement decisions due to the big movements in labour status that the current crisis produces. As a result, the total effect of the crisis in terms of expenditure to wage bill (panel b) is high, despite the sizable decrease in entry pensions shown in panel b. It is coherent with the dramatic fall in wages due to the crisis and the relatively smaller reduction in entry pensions level shown in panel b. In a behavioural model as the one considered here, agents can exit the labour market through early retirement, escaping penalties, and then avoid a higher reduction in entry pensions level. As we will see in the next section, it seems that, when behaviour is incorporated in the model, workers effectively tend to retire later, coping this way the effect of the crisis in their labour careers.

Figure 4.2 Effect of the current crisis

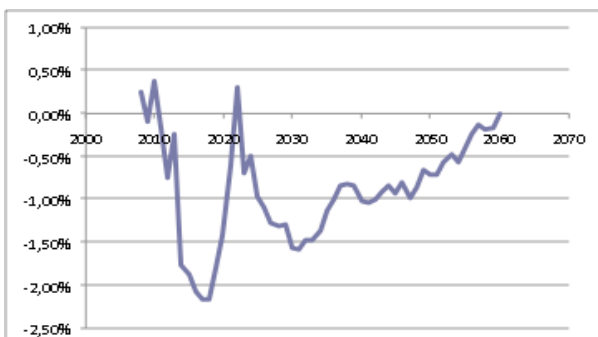
a) Evolution of unemployment rate



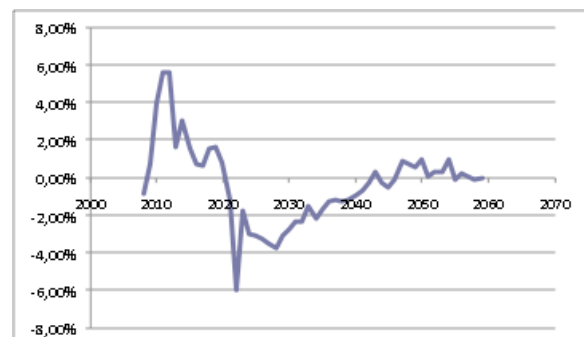
b) Ratio of total expenditure to wage bill



c) Changes in the entry pension (%)



d) Changes in number of entry pensions (%)



Source: Authors' elaboration.

b) The effects of the 2011 reform

Below, the effects of the main reform measures approved in 2011 in Spain are simulated. Table 4.1 gives an overview of the kind of measures approved (see Appendix C for further details). The first two measures aim at increasing contributiveness, or proportionality between contributions and pensions, strengthening the *Bismarckian* nature of the system. This motivation has been present in the Spanish reform agenda since it was explicitly expressed in the Toledo Agreement in 1995. Interestingly, these measures tend to decrease pension rights in different ways, as we will see later. This way they have a positive effect on sustainability and potential effects on redistribution. The first reform measure increases the amount of past years' contributions considered to compute the basic pension amount – BR – from 15 to 25. The second goes in the same direction by modifying the share of BR received as a pension – $p(n)$ – to make it more linear. Nevertheless, it also increases the total number of years needed to obtain 100% of BR , implying a direct cut in pension rights.

The last and most discussed measure modifies the reference retirement age from 65 to 67. It also changes the retirement penalty for early retirement and premium for delayed retirement – $cc(n)$. All the measures are implemented gradually from 2013 to 2027. Below, we will present the simulation results and discuss the effects on pension expenditure sustainability and redistribution.

In order to interpret the results one should bear in mind that the effects of the reforms might differ depending on a main issue: the extent to which reform affects one pathway or all of them. The latter would imply that being able to choose the pathway does not make a difference and, hence, we will not observe changes in the number of pensions, but only in the level. Most of the approved measures apply to all the pathways at once: Changes in BR and $p(n)$. Only the change in $cc(n)$ could have an impact on pathways, but this measure is implemented together with the change in the retirement age, which does, indeed, affect the number of pensions.

Table 4.1 Summary of the main reforms in retirement approved in 2011 (27/2011 Act)

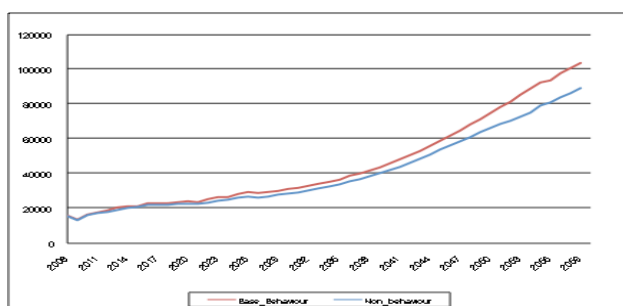
	Previous Situation (since 40/2007 Act)	Reform 2011 (27/2011 Act)
$p(n)$	$p(n)= 100\% ; n=35$ Three levels for n - First 15 years: 50% - 16 to 25: 3% / year - 26 to 35: 2% / year	$p(n)= 100\% \quad n=37$ Three levels for n - First 15 years: 50% - next 248 months: 0.19 per month - next months: 0.18 per month (gradual implementation 2013-2027)
$BR[bc_{t-15}, \dots, bc_{t-1}]$	bc from the last 15 years	bc from the last 25 years (gradual implementation 2013-2022)
Retirement age	General 65 Minimum 61 (except Old system)	General 67 (65 if $n \geq 38.5$) Minimum 63 (61 if involuntary unemployment)
	<u>Retirement premium (*)</u> - $n < 40$: 2% / year - $n \geq 40$: 3% / year (*) There is a maximum limit. <u>Early retirement</u>	<u>Delayed premium (*)</u> - $n < 25$: 2% / year - $25 \leq n \leq 37$: 2.75% / year - $n > 37$: 4% (*) Maximum limit maintained <u>Early retirement relaxed</u> (not yet simulated)

Source: Authors' elaboration

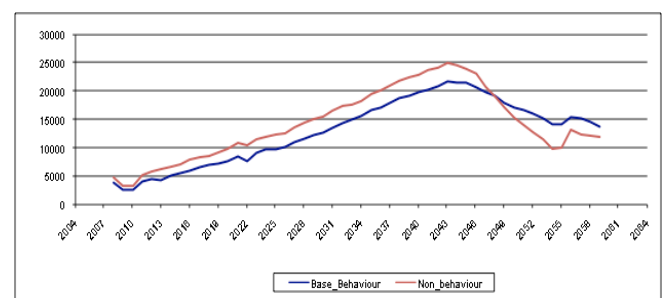
Given that our analysis incorporates more than one dimension, we will first briefly present the effects of introducing behaviour in the model in the most relevant indicators. This will allow for testing if agents behave as expected. In a second step, the effects of the 2011 reform introduced in both scenarios -with and without behaviour- and these scenarios are compared. Finally, the effects of the different measures that comprise the 2011 reform are analyzed separately for one of the scenarios (the behavioural one).

4.3 Behaviour versus non-behavioural model

a) Entry pensions level.



b) Number of entry pensions



Source: Authors' elaboration

Figure 4.3 shows the pure effects of introducing behaviour in the retirement event. As expected, initial pensions are higher when individuals can react to financial incentives. Less straightforward is the effect in the number of entry pensions. Graph 4.3 b) shows that, when behaviour is considered, individuals tend to retire later. It make sense for several reasons: first, if we see the variables involved in the simple model without behaviour we'll see that most of the variables -and with powerful effects as shown in the estimations- impulse individuals to retire early. Only the most sophisticated indicators related to financial incentives introduced in the behavioural model drive workers to consider future benefits of waiting for a higher pension. Second, as seen in the previous section, the effect of the crisis in working careers must be sizable, indicating that the benefits of keep working after the crisis and incorporate years of working history in the computation of the basic pension amount must be remarkable.

