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The Effects of Social Security Incentives on Retirement in Spain
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ABSTRACT

In this paper, we analyze the extent to what financial incentives have influenced individual and couples retirement decisions over the last two decades in Spain. We use administrative data on earnings histories to create synthetic measures of financial incentives that we link to individual survey data from the European Community Household Panel and the European Union Statistics on Income and Living Conditions. The ocurrence of several major reforms in the period largely facilitates identification. We find that retirement is highly responsive to incentive variables (both ITAX and SSW). We find that a 10% change in the implicit tax rate on working longer increases the probability of retiring by about 0.70 pp (0.90 pp for men and 0.54 for women). Furthermore, we find that couple incentives matter more in husband's retirement decisions than in wife's retirement decisions.

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1 Introduction

With the rise in life expectancy rates in developed countries and the reduction in fertility, publicly provided pensions systems have been subject to several reforms to ensure their sustainability. Some of the proposals implemented in several countries have the objective of prolonging the labor force participation of older workers. In fact, in many OECD countries labor force participation rates at older ages have been on the rise since the mid-1990s. This is also the case in Spain, which is the focus of this paper. Panel A1 of Figure 1 shows that participation rates of men aged fifty-five to sixty-four have increased by almost ten percentage points from the mid-1990s to 2017. From the figure, we can also see that there is a clear reversal in labour force participation rates for men in Spain in 1995 for the three age groups plotted. At the same time, participation rates of women in the same age group have more than doubled (see Panel A2 of Figure 1). More generally, the increase in participation rates for women is also pretty big for the age group 60-64.

If we now look at employment rates, we can see a similar picture than labour force participation rates for Spanish women. Employment rates for the age groups fifty-five to fifty-nine and sixty to sixty-four increase exponentially from the mid-1990s for women (Figure 1, Panel B2). For the case of older men, there is a downward employment trend since the 1990's and a reversal until the financial crisis in 2008. During the years of the crisis, employment was massively destroyed even if participation rates remained constant (see B.1 in Panel A of Figure 1). At the end of this period, there seems to be a mild recovery in employment rates of older men in Spain as a result of the improvement in the general economic conditions of the country. Both employment and labor force participation of men aged sixty-five to sixty-nine remained relatively constant at low levels over the entire period.

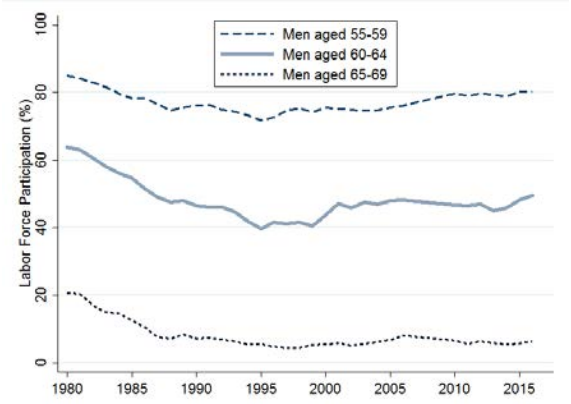
There are several elements that have been put forward as potential factors behind the rise in employment and participation trends in the last decades. The more salient explanations are the potential role of changes in the skill composition of workers, favorable economic conditions until the Great Recession or the effect of wife's labor market participation on the probabilities that men retire later (See Coile (2018); García-Gómez, Jimenez-Martin and Castelló (2018)). Our aim in this paper is to assess the contribution of one of these potential

factors, financial incentives from Social Security (SS) programs.

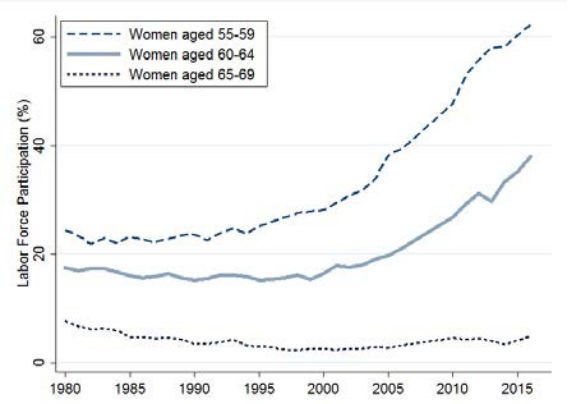
Figure 1: Trends in Employment rates and Labor Force Participation of men and women from 1987 to 2017

A. Labor Force Participation

A.1. Men

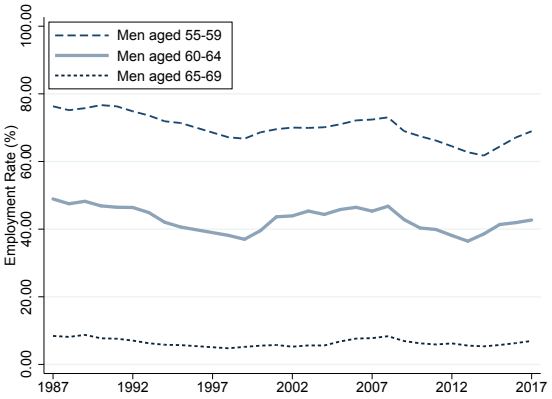


A.2. Women

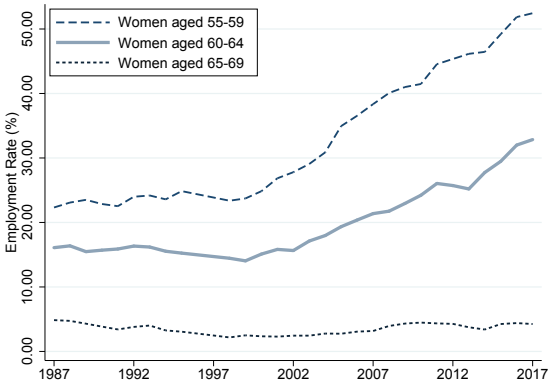


B. Employment Rates

B.1. Men



B.2. Women



Source: Spanish Labor Force Survey (EPA) from 1987 to 2017

There is consensus that changes in the Social Security system may incentivize workers to modify their retirement decisions. However, there is less evidence about the magnitude of these effects. We include in our definition of the Social Security system the old-age pension system (OA), the unemployment insurance (UI) system and the disability insurance (DI) system. There is an extensive empirical literature analyzing the effect of financial incentives on retirement behavior of employed workers (Samwick 1998; Gruber and Wise 1999, 2004; Börsch-Supan 2000; Belloni and Alessie 2009) and these papers usually find that

more generous financial incentives significantly increase the probability of (early-) retirement.

With respect to the incentives provided by the Social Security system to unemployed workers, the literature is more recent and, in general, also reports significant effects. In the context of the US, Coile and Levine (2007, 2011) investigate how the Social Security system affects the retirement responses of older unemployed workers. In Europe, Hairault et al. (2010) use French data and find that the distance to the statutory retirement age is a key predictor of retirement behavior. Although, in general, the authors find that financial incentives affect retirement behavior, eligibility conditions turn out to be the most important determinant of retirement behavior.

In Spain, this literature started with the papers by Boldrin et al. (1999, 2004) and Jiménez-Martín and Sánchez-Martín (2004) that concluded that financial incentives have a significant effect on retirement probabilities, although the magnitude is small. More recently, Cairó-Blanco (2010), García-Pérez et al. (2013) and Sánchez-Martin et al. (2014) explicitly consider the behavior of unemployed workers and find a significant but weak influence of financial incentives on labor force exit.

In a previous paper (Garcia-Gomez, Garcia-Mandico, Jimenez-Martin and Vall-Castello (2018)), we computed financial incentives and tested the correlation between the implicit tax rate on employment and the employment rates for older workers using both graphical inspection and regression analysis with data aggregated at the regional level. In the current paper, we go one step further and estimate the effects at the individual level using rich survey data and covering several reform periods (1994-2019). We overcome the lack of survey data (with working histories) covering all the desired period, combining rich individual and family survey data with synthetic financial incentives data constructed from individual working histories. This approach has the advantage that the measure of financial incentives we use is exogenous to individual retirement decisions.

We proceed in two steps. First, using data from social security working histories (as in Garcia-Gomez, Garcia-Mandico, Jimenez-Martin and Vall-Castello (2018)) we first compute expected social security benefits from each possible retirement pathway (OA, UI, and DI) at ages fifty-five to sixty-nine for representative workers for each cohort falling in this age range in our observational period. We allow representative workers to differ by region, marital

status, gender and earnings level. We then compute the *implicit tax rate on employment*, a measure that weights the gains and losses from working one additional year for each representative worker. The representative synthetic incentives are then evaluated with individual data.

In a second step, the synthetic financial incentives are then matched, by region, gender, marital status, and skill group, to rich individual and family data from the European Community Household (1994-2001) and the European Union Statistics on Income and Living Conditions (2004-2019) Surveys.

Using this data we run simple individual models of retirement of the labor force for older individuals and couples accounting for financial incentives to retire (as well as health status and other family covariates). Our results show that a 10% change in the implicit tax rate on working longer increases the probability of retiring about 0.70 pp (0.90 pp for men and 0.54 pp for women). These results are robust to several specification and heterogeneity exercises.

We also investigate what is the relationship between the couples incentives and the retirement decisions, and find that the couple incentives seem to matter more for husbands retirement than they matter for wives, which is in stark contrast with what it is often found for other outcomes, like health.

The rest of the paper is organized as follows. Section 2 briefly summarizes the reforms of the Spanish Social Security system over the last three decades and shows the evolution of the key parameters of the system. Section 3 explains the measurement of the Social Security incentives and the assumptions behind our calculations. Section 4 reports the effects of financial incentives on individual and couples retirement, Section 5 concludes.

2 Social Security reforms and evolution of key parameters

The Spanish old-age pension system is a defined benefit pay-as-you-go system. There have been several reforms in the system over the last 30 years, which we enumerate here (see Appendix A as well as Table A1 for a summary, and Boldrin et al. (2010) and García-

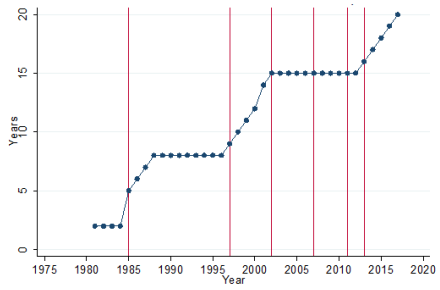
Gómez et al. (2012) for a detailed exposition of the changes in the old-age pension system in Spain). There have been substantial parametric reforms in 1985, 1997, 2002, 2007, 2011 and a non-parametric reform in 2013. Figure A1 depicts the timeline of the reforms of the Spanish Social Security System from 1980 until 2015, as well as the main parameters that were modified in each of the reforms.

Figure 2 plots the temporal evolution of the key parameters of the old-age pension system. Panel A in Figure 2 shows the increase in the years of contributions included in the benefit calculation. Reform years are marked with a vertical red line. We see that after the reforms in 1985, 1997 and 2011, the number of years included increased staggeringly. Panel B shows the earliest and statutory eligibility pension ages. The latter has only been increased at the end of the period with the reform of the pension system in 2011. The earliest eligibility at age sixty was initially only available for those that started contributing before January, 1967. In 2002, early-retirement at age sixty-one was introduced for all the other workers. This possibility became restricted in 2011 to situations of involuntary retirement. At the same time, the earliest eligibility age for voluntary retirement was set at sixty-three. Panel C shows the increasing trend in the ratio of minimum benefit to minimum wage, highlighting the generosity of the Spanish pension system. This trend was reverted with the 2013 reform and the introduction of the sustainability factor. Panel D shows the ratio of the minimum to the maximum benefit. Since the early nineties, and in particular after the 1997 and 2002 reforms, the gap between minimum and maximum benefits widens over time. This tendency seems to have been curbed with the 2013 reform.

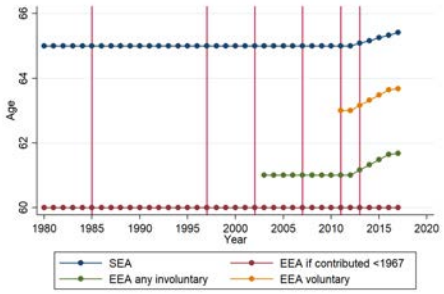
Other factors that may affect the labor market behavior of older workers are disability and unemployment insurance policies (García-Gómez et al. 2012). During the 1970's and 1980's the use of the permanent disability system increased in several OECD countries as workers in developed countries used disability benefits as an alternative way of permanently exiting the labour force (OECD, 2001). The strong increase in inflows into the disability system forced affected governments to introduce several reforms during the second half of the 1980s and beginning of the 1990s (see Table A2 for a summary). The main objective of these reforms was to prevent workers from permanently leaving the labor market before reaching the statutory eligibility age for retirement and to provide incentives to remain em-

Figure 2: Time Trends of Key Parameters

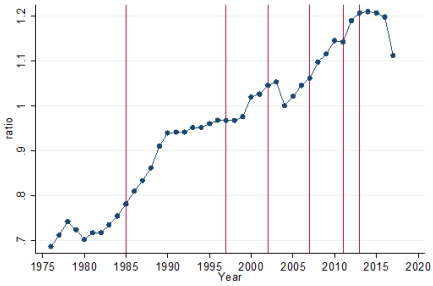
Panel A. Contributive Years in Benefit Calculation



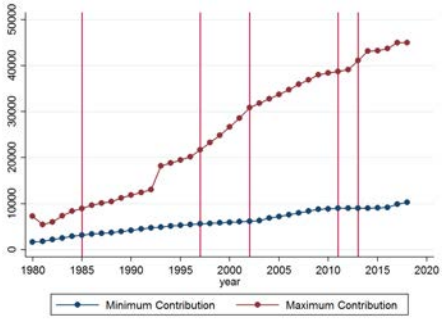
Panel B. Earliest and Statutory Eligibility Age



Panel C. Ratio of Minimum Benefit to Minimum Wage



Panel D. Minimum and Maximum Benefits



source: Spanish Social Security Administration: www.Seg-social.es

ployed. Similarly, some of the reforms were targeted to the unemployment scheme which, for the case of Spain, was modified in 1984, 1989, 2002 and 2012. In the 1980's unemployment benefits were extended to some groups of the population while in the 2000's the amount of benefits after six months in unemployment was reduced. A detailed summary of all these changes can be found in Table A2 in Appendix A.

3 Data and measures of financial incentives

3.1 Data

To study retirement behavior in Spain, we use two main sources of data. The first database is administrative data constructed from Social Security records (Muestra Continua de Vidas Laborales, MCVL), which contains the complete earning histories for a 4 percent random sample of everybody that had some relationship with the Spanish Social Security in 2016. That includes workers, pensioners, and unemployment benefit recipients. We recover the labor market history of these individuals since they entered the labor market. We use this information to construct *representative* earnings histories from individuals in the MCVL sample for each combination of (1) men and women, (2) three education levels (primary, secondary and higher education), (3) seven regions (Northwest, Northeast, Madrid, Center, East, South, Canary Islands), and (4) year of birth (1924 to 1966). That implies forty-two subsamples per each cohort born in between 1924 to 1966, for which we construct the median wage distribution for ages forty to seventy. The *representative* earnings histories allow us to calculate the social security incentives for *representative* individuals, as described in more detail below.

The MCVL does not contain information on health status or marital status. We thus combine the social security incentives for *representative* individuals with survey data from the European Community Household Panel (ECHP) and the European Union Statistics on Income and Living Conditions (EU-SILC). The ECHP is a panel survey that interviewed

yearly a sample of individuals and households from 1994 to 2001 (8 waves). From 2004 onward, the EU-SILC replaced the ECHP, with a panel component surveying households over a four-year period, with a rotational design that included new households every year. We use data for the EU-SILC until 2019, which combined with the ECHP allows us to construct a sample from 1994 to 2019, with a two-year gap in 2002 and 2003. This covers the last part of the downward trend in the labor force participation of the population aged fifty-five to sixty-nine, the turning point, and the upward trend thereafter (see Figure 1). Similarly, this period includes all the reforms since 1985.

3.2 Social Security Incentives

Our measure of financial incentives is based on the social security wealth (SSW), which is the present discounted value of lifetime social security benefits. For an individual of type i, where the type is defined by her cohort, gender, skill level, region and marital status, starting to claim benefits B from program k at age R, her social security wealth is defined as:

$$SSW_{k,t}(R,i) = \sum_{a=R}^{T} B_{k,t,a}(R,i)\sigma_{t,a}\beta^{a-R} \tag{1}$$

Where $\sigma_{t,a}$ is the survival probability at age a in year t, T is the maximum length of live, and β^{a-R} is the discount factor set at a rate of 3%.

Postponing claiming by one year has two effects on SSW. On the one hand, annual benefits $B_{k,t,a}(R,i)$ increase with later claiming due to additional contributions and actuarial adjustments. On the other hand, however, benefits are received one year less. We thus define the implicit tax rate on working longer and claiming benefits later as:

$$ITAX_{k,t}(R,i) = -\frac{SSW_{k,t+1}(R+1,i) - SSW_{k,t}(R,i)}{Y_{t+1,i}} \tag{2}$$

where $Y_{t+1,i}$ is the after tax earnings during the additional year at work. The Social Security System provides incentives to continue working when $ITAX_{k,t}(R,i) \leq 0$, and to retire otherwise. That is, when the ITAX is positive, the Social Security system imposes an implicit tax on working longer and claiming later.

3.3 Assumptions and Scenarios

In this section we briefly describe the assumptions used to calculate the previously defined measures using data from the MCVL for each combination of (1) men and women, (2) three education levels (primary, secondary and higher education), (3) seven regions (Northwest, Northeast, Madrid, Center, East, South, Canary Islands), and (4) year of birth (1924 to 1966).

We construct survival probability curves for each type of worker using average EU-28 survival rates (Eurostat, 2016). The underlying life expectancy at age 15 is 67.8 years for women and 64.7 years for men. We adjust these survival curves for differences in life expectancy across skill levels. In particular, we generate a life expectancy which is 3 years higher (lower) to reflect the difference in life expectancy across the three earnings categories (Van Baal et al. 2016 and Regidor et al. 2016). [1]

All calculated magnitudes are net of Social Security contributions and personal income taxes. Exact calculations of after-tax social security wealth and replacement rates are complicated by the fact that the number of bend points in the Spanish marginal tax schedule is high although decreasing over time (thirty-four in 1985, seventeen in 1995, seven in 2011 and five in 2016). As an approximation, we proceed as follows. We first use the 1995 tax schedule to trace out the relation between the average tax rate (net of standard deductions) and income (net of social security contributions paid by a worker). We then fit by least squares a fourth-order polynomial to this relation. Finally, the estimated coefficients are used to determine after-tax earnings for all previous and subsequent years.