We describe the effects of the 2011 Reform in the both scenarios considered -with and without behaviour- in figures 4.4 to 4.6. Figure 4.4 shows the effects of the reform in the level of entry pension. In both scenarios, pensions increase until 2025 approx. and decrease afterwards. This increase is higher in the behavioural model, which is coherent with the results shown in figure 4.3. Attending to the measures that cause this trend in pensions level, the changes in the number of years used to compute *BR*, increasing the years gradually from 15 to 25, seems to be, in both scenarios, associated to the increase of pensions.

The strong positive effect on entry pensions of changes in the number of years used to compute *BR* might seem surprising at first glance. The expected effect of this measure depends on the shape of the lifetime real earnings profile.¹⁷ If the real earnings profile is increasing, when *BR* takes more years in the past this implies a reduction in the level of wages considered and, hence, a cut in pension rights. Nevertheless, the earnings career does not always grow to the same extent during the life cycle. It is expected to grow more at the beginning, to stabilize around the 50s and then remain constant or possibly worsen, if the working career is interrupted because of unemployment events. Hence, the effect of this measure can be a small cut or even an increase in pension benefit if wages are not growing in real terms. The fact that we obtain this result

¹⁷ The relevant magnitude is real wages (and hence contributions) as the formula to compute *BR* updates wages to inflation two years prior to retirement.

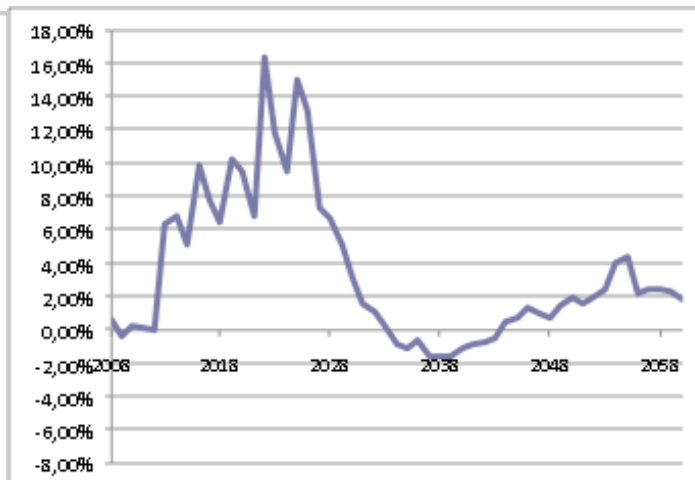
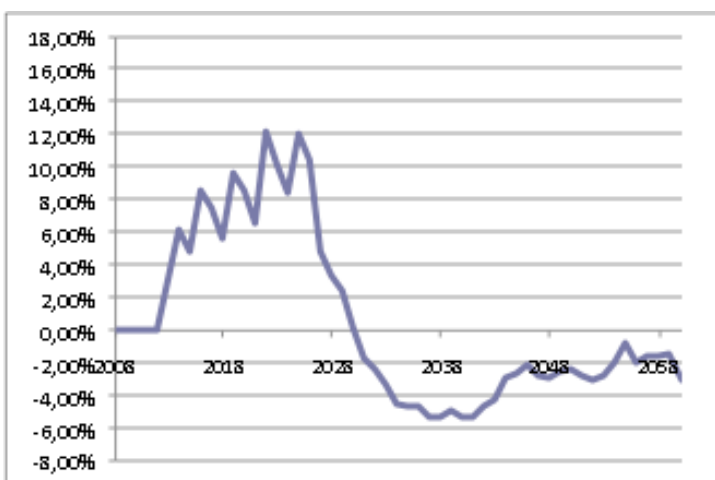
during the years after the crisis is probably due to the fact that the increase from 15 to 25 years implies adding years of contributions not affected by the crisis.

The change in $p(n)$ implies a decrease in the level of the initial pensions, reaching almost 3% in the case of the non-behavioural model and 2% in the behavioural one. This average negative effect is probably hiding positive and negative effects for people with different working careers. In general, reforms of $p(n)$ have potential effects on redistribution, as discussed in Appendix C. Nevertheless, in this particular case they are very small, due to the small scale of the current reform. Changes in the delay retirement are associated to higher pensions in the case of the behavioural model and have no effect in the model without behaviour, which seems to be coherent.

Figure 4.4. Effects of the 2011 Reform on the level of entry pensions

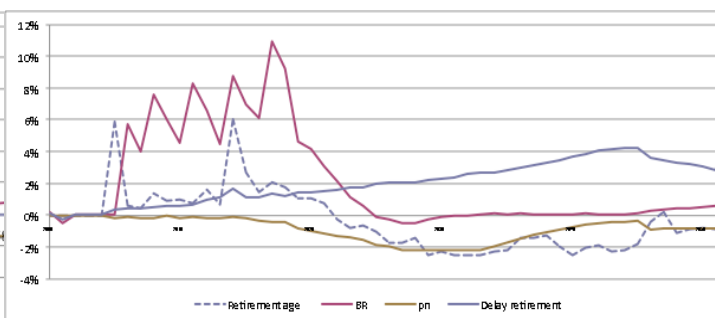
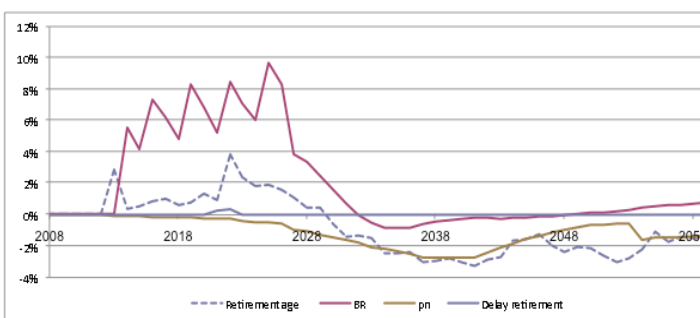
a) Effect on level of entry pensions. Non-behavioural

b) Effect on level of entry pension. Behavioural



c) Contribution of each reform. Non-behavioural

d) Contribution of each reform. Behavioural

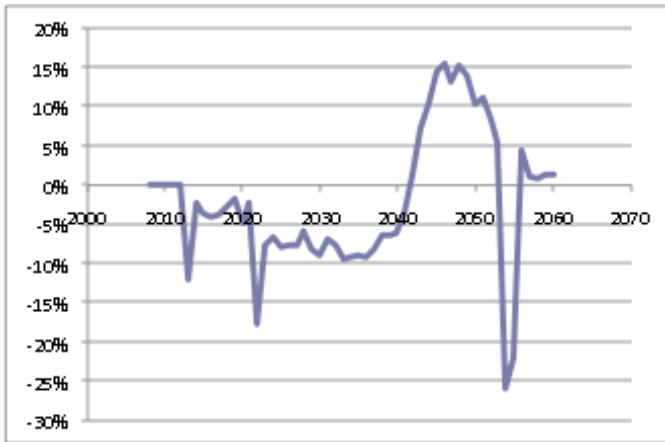


Source: Authors' elaboration

Figure 4.4. Effects of the 2011 Reform on the number of entry pensions

a) Effect on number of entry pensions. Non-behavioural

b) Effect on number of entry pension. Behavioral



c) Contribution of each reform. Non-behavioural

d) Contribution of each reform. Behavioural

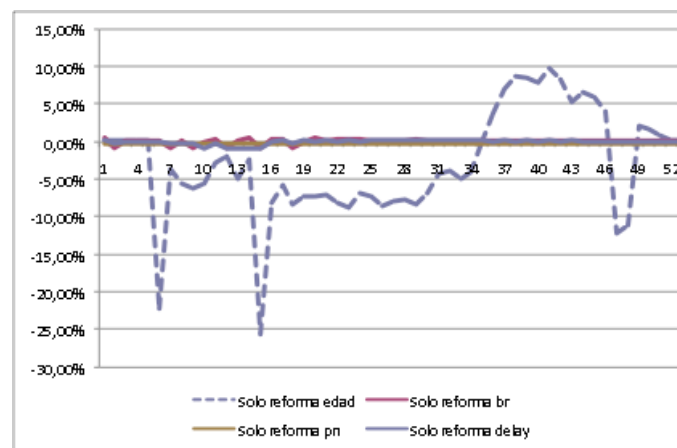
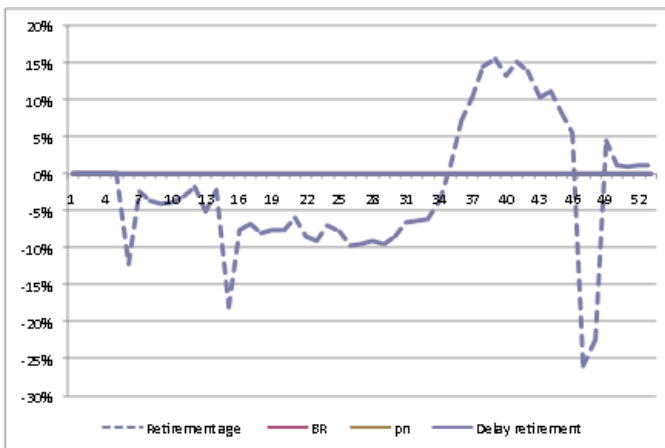


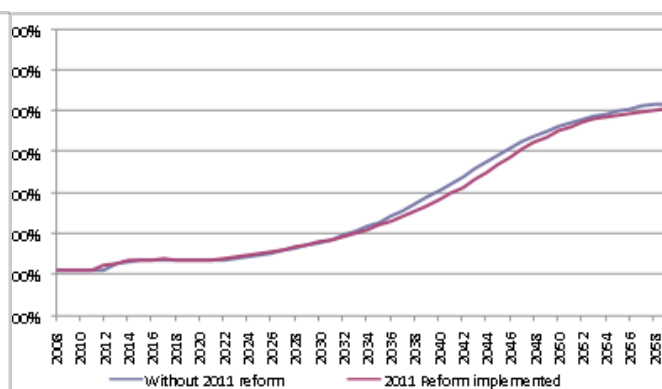
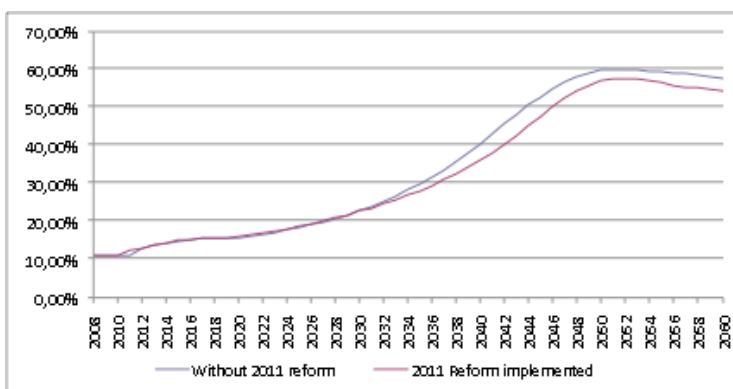
Figure 4.5 describes the results regarding number of entry pensions. The 2011 reform reduces, in both cases, the number of entry pensions during the first years of simulation and increases it afterwards. When individuals are allowed to react to changes in financial incentives, the reduction is more abrupt. Not surprisingly, the measure that has more effect on these changes is the reform of retirement age. As expected, the rest of the measures exert no effect in the case of the non-behavioural model and its effect is weak in the behavioural model.

Finally, the most general indicator, which summarizes the effects of the reform in different dimensions, is the ratio of pensions to wage bill. Figure 4.6 shows the evolution of this ratio for both the behavioural and non-behavioural model and the percentage changes in the ratio. In both models, this ratio decreases due to the introduction of the reform, but this reduction is more abrupt in the case of the non-behavioural model, reaching the 12% of decrease. These results suggest that the increase in the initial pension due to the reform is compensated in by the reduction in number during the first years.

Figure 4.6. Effects of the 2011 Reform on the ratio pensions to wage bill

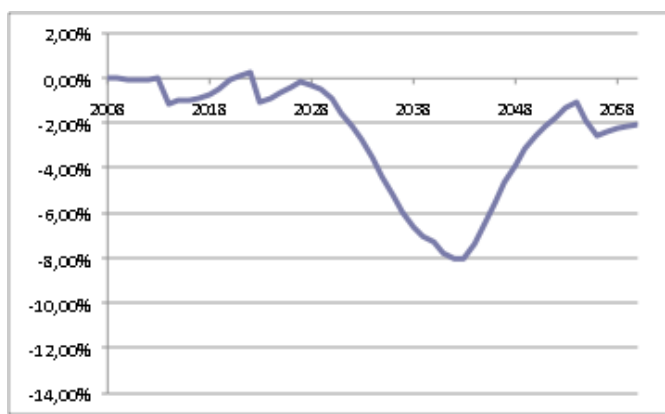
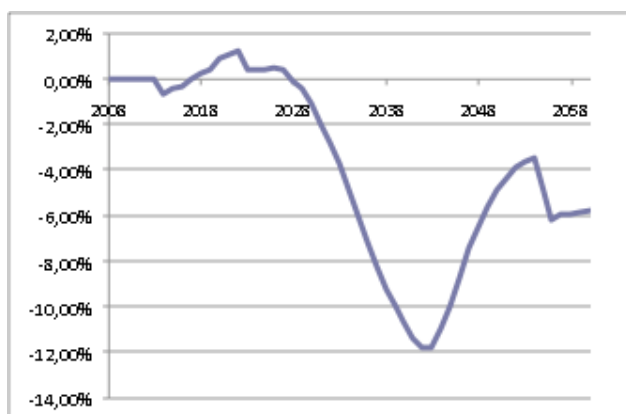
a) Ratio pensions to wage bill. Non-behavioural

b) Ratio pensions to wage bill. Behavioural



c) Changes in the ratio. Non-behavioural.

d) Changes in the ratio. Behavioural



Source: Authors' elaboration

5. Final remarks

The reform of the pension system is one of the main topics on the EU policy agenda. The design and evaluation of reform measures requires the availability of analytical tools suited to that purpose.