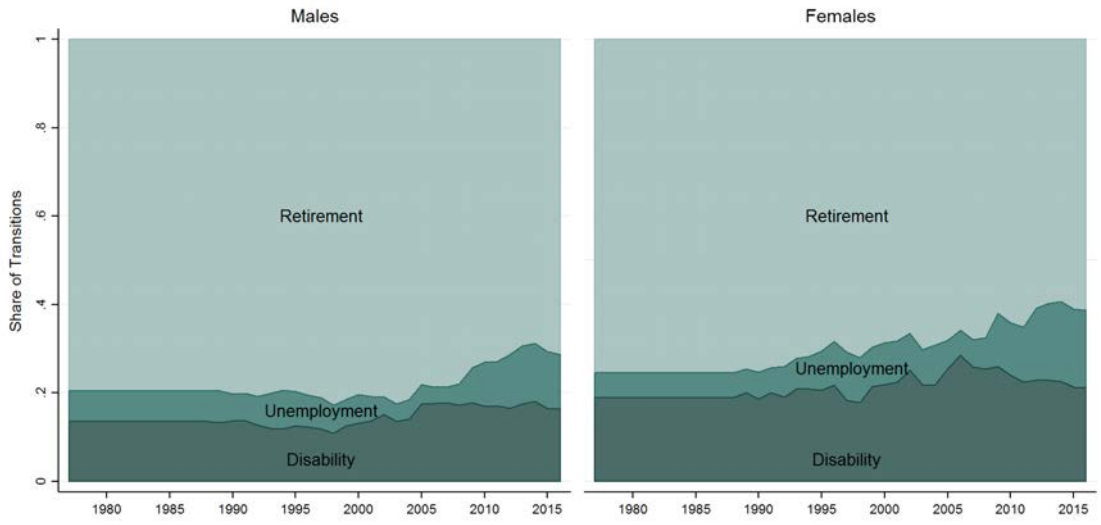
As in Garcia-Gomez, Garcia-Mandico, Jimenez-Martin and Vall-Castello (2018) we consider three potential pathways to retirement: old-age, unemployment and disability insurance. Figure 3 shows the share of the population aged fifty-five to sixty-nine that reports being, in any given year, into unemployment, disability or receiving an old-age pension, obtained from the Spanish Labor Force Survey (Encuesta de la Poblacion Activa, EPA).[2] DI

[1] The measures of financial incentives remain practically unchanged using Spanish survival rates in 2014. Results are available upon request.

[2] The EPA is a rotating quarterly survey carried out by the Spanish National Statistical Institute (Instituto Nacional de Estadstica, INE). The planned sample size consists of approximately 150,000 adult individuals. Although the survey has been conducted since 1964, publicly released cross-sectional files are available only from 1977. The 1977 questionnaire was modified in 1987 (when a set of retrospective questions

and UI represent about 20% of all transitions to retirement, with an increasing trend in the recent years.

Figure 3: Pathways to Retirement for men and women from 1975 to 2016



Notes: Data obtained from the shares of males and females in each pathway from the EPA. There was a major change in the survey in 1988, so we cannot obtain a consistent definition of the different pathways prior to 1988. We then normalize each share in this time interval to the level in 1988.

We compute our measures of financial incentives for each of the pathways into retirement. We present estimates of both the effect of the old-age program, and a combine measure that weights the different pathways using as weights the population share that transits in a given year from employment to retirement through each of the three programs, as presented in Figure 3. As we have information on these shares over time and gender, we are able to attribute a particular weight to each gender-age time observation.

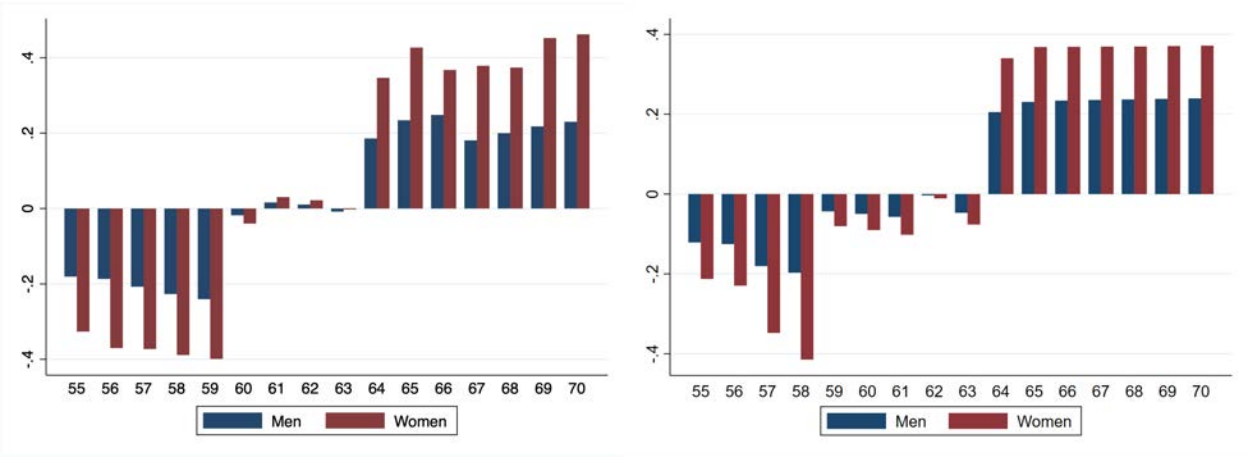
3.4 Implicit Tax Rate

In this subsection, we describe how our main measure of financial incentives, ITAX, varies over time and across age groups. We focus on both a measure that considers only the (early-) retirement pathway through the old-age pension program, as well as a combined

were introduced), in the first quarter of 1992, in 1999 and 2004. The EPA provides fairly detailed information on labor force status, education and family background variables, but it does not include information on earnings. The reference period for most questions is the week before the interview

measured that weights the different programs as explained above. Figure 4 presents the implicit tax rate in 1994 (Panel A) and 2016 (Panel B) for married male and female workers with national-level median earnings. From the figure, we note that ITAX is negative for both men and women before aged 60. ITAX is close to zero around early-retirement ages, although the value is slightly more negative in 2016 due to the additional restrictions to early-retirement. From age 65 onward, the ITAX is positive, and remains rather constant as age increases. Overall, the ITAX is larger in absolute terms for women compared to men.

Figure 4: ITAX by age and gender



Notes: This figure show the implicit tax rate in the first and last year of our observation sample (1994 and 2016) for married male and female workers with national-level median earnings. Only the pathway to retirement through old age benefits is considered.

Figure 4 provides an interesting snapshot of the incentives to retire but doesn't show how these incentives varied with the numerous reforms of the Spanish social security system over the last three decades. Figure 5 shows the evolution of the implicit tax rate by gender and for different age groups. The figures show the the tax rate of the old-age system from 1980 to 2015 for workers aged fifty-six, fifty-eight, sixty, sixty-two, sixty-four and sixty-five. Common to both men and women, we note some discontinuities in the trends that correspond to reform periods of the system. For instance, the implicit tax rate increases in 1985 for ages fifty-eight to sixty-five, associated to the significant reform in 1985.

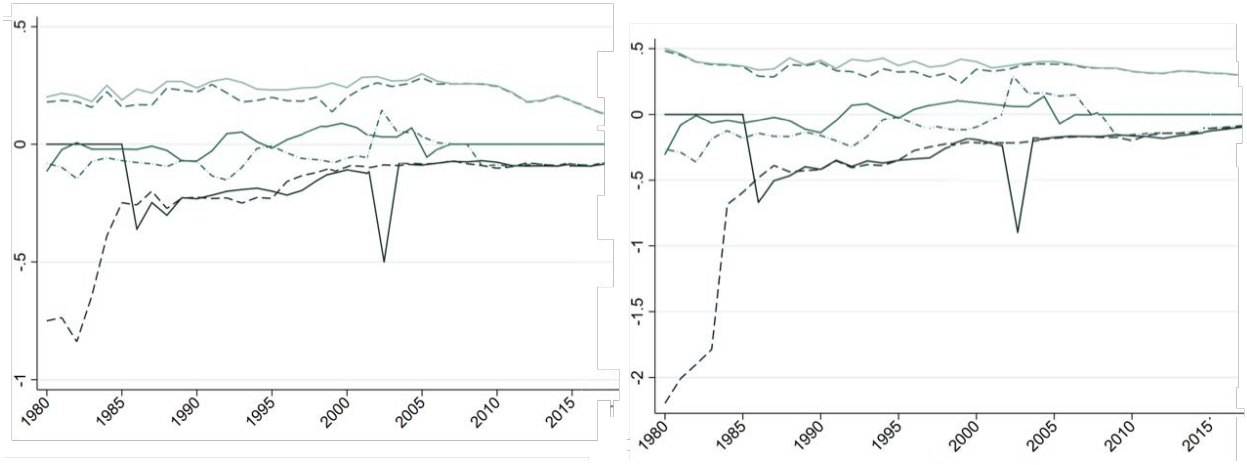
In 2002, we observe a change in the implicit tax rate for ages fifty-six to sixty, coinciding with the introduction of the earliest eligibility age at sixty-one for workers that started

contributing into the system after 1967. The implicit tax rate only increases for those aged sixty. Instead, those aged fifty-six and fifty-eight experience a one-year decrease in 2003 and 2005, respectively. This is the result of our calculations, which give the cohort born in 1947 a strong incentive to retire once the early retirement scheme was introduced.

Regarding the level of the implicit tax rate, we note that men and women older than sixty-two are incentivized to retire thorough the observed period. Workers aged sixty-two faced a positive implicit tax rate until 2012. Their ITAX became zero in 2013 as the earliest eligibility age increased to sixty-three. The incentives to retire faced by workers aged sixty change over time. They were incentivized to retire under the system of 1980 and part of that of 1985. In the mid-nineties, the system seemed to subsidize employment, but by the late nineties, it was incentivizing retirement. Since 2007, they have been incentivized to work mostly due to the increase in the earliest eligibility age. As expected, workers younger than sixty have always been incentivized to remain employed.

Figure 5: Implicit Tax Rate

A.1. Men **A.2.** Women



Notes: These figures show the time-varying implicit tax rate for married male and female workers with national-level median earnings. Panel A considers only retirement through old age benefits. Panel B aggregates the pathways to retirement through old age, DI and UI benefits are aggregated over time by weighting the national and gender-specific incidence of each pathway for every year from 1980-2015.