This paper presents the results of DyPeS, the first dynamic microsimulation model of the retirement pensions system applied to the Spanish case. The model is based on a sample drawn from the 2007 wave of the MCVL - the administrative data set of the social security administration. It reproduces the main events occurring over the life cycle: birth, entrance into the labour market, unemployment events, retirement and death. DyPeS introduces behavioural reactions to account for retirement decisions. Regarding the programming strategy, it is a case-based model, population based, and it has been modelled in continuous time. DyPeS has been implemented using ModGen, a programming language developed by Statistics Canada. In order to show the potentialities of the model, the effects of the reform approved in 2011 are simulated. The results show that the reform would have an impact on pension expenditure, but it does not seem to be sufficient to ensure sustainability. In particular, once the effect of the current crisis is introduced, three main reforms are implemented: The increase in the number of years considered to compute the basic pension benefit (BR) from 15 to 25, the change in the share of BR received as a pension, $p(n)$, – implying changing the weight given to the years of contribution - and the delay in retirement age. As expected, when individuals are allowed to react to financial incentives, initial pensions grow and the number of initial pensions reduces - suggesting that individuals delay retirement to obtain higher pensions. The simulation of the reform approved in 2011 shows that only the delay in retirement age (from 65 to 67) would have a significant effect on the number of entry pensions, while other measures changing the computation of the initial pension for new retirees have a limited impact. Paradoxically, it is found that the consideration of more contribution years in the computation of the initial pension amount, combined with the effect of the crisis on wages, has a positive impact on initial pensions level.

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Appendix A: The MCVL data set and the sample extraction¹⁸

The MCVL is a sample extracted from Social Security administrative data. Four per cent of all individuals registered with the Social Security administration – both contributors and recipients of benefits – over the sampling year are selected and their entire life history in the social security records is included in the data set.¹⁹ Thus, although it is not a pure panel, the data set is rich in longitudinal data. This feature, however, complicates the structure of the information as the registration unit varies substantially ranging from the person – in the personal data file – to the contract – in the affiliation file – or to the contract and year – in the contribution file. This structure also complicates the data selection. Furthermore, the quality of data is not homogenous, deteriorating the further back in time we go as more data are missing. The data collection itself was initiated at different points in time: data on pensions were first included around 1996; data on contributions around 1980; while some data on affiliation (contract registering) are available from as early as 1970. Clearly, all these factors condition our analysis. We provide details of the data employed below. We focus primarily on the pension file whose registration unit is defined by the individual, the benefit and the year, but we also recover contributory data for those individuals in our sample.

Among the difficulties of dealing with such a large administrative data set – the sample size reaches about a million people in 2005 – the most challenging are dealing with empty contribution bases and relating contribution, affiliation and benefit data from the same individual, all defined with different registration units. In particular, in order to extract reliable data regarding contributions in a specific time unit, it is necessary to follow up all the contracts in which an individual has been involved, computing time and contribution separately so as to avoid an erroneous correspondence between working time and contribution per unit of time. Below we describe in detail how we dealt with this.

¹⁸ See MTAS (2006b) for a detailed description of the *Muestra Continua de Vidas Laborales* (MCVL), available upon request at www.seg-social.es/Internet_1/Lanzadera/index.htm?URL=82.

¹⁹ Both workers and pensioners are thus included and also individuals receiving unemployment benefits or benefits prior to early retirement. The latter can be identified by the type of relation they have with the Social Security.

The model presented in this paper drives mainly on administrative data, extracted from the Social Security administration – the MCVL. It seeks to examine the impact of certain reform measures on the probability of retiring. The MCVL allows for this kind of analysis because it contains data of the main factors included in the initial pension formula. Specifically, over the period covered by the database, we are able to recover the number of working years, the life-cycle contributions of the individual and the retirement age, thus determining any penalizations for early retirement. It is also possible to recover these variables – except the not yet observed retirement age – to analyze future pension rights for potential pensioners – i.e. all the individuals in the sample who can opt for retirement. For pensioners, the total number of lifetime working years considered on computing the initial pension is also registered in the MCVL. Nevertheless, it is also necessary to obtain the annual working time in order to fill the gaps in the contribution data, in line with Spanish legislation.²⁰ Hence, the annual contribution period or working time is obtained by recovering all the contracts signed by the individual for each year, taking into account part-time work as well as the possibility of contracts that ran simultaneously.

At the same time, the average hourly contribution is obtained. One of the main problems we faced was the existence of missing contribution data. This can occur either within a contract registered in the contribution file or due to a lack of correspondence between the affiliation data – starting long before 1980 – and contribution data – starting in 1980. For example, we might find, even after 1980, no recorded contribution for one specific worker, while data regarding affiliation showed the worker to be actually contributing.²¹ An imputation process is developed to provide figures for the missing contributions. By tracking affiliation and contribution data, we treat missing values differently considering whether the individual is actually working – actual missing value – or not – if he is out of the labour force. In the former case, data from the same individual during the same year are used in order to recover absent contributions. If this is not available in the same year, the individual is dropped from the sample. This implies keeping more than 60% of the 2007

²⁰ When the individual presents a non-contributory period within the last 15 years considered for computing the *RB*, the minimum contribution threshold rather than zero is considered to compute the *RB*.

²¹ Information regarding contributions was first gathered in 1980, but is more reliable after 2001. The providers of the sample found that the share of contracts with missing data fell from 78% in 1984 to 94% in 1992 and to 99% in 2003.

sample. In the latter case, the gaps occurring in the last 15 years are filled with the minimum contribution threshold, according to Spanish legislation.

Appendix B: Data employed for the labour market transitions.