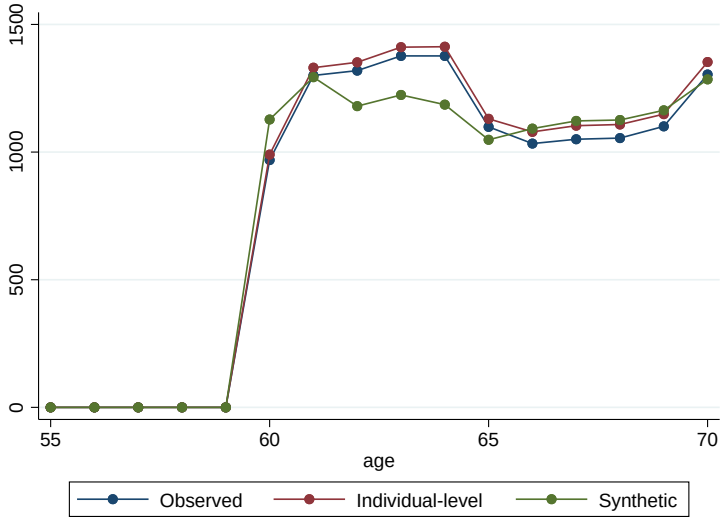
3.5 Validation of the synthetic profiles

To validate our assumptions regarding representativeness of the financial incentives imputed to individuals, we perform several analyses to check the influence of the different steps from the individual data on earnings and benefits to the *representative* financial incentives used in the survey data.

First, we compare the old-age monthly pension payments using individual-level earnings histories (individual benefit) and our *representative* earnings profiles (estimated benefit) using a random subsample of 40,000 individuals from the MCVL. Figure 6 shows the observed benefit, the individual calculated benefits and synthetic estimated benefit entitlement by age for the sample receiving benefits. The observed benefits are the average old-age payments observed in the MCVL sample for the period 1994 to 2016. These are set to zero for ages younger than 60, according to the eligibility in the old-age pension. The observed pension benefit peaks at age 64, to then drop at 65 and remain rather constant. This is because there is an observation bias in the sample: individual retiring at younger ages retire early if it is financially beneficial for them. One can expect that those that early-retire have, on average, higher pension benefits. The benefits simulated using individual-level earning histories follow very closely the pension benefits, with a slight overestimation that is similar across ages. This is reassuring, as it appears that the model simulates well what is observed in the data. When simulated using synthetic earnings histories, there is a gap between the observed and simulated pension for ages 60 to 64. The simulated pension is lower, and is rather decreasing from age 60 to 64. By adding more structure to the age profiles in the simulation, we remove the observation bias that is present in the data. The synthetic simulation does not capture the fact that individuals with higher incomes (and thus pension entitlement) may retire earlier. From ages 65 onward, the simulated benefit follows closely the observed benefit.

To further investigate the implications of our choice of using synthetic earnings histories, figures 7 and 8 plot the distribution of the benefits as well as the prediction errors of observed and simulated benefits using synthetic earnings profiles. In the full sample as well as for men and women, the simulated pension benefits are more skewed to the right. There is also

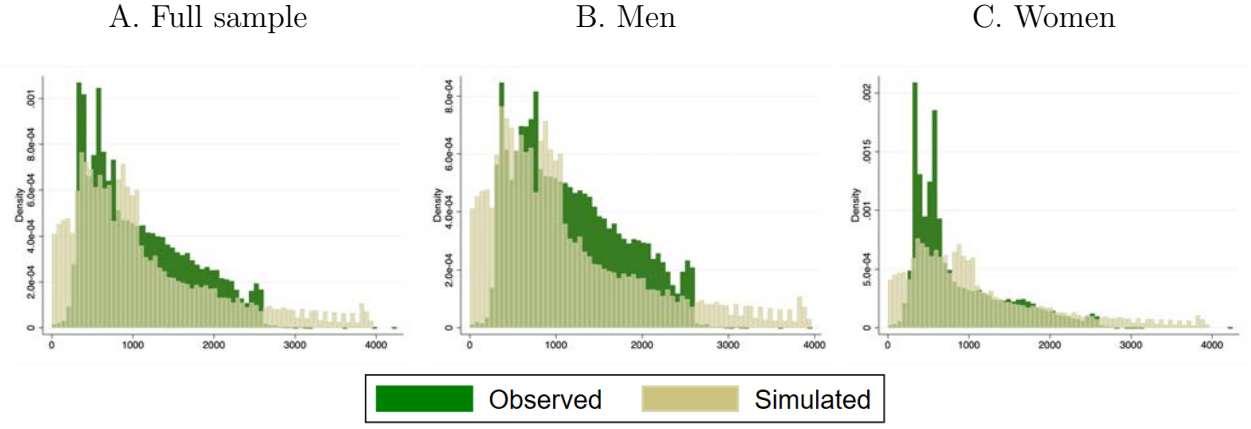
Figure 6: Observed and simulated monthly pension payments per age



Notes: Observed benefit entitlement id the average entitlement from a random subsample of 40,000 individuals from the MCVL (1994 to 2016). Estimated entitlement is calculated from incentives calculation with synthetic earnings profiles and individual-level earnings profiles. Quantities are real, expressed in 2015 €.

a higher density of low simulated benefits (under 500€) than observed. However, these differences translate into small errors, of around 1% (Figure 8).

Figure 7: Validation of pension benefit calculator

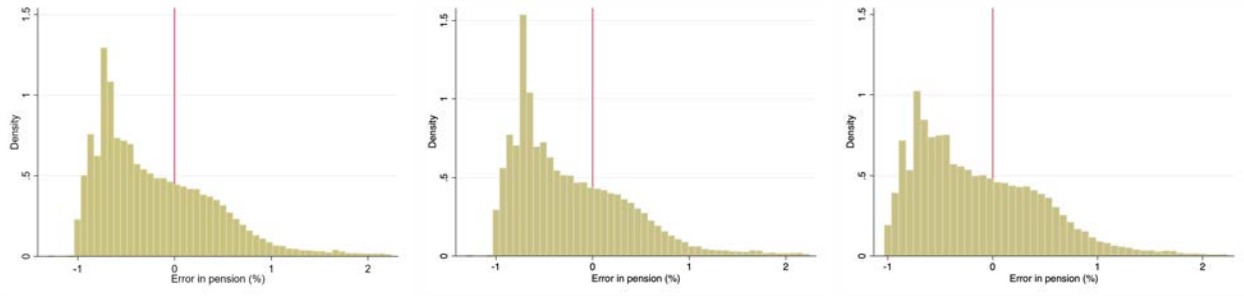


Notes: Observed pension in MCVL, simulated pension based on synthetic earnings histories. Mean observed pension is 1,082.5 (s.d. 633.6). Mean simulated pension is 1,107.2 (s.d. 882.5). For men, mean observed pension is 1,176.9 (s.d. 630.3), and mean simulated pension is 868.1 (s.d. 794.8). For women, mean observed pension is 858.2 (583.1), and mean simulated pension is 697.1 (675.6).

Our synthetic measure of incentives can be considered as an instrument for the individual measure, as the variation is driven by characteristics exogenous to the individual at the time

Figure 8: Error in pension calculation (%)

A. Full sample B. Men C. Women



Notes: See Notes from Figure 7. Error is calculated as (simulated pension -observed pension)/(observed pension).

of retirement. In this spirit, we test to what extent our measure would predict the individual variation. We estimate a model with the individual measure as the dependent variable, and the *synthetic* measure as the explanatory variable. That is, for both SSW and ITAX of individual i in region r and at time t, FI_{irt}, we define:

$$FI_{irt} = \alpha + \delta FI^{S}_{irt} + \gamma_t + \mu_r + \epsilon_{irt}$$

Where FI^{S}_{irt} is either the SSW or the ITAX computed using synthetic earnings profiles, γ_t and μ_r are a full set of year and region fixed effects, and ϵ_{irt} is the error term. Standard errors are clustered at the sex, skill, region and year of birth level. We test whether the coefficient δ is statistically different from zero.

Table 1 reports the estimated coefficients. We cannot reject that the key coefficient of the model is different from zero. In addition, the F-statistic is in both cases well above the rule-of-thumb of 10. The results in table 1 show not only that our instrument would be relevant, but also strong. Therefore, our approach is equivalent to estimate a reduced form equation of the instruments on the probability of retirement (see section 4).

Table 1: Comparison of individual and synthetic incentive measures

	SSW	ITAX
Point estimate (β)	1.018***	.961***
	(.013)	(0.008)
Adj. R^2	.484	.591
F-stat	520.94	923.39
F-test, p-value	<.01	<.01
Observations	39,984	

Notes: All specifications include a full set of year dummies and region dummies. Standard errors, in parentheses, are clustered at the sex, skill, region and year of birth level.

4 Effects of financial incentives on retirement

4.1 Empirical strategy

We model the probability to retire, conditional on working in the previous period. For each individual i, we write $ret_{it} = 1$ if the individual has retired in period t (conditional on working in period $t-1$). We then model the probability of this event as a function of observable individual characteristics X measured at $t-1$, such as an age function, region and year dummies, sex and skill indicators, and a quartic of the wage. We include the SSW and the ITAX, both measured at $t-1$ to capture the effects of financial incentives. Our conditional probability model may be expressed as:

$$PR(ret_{it} = 1|work_{it-1}) = G(\beta_0 + \beta_1 SSW_{it-1} + \beta_2 ITAX_{it-1} + \gamma' X_{it-1} + \delta_t \rho + \epsilon_{it}) \qquad (3)$$

$\delta_t \rho$ captures time fixed effects, and $G(.)$ is the cumulative distribution function of unobservables in the conditional exit model, and ϵ is an error term. The βs are unknown response coefficients, which we estimate using a logit model, with standard errors clustered at the individual level.

Specification (3) is equivalent to a discrete duration model, in which we control for duration dependence by including a third-order polynomial age function. We consider alternative versions in which the age polynomial is replace by age or year of birth dummies.

Our specification, however, does not account for unobserved heterogeneity. The necessary assumption for the estimation of our model is that the error term ϵ is i.i.d. in our sample of analysis, but not in the population (Jenkins, 1995).

4.1.1 Sample selection and Descriptive Statistics

We select our sample by keeping only those individuals who were in between 50 to 70 years old at the time of the survey and that were surveyed at least twice, which gives a final sample of 8,477 individuals (19,350 individuals/year).