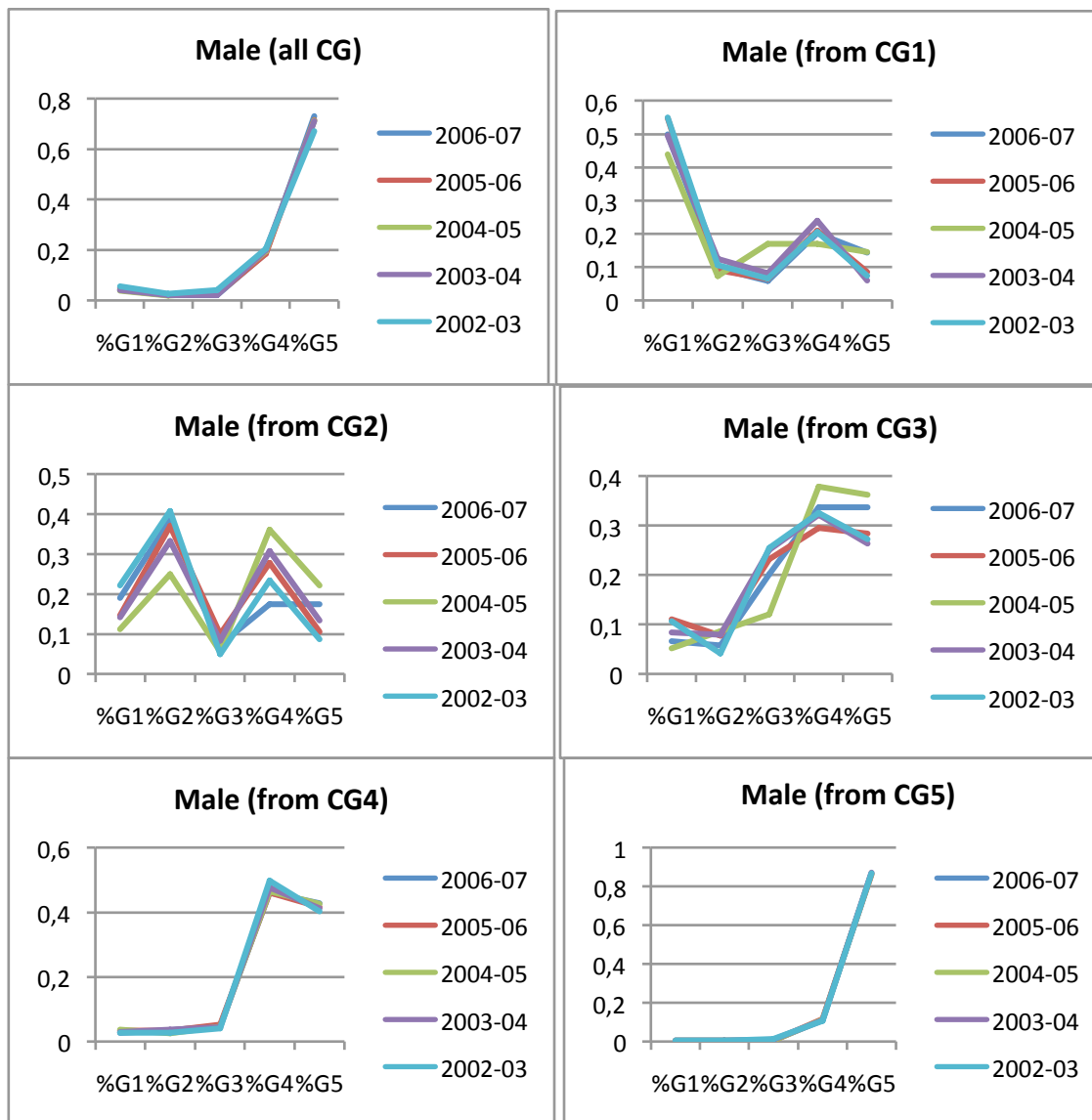
This appendix details the data employed in the employment transitions. Abstracting from exits and re-entering the labour market, they have been simplified to changes among qualification level – being employed - and changes from employment to unemployment and vice versa. Figures B.1 to B.3 show the evolution of the transition hazards observed from 2002 to 2007. Figure B.1 shows the changes in qualification level for workers re-entering employment from unemployment, both for male (panel a) and female (panel b). In all cases the transition hazards remain quite stable during the period covered. Only slight changes – more pronounced in 2004-05 - can be appreciated for males entering from groups 2 and 3 and females entering from group 3 to group 4.

In Figure B.2, the transition hazards from employment to unemployment are shown. In this case, stronger differences can be appreciated among the different years, probably because the Figures show the detail by age. Nevertheless, the trend is also quite stable both for males and for females. Finally, in Figure B.3 hazard rates for transitions between different qualification levels (contribution groups) within employment can be observed. Again, no significant changes are appreciated for the different years analyzed.

As the transition hazards among the different qualification levels are quite stable during the period observed, the value of the last transition observed before the economic crisis (2006 to 2007) is taken and it is held constant for the future. In Section 4.a), an explanation is given of how these hazards are altered during the crisis.