The ECHP and EU-SILC classify the labor status of its respondents as employed, unemployed, retired, disabled, in housework, or another type of inactivity.[3] Our main definitions of retirement consider transitions from work to self-reported retirement *(retirement)*, from work to out of the labor force *(not working)*, and from in the labor force to out of the labor force *(exit the labor force)*. Table 2 shows the magnitude of the different transitions and Table 3 presents descriptive statistics for the key variables in the analysis.

Table 2: Transitions to retirement, non-employment, and out of the labor force

	Retirement	Not Working	Exit the LF
Total	25.69%	43.41%	62.59%
Men	34.22%	56.45%	56.54%
Women	16.90%	29.95%	68.83%

Notes: Our main definitions of retirement consider transitions from work to self-reported retirement *(retirement)*, from work to out of the labor force *(not working)*, and from in the labor force to out of the labor force *(exit the labor force)*.

4.2 Results

We first report our results from estimating specification (3) using the MCVL and individual-level calculated incentives. Then, we report the effect of financial incentives on retirement

[3]The survey specifies whether workers were in paid employment or self-employed. We purposely leave the self-employed out of the sample, due to the difficulty of modeling the pension system's financial incentives for this subgroup.

Table 3: Descriptive statistics for individuals retiring and not retiring during the observation period

	Never retired	Retired
Age	60.34	64.83
Female	0.56	0.35
Pre-retirement yearly wage	9,979.40	4,447.03
Age of entry in the labor force	19.15	18.07
Household annual income	37,510.24	35,323.05
Poor health	0.58	0.53
Skill level (%)		
Low	13.79	12.67
Middle	69.83	69.55
High	16.38	17.78
Region		
Northwest	15.33	17.98
Northeast	16.05	17.92
Madrid	14.42	16.63
Center	16.91	13.80
East	14.90	13.95
South	17.62	16.19
Canary Islands	4.77	3.54

Notes: Sample of individuals from the ECHP and SILC aged 50-70 at the time of survey. Descriptives are reported for years 1993-2019. The sample is divided between individuals who never retire during the observation period (i.e., transition from work to self-reported retirement) and those who did.

decisions using survey data, which will allow us to add more control variables, and explore spillovers of financial incentives across partners.

We restrict the analysis in both cases to individuals aged between fifty-five and seventy. Our main definition of retirement is constructed from self-reported retirement, and is conditional on being employed in the previous period.

4.2.1 Individually calculated incentives

Table 4 reports the elasticity of retirement to financial incentives using the MCVL. In MCVL, we define retirement as claiming old-age pension, conditional on not claiming benefits in the previous period. We can see that the results in columns 1 and 2 are relatively similar so that including controls for age as a linear function (column 1) or as dummy variables (column 2) does not significantly alter the marginal effects of the financial incentives to retire. The results show that a 10% change in the implicit tax rate on working longer and claiming benefits later, the ITAX, increases the probability of retiring by 7 percentage points. At the same time, an increase in the Social Security Wealth by €100,000 increases the probability of retiring by 302 percentage points. In column 3 we see that, when we substitute the age dummies by cohort dummies the results get larger than in the previous two columns pointing towards differences across cohorts.

4.2.2 Representative earnings profile

Table 5 reproduces the marginal effects of financial incentives on retirement, not working and exiting the labor force to financial incentives using survey data and synthetic measures of financial incentives. We see that the estimates of the impact of ITAX are very similar to those in Table 4. Therefore, whether we use administrative data and individually calculated incentives or survey data and representative earnings profiles do not seem to matter much for our conclusions. In the latter case, A 10% change in the implicit tax rate of working longer increases the probability of retiring by 6 percentage points (a slightly lower estimate). By gender (Panels B and C) we observe that the ITAX has a stronger effect on the probability of retiring for men (6.9 versus 4.8 percentage points for men and women respectively). On

Table 4: Marginal effects of retirement to financial incentives- MCVL, individually calculated incentives

	(1)	(2)	(3)
ITAX	0.070***	0.078***	0.092***
	(0.006)	(0.007)	(0.008)
SSW	3.02***	1.93***	5.84***
	(0.05)	(0.06)	(0.09)
Controls			
Age function	X		
Age dummies		X	
Year of birth dummies			X
Individuals	2,366,475	2,366,475	2,366,475
Observations	11,007,860	11,007,860	11,007,860

Notes: Columns (1), (2) and (3) report the marginal effect a change in 10% on the ITAX and in €100,000 in SSW on the probability to retire, resulting from a logistic regression. Retirement is measured as receiving old-age pension, conditional on not claiming benefits in the previous period. All models include region and year dummies, sex and skill indicators, and a quartic of the wage. Column (1) includes an age linear function and two dummies for ages 60 and 65, Column (2) includes age dummies, and Column (3) includes year of birth dummies. Individuals refer to the number of persons in the sample. Observations refer to the person-years in the sample. Standard errors (in parentheses) are clustered at the individual level. **p<0.05, ***p<0.01.

the other hand, the effects of an increase in the Social Security wealth on the probability of retiring are much lower, although still large, using survey data and the representative earning profiles than using individually calculated incentives. The effects of the Social Security Wealth on retirement are also larger for men compared to women.

Columns 2 and 3 of Table 5 show the estimated impact of financial incentives on the probability of not working and on the probability of exiting from the labor force. The effects of the implicit tax rate are slightly smaller for the probability of not working or being out of the labor force than for the probability of retiring for the full sample and men. This points towards stronger incentives to take the retirement route.

In Table 6 we present results of similar regressions in which the financial incentives are weighted and aggregated over the unemployment insurance system, the disability system and the retirement scheme. In this case, the estimated effect of an increase in the ITAX is stronger for the three exit routes (retirement, not working and exit from the labor market)

compared to previous estimates. This difference exists for both men and women. On the contrary, the incentive effects of the Social Security Wealth are slightly smaller when financial incentives are calculated in this aggregate manner.

In Table 7 we test the robustness of our results to several econometric models. More specifically, in column 1 we estimate the same regression using a linear probability model, in column 2 we use a linear probability model with random effects, in column 3 we estimate a linear probability model with fixed effects, in column 4 we employ a probit model and in column 5 a random effects probit model. We can see that the incentive measures are significant in most of the different model specifications although the point estimates vary marginally depending on the choice of model estimated. Overall, we believe that these robustness checks provide evidence of the consistency of our estimates across several econometric models.

4.2.3 Couples behavior

In Table 8 presents the marginal effects and standard errors from estimating (3) for couples. We select couples from our sample of individuals aged 50 to 70 following the condition that they remained together through the period of observation.[4] This leaves us with a sample of 4,274 couples (19,350 observations).

We expand specification (3) to include the effect of one partner's social security incentives on the other partner's decision to retire. That is, we include in our specification the partner SSW and ITAX in addition to the individual SSW and ITAX. As with the individual-level results, we present the results for our three definitions of retirement (retirement, not working and exit of the labor force), this time separating for husbands and wives.

Focusing first on the direct effects of pension incentives, in the first row of Table 8, we note that in all cases, the SSW and ITAX are significant. The estimated effects are comparable to those presented on the full sample and excluding partners' social security incentives for wives, but significantly stronger for husbands. The previous conclusion that men's incentives have a stronger impact on their retirement decision remains.

[4]Separations only occurred in 2.7 percent of couples, of which 0.36 percent due to death.

Husbands' social security wealth seems to have a very limited impact on wives decisions to retire, regardless of the definition of retirement used. Instead, wives' incentives significantly affect husbands' decisions to retire: the larger are the incentives of their wives to retire, the larger the probability that husbands retire. This result is aligned with the phenomenon of joint retirement, by which partners coordinate their retirement dates.

Table 5: Marginal effects to financial incentives

	Retirement	Not working	Exit of the labor force
	(1)	(2)	(3)
		A. *Full sample*	
ITAX	0.057***	0.050***	0.054***
	(0.001)	(0.001)	(0.001)
SSW	1.42***	1.56***	1.37***
	(0.07)	(0.05)	(0.05)
Individuals	20,475	20,475	20,475
Observations	45,210	45,210	45,210
		B. *Men*	
ITAX	0.069***	0.050***	0.067***
	(0.002)	(0.001)	(0.001)
SSW	1.83***	1.56***	1.84***
(0.08)	(0.05)	(0.06)	
Individuals	10,890	10,890	10,890
Observations	24,037	24,037	24,037
		C *Women*	
ITAX	0.048***	0.050***	0.046***
	(0.002)	(0.001)	(0.001)
SSW	0.71***	1.56***	1.21***
	(0.10)	(0.05)	(0.08)
Individuals	9,824	9,824	9,824
Observations	21,173	21,173	21,173

Notes: Column (1), (2) and (3) report the marginal effect on retirement, not working and exiting the labor force, respectively, from a change in 1% on the ITAX and to a change in €100,000 in SSW. All marginal effects result from a logistic regression. All models include age, region and year dummies, sex and skill indicators, and a quartic of the wage. We also the a quadratic function of the age of entry in the labor force, household income, and an indicator for poor health. Individuals refer to the number of persons in the sample. Observations refer to the person-years in the sample. Standard errors (in parentheses) are clustered at the individual level. **p<0.05, ***p<0.01.

Table 6: Marginal effects to financial incentives (weighted UI, DI & Ret pathways)

	Retirement	Not working	Exit of the labor force
	(1)	(2)	(3)
		A. *Full sample*	
ITAX	0.082***	0.074***	0.085***
	(0.002)	(0.002)	(0.002)
SSW	0.84***	1.04***	0.59***
	(0.11)	(0.10)	(0.10)
Individuals	20,475	20,475	20,475
Observations	45,210	45,210	45,210
		B. *Men*	
ITAX	0.110***	0.074***	0.111***
	(0.003)	(0.002)	(0.003)
SSW	1.40***	1.04***	1.41***
	(0.15)	(0.10)	(0.13)
Individuals	10,890	10,890	10,890
Observations	24,037	24,037	24,037
		C *Women*	
ITAX	0.060***	0.074***	0.065***
	(0.002)	(0.002)	(0.002)
SSW	0.42	1.04***	0.54***
	(0.14)	(0.10)	(0.15)
Individuals	9,824	9,824	9,824
Observations	21,173	21,173	21,173

Notes: See Notes in Table 5.

Table 7: Marginal effects of retirement to financial incentives- Alternative specifications

	Linear Probability (1)	Linear Probability - Random Effects (2)	Linear Probability - Fixed Effects (3)	Probit (4)	Probit- Random Effects (5)
ITAX	0.062***	0.037***	0.014***	0.054***	0.060***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
SSW	1.31***	0.97***	0.35	1.55***	1.12***
	(0.05)	(0.03)	(0.07)	(0.06)	(0.08)
Individuals	20,475	20,475	20,475	20,475	20,475
Observations	45,210	45,210	45,210	45,210	45,210

Notes: Columns (1), (2) and (3) report the percent effect on retirement of a 10% change in ITAX and a change in €100,000 in SSW, using a standard linear probability model (LP), a LP with random effects and a LP with fixed effects, respectively. Column (5) and (5) report the marginal effect on retirement from a change in 10% on the ITAX and to a change in €100,000 in SSW, resulting from a probit and random effects probit model, respectively. See Notes from Table 5 for details on the specifications.

Table 8: Marginal Effects to financial incentives of couples

	Retirement		Not working		Exit of the labor force	
	Wife	Husband	Wife	Husband	Wife	Husband
	(1)	(2)	(3)	(4)	(5)	(6)
ITAX (Own)	0.040***	0.025***	0.038***	0.145***	0.038***	0.13***
	(0.004)	(0.041)	(0.004)	(0.028)	(0.004)	(0.022)
SSW (Own)	0.78***	0.74***	0.73***	0.43**	0.73***	0.49***
	(0.15)	(0.21)	(0.16)	(0.16)	(0.16)	(0.12)
ITAX (Spouse)	0.052	0.12***	0.122*	0.12***	0.053	0.15***
	(0.030)	(0.03)	(0.50)	(0.03)	(0.36)	(0.03)
SSW (Spouse)	0.88	0.57***	-0.01	0.58***	0.11	0.54***
	(1.20)	(0.15)	(0.20)	(0.15)	(0.15)	(0.15)
Couples	4,274	4,274	4,274	4,274	4,274	4,274
Observations	19,350	19,350	19,350	19,350	19,350	19,350

Notes: See Notes in Table 7.

4.3 Simulations (Counterfactual Exercises)

In this section we present the result of a very simple counterfactual exercise. Taking as a point of departure the estimates obtained in our best model for couples, we predict the retirement probability by switch off the effect of all reforms that have been introduced since 1985. This means that we assume the 1985 legislation has remained active henceforth.

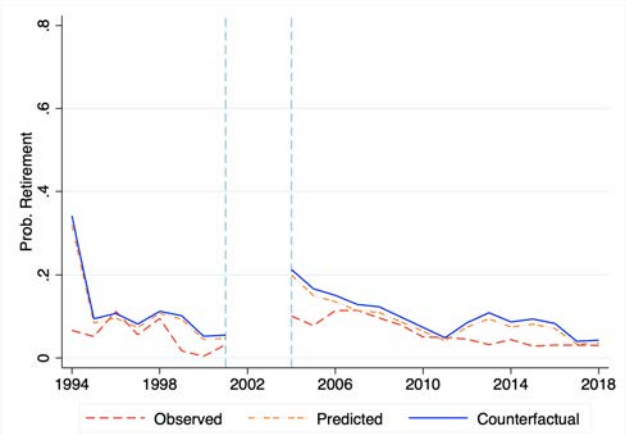
In Figure 9 we present the results from the counterfactual exercise described above for both men and women (aged 55-59 and 60-70) and compared them with the prediction of the estimated model and the observed data. For men, replacing the current incentive variables with the ones calculated with the initial legislation (the 1985 legislation in our case) implies a shift towards retirement at early ages. In particular it leads to overestimation of the retirement probability before age 60 and underestimation afterwards. For women only the underestimation after age 60 seems to be noticeable.

An immediate implication of these counterfactual exercise is that successive changes in legislation introduced since 1985 have induced later retirement, especially for men. So, they have been, at least partially, effective in postponing retirement for the average individual.

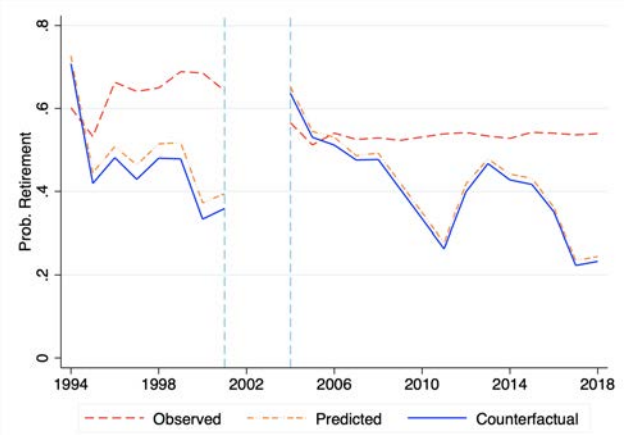
Figure 9: Counterfactual simulations

A. Men

A.1 Aged 55-59

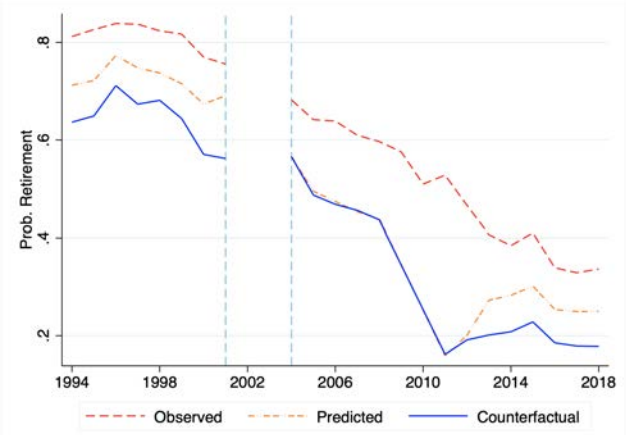


A.2 Aged 60-70

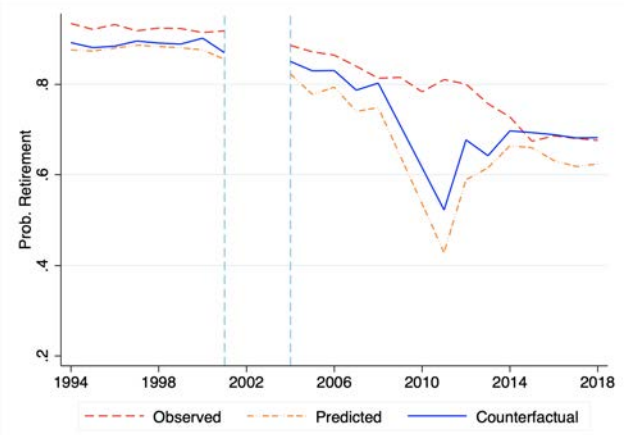


B. Women

B.1 Aged 55-59



B.2 Aged 60-70



Notes: Counterfactuals are obtained from our preferred specification on couples. We have no data available to support simulations for the years 2002-2003

5 Concluding Remarks

In this work we evaluate the importance of synthetic financial incentives in explaining labor supply behavior of older individuals and couples. In order to do so we combine data synthetic incentives obtained from individual working histories using administrative data (from MCVL), and individual and family data from two surveys: the ECHP 1994-2001 and the SILC since 2004 to 2019. This long time span allow us to have sufficient time variation in order to evaluate the impact of pension reforms on individual and family behavior.

Our results using more that two decades of data make evident the importance of financial incentive measures in explaining individual retirement patterns of older Spanish workers. In our basic specification we find that a 10% change in the implicit tax rate on working longer increases the probability of retiring about 0.70 pp (0.90 pp for men and 0.54 pp for women). These results are robust to several specification and heterogeneity exercises.

We then consider the impact of financial incentives on both members in a couple. The results on the importance of individual incentives remain similar. In addition, we find that couple incentives seem to matter more for husband retirement than wife's retirement decisions. This result is in stark contrast with what it is often found for health variables, where typically health matters more for wives.

Finally, evidence from a counterfactual exercise suggests that successive changes in legislation introduced since 1985 have been, at least partially, effective in inducing later retirement, especially for men.

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A Appendix

A.1 Reforms in the Social Security System

A.1.1 Changes in the Old-Age Pension System

As described in Boldrin et al. (1999) the transition from the old *Mutualidades* system to a system of Social Security contributions was completed in 1979, with the removal of *bases tarifadas* (fixed covered wages). The crucial ingredients of the system until 1985 were as follows:[5]

- The earliest eligibility age was 60, and statutory eligibility age, 65 if the individual did not have any job that required an affiliation to the social security system.
- A minimum of 10 years of contributions were required to gain access to a contributive pension.
- The pension was calculated on the basis of three elements: (1) the average of the contributions in the 24 months preceding retirement, (2) the penalty for early retirement (8 percent per year anticipated) and (3) the penalty for insufficient contributions (2 percent per year not contributed, full benefit reached with 35 contribution years).