Figure B.1 Changes in qualification level from unemployment to employment

Panel a) Male



Panel b) Female

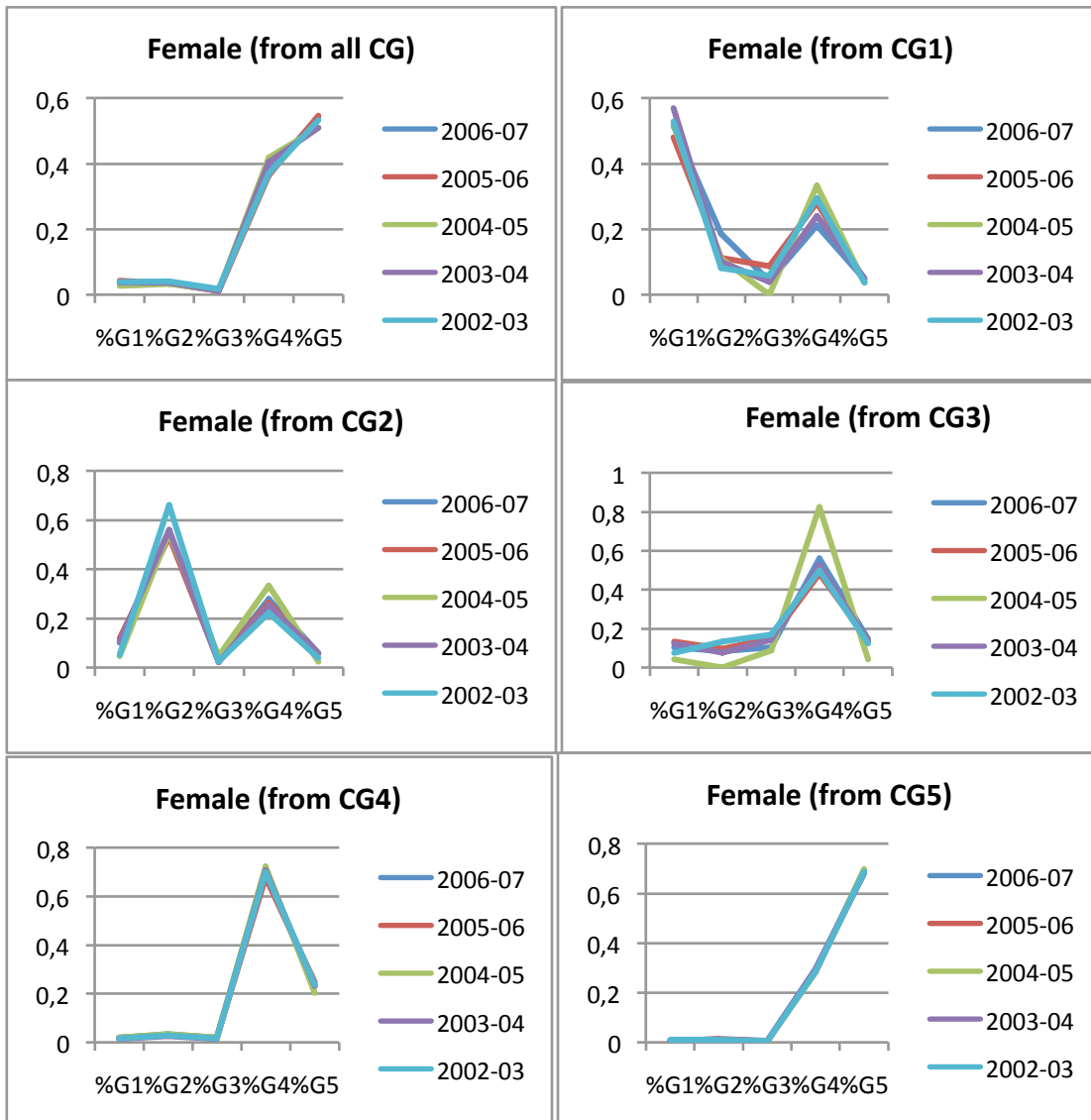


Figure B.2 Changes in qualification level from employment to unemployment

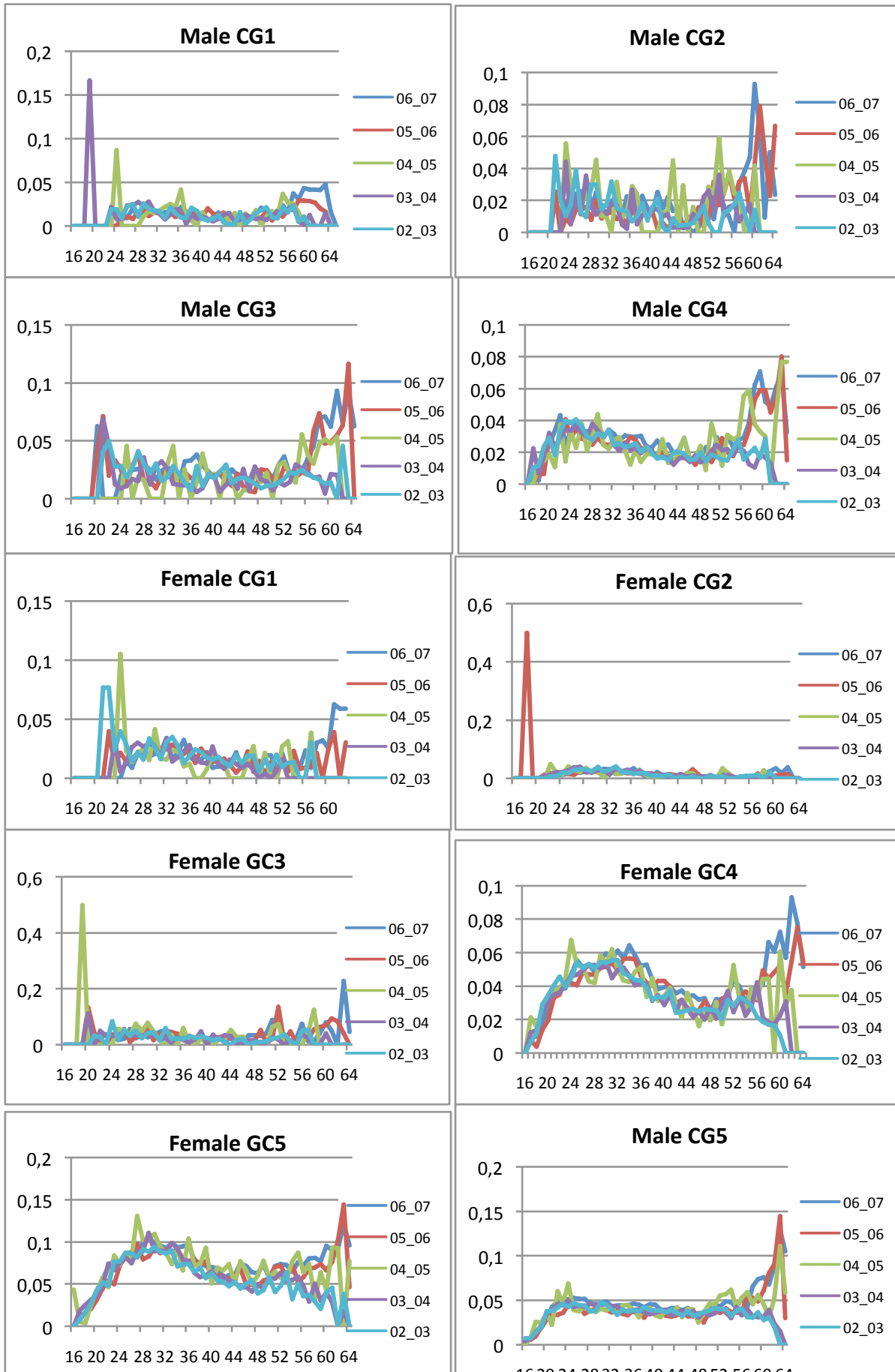
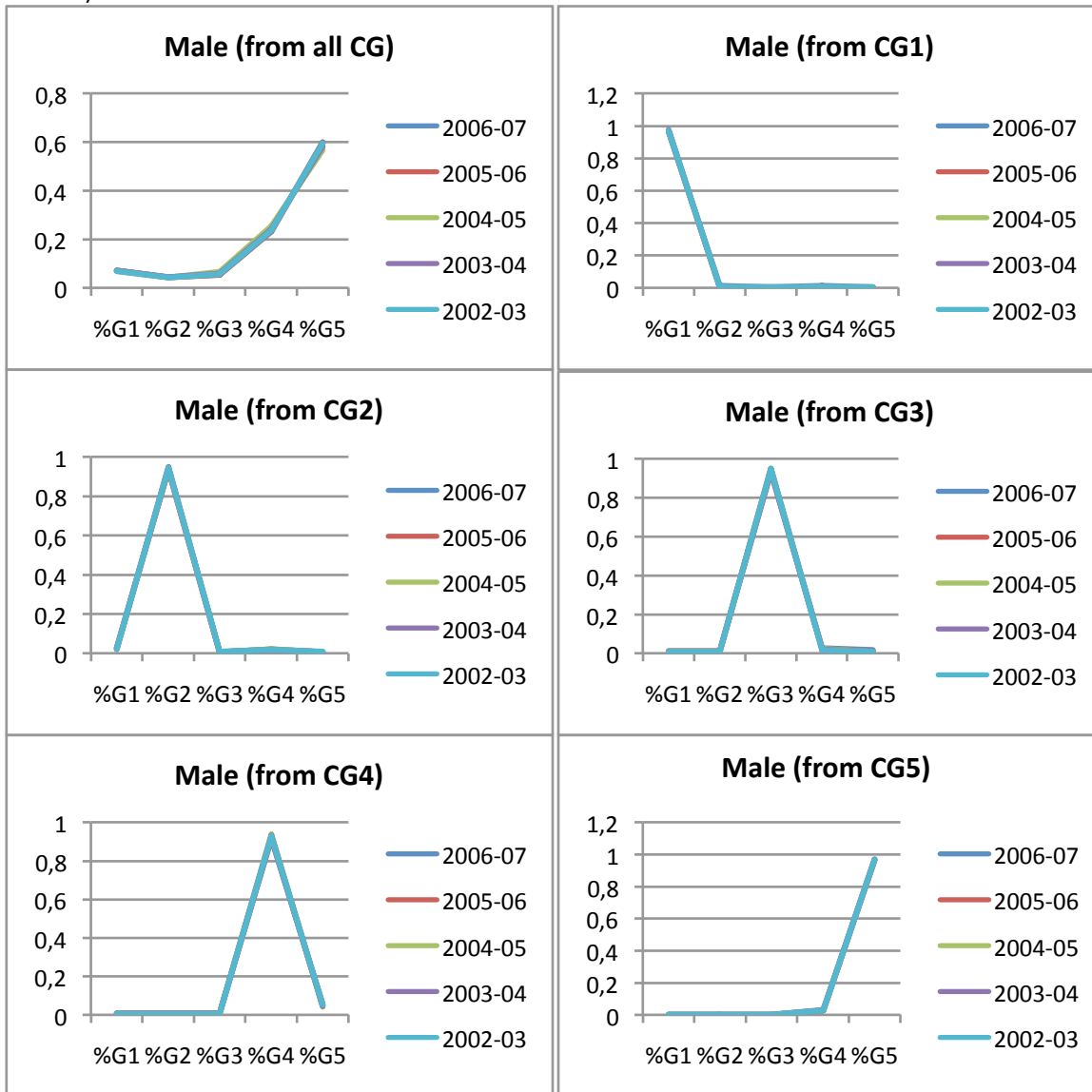
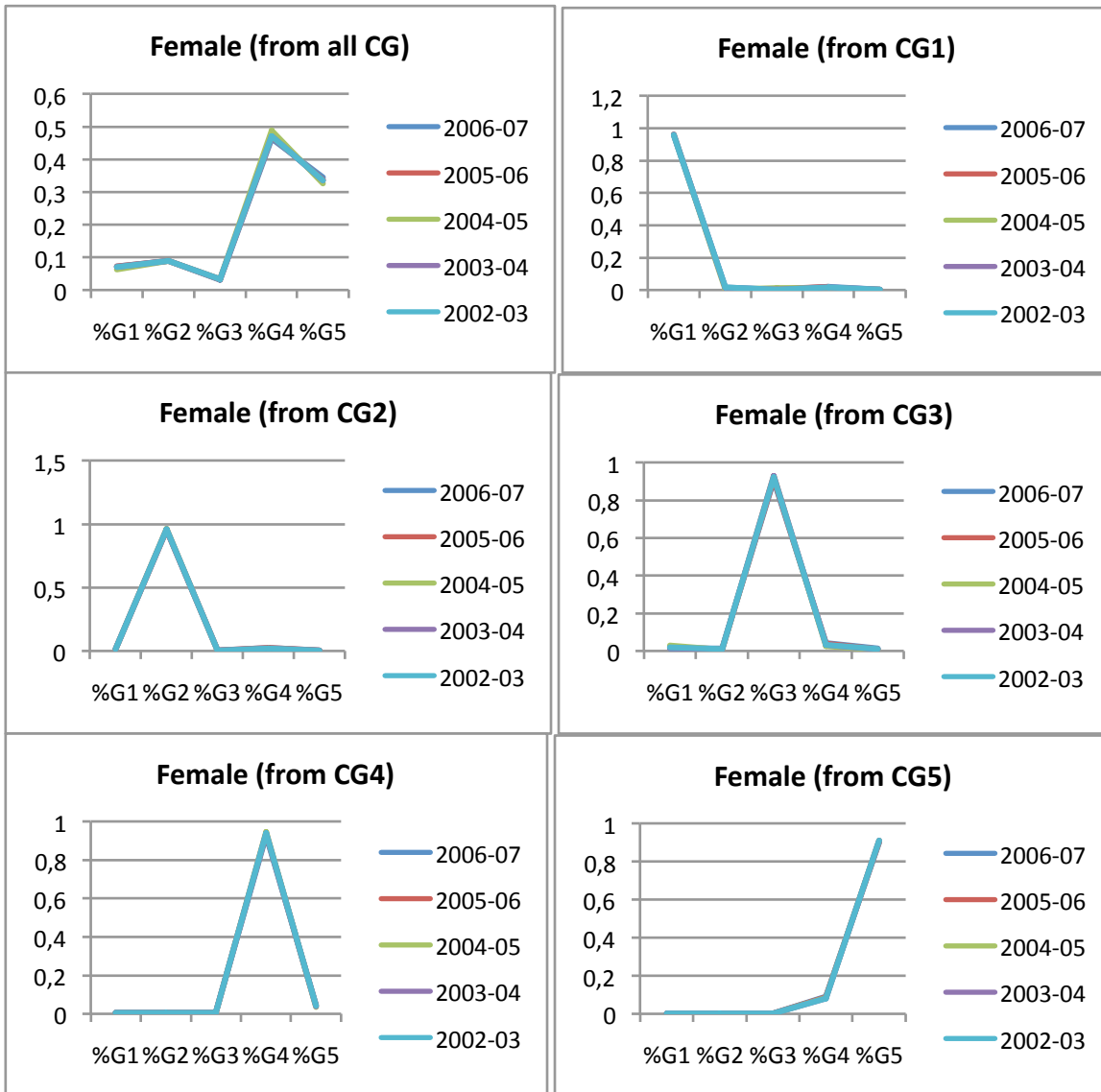