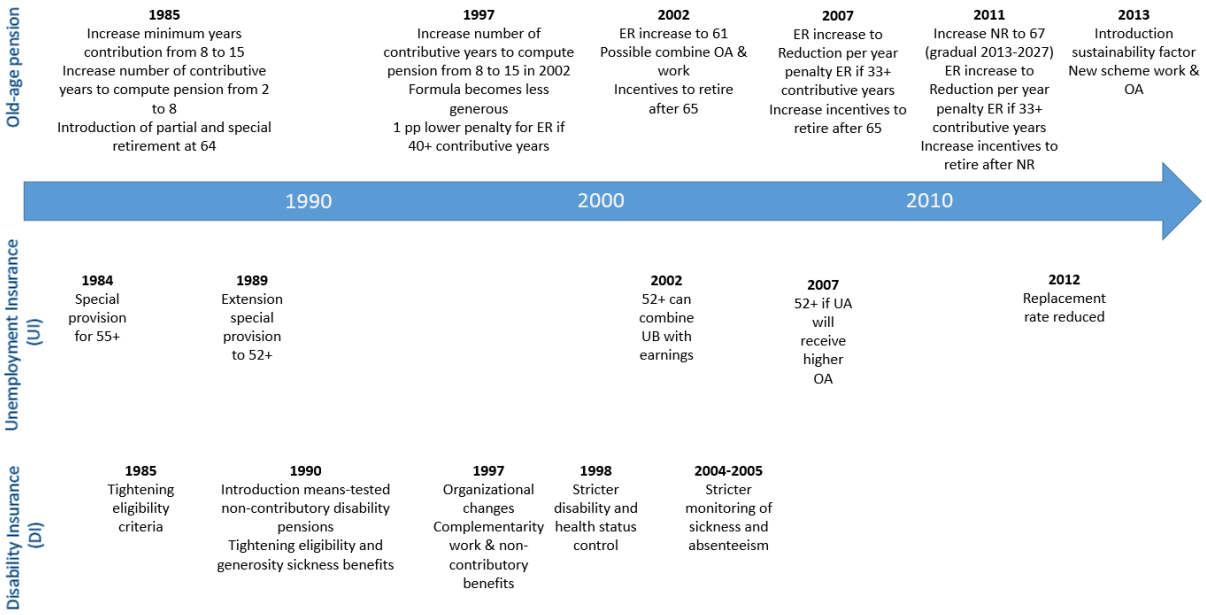
The key elements of the Spanish pension system prevailing until 2011 were set in 1985. Eligibility for the old-age benefits increased from 10 to at least 15 years of contributions to the system. The pension amount was calculated by multiplying a regulatory base by a percentage which depended on the age of the individual and the number of years contributed to the system. Under the 1985 regime, the regulatory base was obtained by dividing by 112 the wages of the last 96 months (8 years) before retiring and the percentage applied to this regulatory base depended on the number of years of contributions (n) as follows:

$$\begin{cases} 0, \text{ if } n < 15 \\ .5 + 0.03(n-15), \text{ if } 25 > n \geq 15 \\ .8 + 0.02(n-25), \text{ if } 35 > n \geq 25 \\ 1, \text{ if } n \geq 35 \end{cases}$$

The pension amount was capped from below by the minimum pension (see Jiménez-Martín 2014 for details) and the maximum benefit (between 4 and 5 times the minimum wage).

[5]See Boldrin et al. (1999, 2004) for other details regarding disability and survivor pensions.

Figure A1: Timeline of the Reforms of the Spanish Social Security System



In 1997 the number of contributory years used to compute the benefit base was progressively increased from 8 to 15 years in 2002, and the formula to calculate the replacement rate was made less generous. On the other hand, the 8% penalty applied to early retirees between the ages of sixty and sixty-five was reduced to 7% for individuals with at least 40 years of contributions at the time of early retirement.

In 2002 further changes were introduced. Before 2002, only individuals who had contributed to the system earlier than 1967 could benefit from early retirement at sixty, while the rest had to wait until the statutory eligibility age of sixty-five. In 2002, early retirement at sixty-one was made available for the rest of the population. At the same time, there was an impulse to the partial and flexible retirement with the possibility of combining income from work with old-age benefits and the introduction of incentives for individuals to retire after the statutory eligibility age of 65.[6] At the same time, the possibility to access retirement was extended to individuals unemployed for reasons beyond their willingness at sixty-one and who have contributed for at least 30 years and have been registered in the employment office for the previous 6 months.

In 2007 the incentives to retire later than 65 were further increased providing an additional

[6] An additional two percent per additional year of contribution beyond the age of 65 for workers with at least 35 years of contributions on top of the 100% applied to the regulatory base

three percent, instead of the two percent agreed in 2002. The 8% penalty applied to early retirees between the ages of sixty and sixty-five was reduced to 6-7.5%, depending on the number of years contributed, for those individuals with at least 30 years of contributions. In addition, the contributions for unemployed workers older than fifty-two were increased so that they would receive a higher old-age pension when retiring.

Although these reform tried to increase labor supply of older male workers, the existing evidence (see for example Cairó-Blanco 2010, García-Pérez et al. 2013) does not show any clear link between these reforms and the increased labor supply of older male workers.

The discouraging demographic and labor market scenarios prevailing during the first years of the great recession led the Spanish government (forced by the EU pressure to reduce future deficit) to deeply reform the pension system in 2011. Two main elements were targeted: (1) the number of contributive years entering the pension calculation was increased from 15 to 25, and (2) the statutory eligibility age was raised from 65 to 67, gradually. The latter was particularly relevant for Spain, since the statutory eligibility age had not been modified since the year it was first established in 1979. These two changes severely cut the generosity of the pension system (see Sánchez 2017 for a recent evaluation). The reform also restricted the eligibility conditions for early retirement, although the effect of this change on the generosity of the system is less clear. In particular, because the reform barely changed the eligibility conditions to access to the minimum pension, workers expecting to receive the minimum pension (that is workers with low income and short contributive careers) were less affected by the reform (Jiménez-Martín 2014).

In an attempt to stabilize the short- and long-term financial sustainability of the Social Security system, the Spanish government amended the 2011 reform in 2013. In particular, this amendment introduced a sustainability factor (SF), which consists in linking the initial pension level to the evolution of life expectancy (Conde-Ruiz et al. 2013). This mechanism can be seen as transforming defined benefit schemes to defined contribution schemes.

The SF has two key components, the intergenerational equity factor (IEF) and the pension revaluation index (PRI).The aim of the IEF is to provide equal treatment to those that retire at the same age, with the same employment history, but different life expectancy (which are specific to the cohort they belong to). The introduction of this factor didn't give rise to much controversy, since it was perceived as reasonable that if pensioners were to receive the same total pension throughout their retirement, an individual with a greater life expectancy should receive a little less each year. The second factor, the PRI, fixes a budgetary constraint on the economic cycle and, as such, is relatively flexible in the short term. However, the discretionary rule chosen by the Government guarantees that, even if Social Security revenues are insufficient to cover pension costs, pensions would rise each year

by at least 0.25%, and by no more than the annual changed in the CPI + 0.25%.

We expect the 2011/2013 pension reform to incentivize the labor supply of older workers in Spain, by reducing benefit expectations and including incentives to work longer (partial benefit compatibility after the normal retirement age) (Sánchez 2014).

Table A1: Main reforms of the old-age pension system Spain since 1980

Year of the reform	Main changes
1985	- Increased the minimum mandatory annual contributions from 8 to 15 - The number of contributive years used to compute the pension increases from 2 to 8. - Several early retirement schemes are introduced; Partial retirement and special retirement at age 64
1997	- The number of contributive years used to compute the pension increases from 8 to 15 (progressively by 2001). - The formula for the replacement rate is made less generous. - The 8% penalty applied to early retirees between the ages of 60 and 65 is reduced to 7% for individuals with 40 or more contributory years.
2002	- Early retirement only from age 61 - Impulse partial retirement; possible to combine it with work - Unemployed aged 61 can retire if contributed for 30 years and the previous 6 months registered in employment offices - Incentives to retire after age 65
2007	- 15 effective contributory years are used to calculate the pension. - Reduction from 8% to 7.5% of the per-year penalty applied to early retirees between 60 and 65 for individuals with 30 contributory years. - Broaden incentives to stay employed after age 65. - Increase contributions made by the social security administration for individuals receiving the special scheme of UA for 52+ (they will receive a higher old-age pension when retiring).
2011	- The number of contributive years used to compute the pension increases from 15 to 20 - The normal retirement age increases from 65 to 67 - Eligibility conditions for early retirement are modified
2013	- Introduction of Sustainability Factor (SF) - Intergenerational Equity Factor - Pension Revaluation Index

A.1.2 Reforms in the Disability system

Here we focus on some distinctive features of the main reforms since the creation of the National Institute of Social Security (NISS) in 1979, while we refer the reader to Table A2 for a summary of all the reforms in the disability system in Spain during this period.

The first large disability insurance reform took place in 1997 and included 4 main points:

1. Sickness benefits: stricter control of the sickness status by Social Security physicians, a reduction of the level of long-term sickness benefits, and the replacement of the old job assessment by a more objective definition of the usual occupation of the individual.

2. Permanent disability pensions of individuals aged at least 65 were automatically transferred to the old-age pension system. This was just a change in the classification within the pensions system.

3. Organizational reform: all the issues related to disability insurance were transferred to the NISS. The permanent disability status was in the past assessed and granted by local GPs and this reform created a group of experts (the disability assessment team inside the NISS) which was in charge of assessing applicants ability to work on the basis of the available medical files and a medical assessment from an NISS physician.

4. The claimant did no longer lose entitlement to non-contributory disability benefits if she started working. She would remain entitled to receive non-contributory disability benefits in case of job loss.

In addition to this major reform in 1997, the 1998 budget law introduced the possibility for NISS physicians and mutual insurance companies to review the health situation and status of beneficiaries. Effectively, only very few claimants in the permanent disability system effectively exit the program.

In 2004 and 2005 monitoring of the use of sick leave was tightened with the creation of a new sub-department at the NISS and a new monitoring tool to reduce absence rates. In 2005, a general absence control was put in place for cases in which the absenteeism took longer than six months.

Finally, at the end of 2007 the minimum contributory period to access permanent disability pensions was reduced for young workers in order to adjust for the current later entrance into the job market. At the same time, the formula to calculate the regulatory base of the benefit was slightly modified: the regulatory base of permanent disability due to a common illness is since then decreased by 50% if the individual had not contributed at least 15 years and it is lower the further the individual is from age 65.