Figure B.3 Changes in qualification level within employment

Panel a) Male



Panel b) Female



Appendix C: Past and future reforms of the pension formula

This appendix summarizes the main features of past and future reforms affecting the pension formula. Past reforms of the pension formula refer to each of the three factors in Equation [1] in the text. First, changes in RB basically relate to the number of past BC used to compute the BR. Only two years were considered when the system started. The number of years increased to 8 in 1985 (26/1985) and to 15 in 1997 (24/1997 Act). The current reform has increased it to 25, still below the recommendation of the Toledo agreement of taking into account the whole contribution history. Second, changes in the $cc(n)$ have been varied and depend very much on the retirement path. Finally, changes affecting $p(n)$, i.e. the weight attached to the number of contribution years, so as to compute the share of the RB received as a pension. Table I.1 summarizes the different legal changes undergone by this scale. According to the present one, fixed by the 24/1997 Act, $p(n)$ is decreasing after the minimum, so that the weight attached to the first years is higher – which results in a redistributive effect. The former scale gave a lower weight to the initial years. The following columns show further reforms in line with the Toledo Agreement proposal, fostering the *Bismarckian* nature of the system: specifically, full proportionality considering the present maximum of 35 years – that is 2.86% a year - or a maximum of 40 years – that is 2.5% a year. As shown in Table I.1, for the various scales considered, the weight attached to one particular year oscillates between 5% in the first ten years prior to the 1997 reform, to 2% during the last years of the current legislation. The reform of $p(n)$ approved in 2011 is in the same direction but has a small impact, while it complicates the computation now based on months instead of years.

Figure C.1 illustrates the potential effect of reforms on this legal parameter. On the one hand, the function $p(n)$ is plotted for each of the legal scales considered. It is worth noting, first, that individuals who do not meet the minimum eligibility requirement would clearly benefit from a proportional rule. Second, it is clear that for those crediting between 15 and 35 years, both the previous and the present rules (26/1985 and 24/1997 Acts, respectively) are more generous than the two proportional rules.

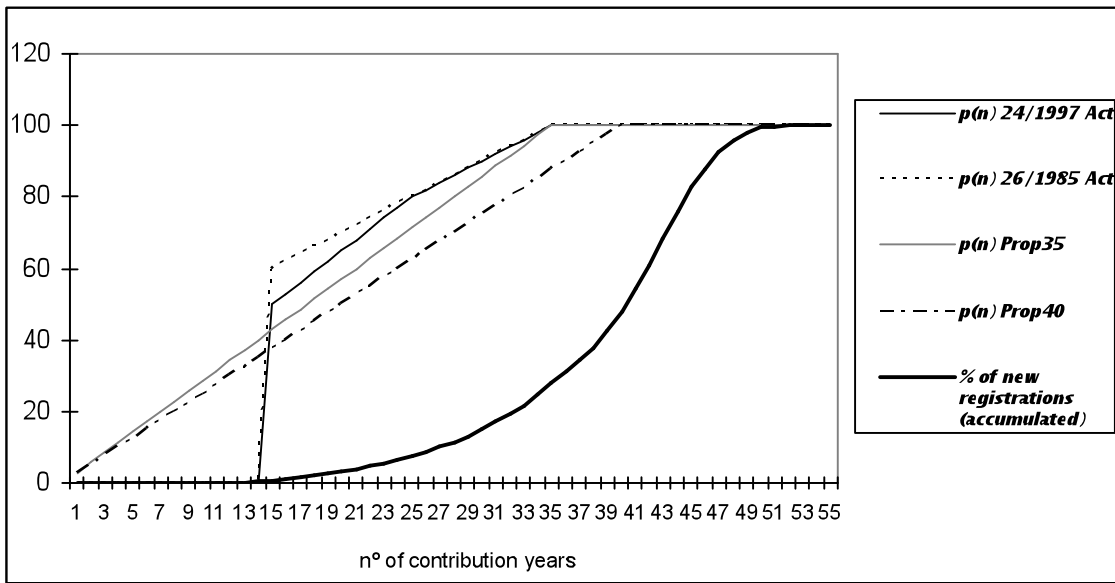
On the other hand, the cumulative distribution of new registrations with respect to the number of contribution years, in the 2004 MCVL wave, is also shown. This highlights the share of individuals affected by each legal scale and hence its specific effect. First, note that most individuals – 72% – credit up to 35 contribution years and, as such, are affected neither by the legal changes already enacted nor by moving to a system of full proportionality with a maximum of 35 years. Second, we can see that the legal change introduced in 1997 only affected 6% of new pensions. Finally, it is interesting to note that an eventual change to full proportionality would affect almost 50% of individuals, which accounts for the highest effect obtained for this simulated legal change.

Table C.1. Weight attached to contribution years in the share of *BR* (several legal scenarios)

	Prior to 1985	26/1985 Act	24/1997 Act	Total Proportionality
Minimum eligibility condition	10 years	15 years	15 years	–
Contribution years	Total $p(n)$ (per year)			
10	50% (5.0%)	–	–	–
15	(2.0%)	60% (*) (5.0%) (2.0%)	50% (3.3%)	In 35 years (2.86%)
16-25			(3.0%)	In 40 years (2.50%)
26-35		(2.0%)	(2.0%)	

(*) 60%: according to the same previous scale, 50% from the first 10 years (5% a year) plus 10% from the next 5 years (2% a year).

Figure C.1. Average effect on pensions from fixing different functions of $p(n)$



Source:

Source: Authors' calculations using MCVL data and legal parameters.

Table C.2. The 2011 reform in the pension formula

	Previous Situation (since 24/2007 Act)	Reform 2011 (17/2011 Act)
a) $p(n)$	$p(n)= 100\% ; n=35$ Three levels for n - First 15 years: 50% - 16 to 25: 3% / year - 26 to 35: 2% / year	$p(n)= 100\% \quad n=37$ Three levels for n - First 15 years: 50% - next 248 months: 0.19 per month - next months: 0.18 per month (gradual implementation 2013-2027)
b) $BR(bc_{t-15}, \dots, bc_{t-1})$	bc from the last 15 years	bc from the last 25 years (gradual implementation 2013-2022)
c) Retirement age	General 65 Minimum 61 (except Old system)	General 67 (65 if $n \geq 38.5$) Minimum 63 (61 if involuntary unemployment)
d) $cc(n)$	<u>Delayed retirement(*)</u> - $n < 40$: 2% / year - $n \geq 40$: 3% / year (*) There is a maximum limit. <u>Early retirement(**)</u> - Old system annual 8% before 65 - Unemployed: annual 7.5% before 65 (or lower if $n \geq 35$) - special retirement at 64 with no reduction <u>Partial retirement (25-75% reduction)</u> - From age 61 to retirement age need to substitute the worker (minimum contribution base 65% of the old contract).	<u>Delayed retirement(*)</u> - $n < 25$: 2% / year - $25 \leq n \leq 37$: 2.75% / year - $n > 37$: 4% (*) Maximum limit maintained <u>Early retirement(**)</u> - Old system annual 8% before 65 - $n < 38.5$: an additional 1.875% quarterly before legal retirement age - $n \geq 38.5$: an additional 1.625% quarterly before legal retirement age - It disappears (**) New possibility if stop working voluntarily (age ≥ 63) or involuntarily (≥ 61), considering time to retirement age as contributed. <u>Partial retirement (25-75% reduction)</u> - = conditions (minimum contribution base 100% of the old contract)

Appendix D: Retirement decision estimations.

	Men			Women		
	Haz. Ratio	Std. Err.	z	Haz. Ratio	Std. Err.	z
Age	21.2169	12.1363	5.34 **	0,8267	0.0181	-8.66 **
Age Sq.	0.97595	0.0043	-5.49 **	-		
Secondary studies	0.9727	0.0551	-0.48	0,8723	0.0794	-1.5
Universitary studies	1.1521	0.0688	2.37 *	0,9418	0.1082	-0.52 *
First year	11.2190	2.2717	11.9 **	7.0650	3.0741	4.49 **
Unemployed	0.6557	0.0444	-6.22 **	0.6886	0.0583	-4.4 **
Unemployed benefit	0.1557	0.0906	-3.19 **	0.2102	0.1229	-2.67 **
Wage	0.9999	3.57E-	- **	0.9999	6.19E-	-8.54 **
Difference max. pension	0.9996	0.0001	-2.3 **	0.9989	0.0003	-3.61 **
Time to max. pension	0.9947	0.0028	-1.83 *	-		
Age at max. pensions	1.0000	0.0001	1.92 *	-		
Replacement rate	1.0744	0.0263	2.93 **	1.1560	0.0558	3.09 **
Minimum pension	1.1235	0.0692	1.89 *	1.4313	0.1021	5.03 **
Months since eligible (log)	1.328927	0.03582	10.5	1.4678	0.0644	8.74
Unemployment	1.011712	0.00403	2.92 **	-		
Constant	5454	1.01E-	-5.39 **	9130.475	13749.2	6.06 **

*base category: no studies or primary studies

**significant at 5% level

Appendix E: Wage estimations.

Dependent variable: yearly wage (full-time equivalent)

	<i>Men</i>			<i>Women</i>				
	Coef.	Error St.	<i>t</i>	Coef.	Std. Err.	<i>t</i>		
Past wage	0.5157	0.0002	2039.91	**	0.5596	0.0003	1779.91	**
Age	802.4182	1.7828	450.09	**	633.5351	2.1533	294.21	**
Age Sq.	-5.0966	.02209	-230.63	**	-4.0222	0.02700	-148.93	**
Immigrant	-1846.894	9.8040	-188.38	**	-	12.795	-76.33	**
				**				**
Secondary studies	1022.908	5.03078	203.33		1059.155	5.9456	178.14	
Universitary studies	1686.268	8.5644	196.89	**	2366.825	8.0633	293.53	**
Experience	0.0424422	.00011	368.00	**	0.05131	0.0001	357.65	**
Experience Sq.	-5.87E-08	4.69e-10	-125.16	**	-8.15E-08	6.10E-10	-133.56	**
Non-manual work	1503.306	4.9434	304.10	**	1360.386	5.6977	238.76	**
Qualified work	3733.781	11.2921	330.65	**	3905.667	12.3322	316.7	**
				**				**
Year of birth	355.1204	0.31383	1131.55		279.1048	0.4010	695.96	
Unemployment	27.12949	0.4591253	59.09	**	45.0072	0.5482	82.09	**
Constant	-714479.5	629.3685	-1135.23	**	-	803.216	-701.41	**

*base category: no studies or primary studies

**significant at 5% level