All these reforms ensured the financial stability of the disability system in Spain as inflow rates have remained stable, at odds with the dramatic increase experienced by other industrialized countries.[7]

A.1.3 Reforms in the Unemployment Insurance scheme

In 1984, the government introduced unemployment benefits for workers employed in temporary contracts, and non-contributory unemployment benefits (also called unemployment assistance benefits). In addition, it established a special provision for workers aged over 55

[7]See Jiménez-Martín et al. (2018).

who were allowed to receive unemployment assistance benefits until the claiming age. To receive these benefits, individuals had to satisfy the entitlement requirements of the retirement pension, except for the age. The subsidy paid 75% of the minimum wage until reaching the age to be transferred to the old-age pension system. Furthermore, the years spent unemployed under this special scheme were counted as contributive years towards an old-age benefit.

In 1989 the special provision of unemployment assistance benefits until the statutory eligibility age of 65 for individuals aged at least 55 was extended to individuals aged 52, thus increasing the incentives of older workers to leave the labor market at younger ages.

The reform in 2002 opened up the possibility for individuals aged at least 52, receiving unemployment benefits, to combine the UI payments with earnings. They could receive 50% of their previous unemployment insurance entitlement, and the employer would pay the remaining amount in wages.

Finally, in 2012 the amount an individual receives from unemployment insurance after the first six months was reduced from 60 to 50 percent of previous earnings.

A.2 Key parameters of the Spanish Social Security System from 1980 onward

Table A2: Main reforms since 1980 of the disability insurance and unemployment systems in Spain

Year of the reform	Main changes
1984	Introduction of temporary contracts and non-contributory unemployment benefits (also called unemployment assistance benefits) **Special provision** for **workers 55+** to receive unemployment assistance benefits until retirement age - Eligible if satisfying the old age pension entitlement requirement except for the age - Paid 75% of the minimum wage - Years spent under this scheme were counted as contributive years towards an old-age pension
1985	Tightening eligibility criteria to DI
1989	Extension of special provision for older workers to all **workers 52+**
1990	Introduction of a **means-tested non-contributory disability pensions** for people aged 65+ and for disabled people aged 18+ who satisfy residency requirements.
1997	**Sickness Benefits:** - Stricter control of the sickness status by doctors of the Social Security system - Reduction of the level of long-term sickness benefits - Replacement of the old own job assessment by a more objective definition of the usual occupation of the individual **Permanent disability pensions individuals 65+** are automatically converted to old-age pensions. **Organizational change, creation of the National Institute of Social Security (NISS):** Disability is assessed by benefit administrators based on a medical assessment performed by the NISS own doctors **Complementarities between work and benefits:** Entitlement to non-contributory benefits is not lost if working, and can be collected if losing the job.
1998	Possibility for NISS doctors and mutual insurance companies to review health situation of beneficiaries.
2002	- Individuals aged 52+ receiving unemployment benefits could combine the receipt of these benefits with earnings (50% of the total benefits paid by the employer, and 50% paid by the Social Security) - Extension of program that helps integrate people in the labor market to all individuals aged at 45+ who have been unemployed for one month and to people with disabilities, among others.
2004-2005	Stricter monitoring of sickness and absenteeism through the creating of a department at the NISS, and a general absence control was put in place when the duration of absence was greater than six months. Possibility to combine non-contributory disability with some earnings.
2007	Increase contributions made by the social security administration for individuals receiving the special scheme of UA for 52+ (they will receive a higher old-age pension when retiring)
2012	Replacement rate was reduced from 60% to 50% after the 180 days of unemployment spell– for the fist six months it was kept constant at 70% – for all unemployment spells starting after the 15th of July 2012.

Table A3: Key parameters of old age pensions from 1980 onwards

	Before 1985	From 1985 to 1997	From 1997 to 2001	From 2002 to 2007
A. Eligibility Conditions				
A1. Normal retirement age [$\bar{a}$]	65 years	id.	id.	id.
A2. Minimum contribution years [n]	10 years	15 years	id.	id.
B. Pension Computation				
B1. Contributions entering in Benefit Base [BB]	2 years	8 years	15 years[a]	15 years
B2. Replacement Rate	$\begin{cases} 0, \text{ if } n < 10 \\ .5 + 0.02(n-10), \text{ if } 35 > n \geq 10 \\ 1, \text{ if } n \geq 35 \end{cases}$	$\begin{cases} 0, \text{ if } n < 15 \\ .6 + 0.02(n-15), \text{ if } 35 > n \geq 15 \\ 1, \text{ if } n \geq 35 \end{cases}$	$\begin{cases} 0, \text{ if } n < 15 \\ .5 + 0.03(n-15), \text{ if } 25 > n \geq 15 \\ .8 + 0.02(n-25), \text{ if } 35 > n \geq 25 \\ 1, \text{ if } n \geq 35 \end{cases}$	id.
C. Early Retirement				
C1. Early retirement age	60, if first contribution prior to 1967	id.	id.	60, if first contribution prior to 1967. 61 if after 1967
C2. Penalization [κ] where $benefit = 1-\kappa(\bar{a}-a)$	$\kappa = .08$	$\kappa = .08$	$\kappa \begin{cases} .08 \text{ if n<40} \\ .07 \text{ if } 40 \geq n \end{cases}$	$\kappa \begin{cases} .08 \text{ if n=30} \\ .075 \text{ if } 31 \leq n \leq 34 \\ .07 \text{ if } 35 \leq n \leq 37 \\ .065 \text{ if } 38 \leq n \leq 39 \\ .06 \text{ if } 40 \geq n \end{cases}$
C2. Minimum Pension				27% average income
C3. Partial Retirement	No	No	No	Yes. Working hours reduced from 25%-85%, replacement of working hours mandatory
D. Late Retirement				
D1. Incentives for late retirement	No	No	$0.8 + .02(a-65)$ if $35 \geq n > 25$ and $a \geq 65$	$1 + .02(a-65)$ if $n \geq 35$ and $a \geq 65$
D2. Partial Retirement	No	No	No	Yes

[a] In 1997 the last 108 months are included, the last 120 months in 1998, the last 132 months in 1999, the last 144 months in 2000, the last 156 months in 2001, the last 180 months from 2002 onwards.

Table A4: Key parameters of old age pensions from 1980 onwards cont.

	From 2007 to 2010	From 2011 onwards	2013 Amendment
A. Eligibility Conditions			
A1. Normal retirement age	65 years	67 years[a], or 65 years old if 38.5 years of contributions	
A2. Minimum contribution years [c]	15 years	id.	
B. Pension Computation			**Introduction of new Adjustment Index (IRP)** $IPR_{t+1} = \bar{g}_{l,t+1} + \bar{g}_{P,t+1} + \bar{g}_{s,t+1} + \alpha\left(\frac{I^*_{t+1} - G^*_{t+1}}{G^*_{t+1}}\right)$ Where $\bar{g}_{l,t+1}$ is growth rate of contributions $\bar{g}_{P,t+1}$ is the growth rate of the number of pensions $\bar{g}_{s,t+1}$ is the growth of the median pension due to substitution effects Minimum: .25%.
B1. Contributions entering in Benefit Base [BB]	15 years	17 years. 25 years from 2022 onwards.	
B2. Replacement Rate	$\begin{cases} 0, \text{ if } n < 15 \\ .5 + 0.03(n-15), \text{ if } 25 > n \geq 15 \\ .8 + 0.02(n-25), \text{ if } 35 > n \geq 25 \\ 1, \text{ if } n \geq 35 \end{cases}$	$\begin{cases} 0, \text{ if } a < 15 \\ 0.5 + 0.023(n-15), \text{ if } 37 > n \geq 15 \\ 1, \text{ if } n \geq 37 \end{cases}$	
B3. Minimum pension	32% average earnings w/o dependent spouse. 39.9% w dependent spouse Maximum: CPI + .50%	34% average earnings w/o dependent spouse. 42% w dependent spouse	
B4. Maximum pension	159% average earnings	153% average earnings	
C. Early Retirement			
C1. Early retirement age	61 (involuntary retirement) or 63 (voluntary retirement), with 33 years of contr.	63 (involuntary retirement) or 65 (voluntary retirement), with 33 or 35 years of contr. resp.	**Introduction of Sustainability Factor (SF)** Intergenerational Equity Factor (IEF) $IEF_{j,t+s} = \frac{e_{j,t}}{e_{j,t+s}}$ $e_{j,t}$ life expectancy of pensioner retiring at age j and period t $e_{j,t+s}$ life expectancy of pensioner retiring at age j and period $t+s$
C2. Actuarial reduction of benefits	$1 - \kappa(a-61)$, if $65 > a \geq 61$ where $\kappa \begin{cases} .075 \text{ if } 30 \leq n \leq 34 \\ .07 \text{ if } 35 \leq n \leq 37 \\ .065 \text{ if } 38 \leq n \leq 39 \\ .06 \text{ if } 40 <= n \end{cases}$	$1 - \kappa(a-63)$, if $67 > a \geq 63$ where $\kappa \in [0.08; 0.085]$	
C2. Minimum pension	30% average earnings w/o dependent spouse. 37% w dependent spouse	32% average earnings w/o dependent spouse. 39% w dependent spouse	
C3. Partial Retirement	Yes. Working hours reduced from 25%-75%, replacement of working hours mandatory, proportional contribution to the pension system	Yes. Full contribution to the pension system	
D. Late Retirement			
D1. Incentives for late retirement	if $a \geq 65$, then $\begin{cases} 1 + .02(a-65) \text{ if } n \geq 35 \\ 1 + .03(a-65) \text{ if } n \geq 40 \end{cases}$	if $a \geq 67$, then $\begin{cases} 1 + .02(a-65) \text{ if } 15 \leq n < 25 \\ 1 + .0275(a-65) \text{ if } 25 \leq n < 37 \\ 1 + .04(a-65) \text{ if } n \geq 37 \end{cases}$	
D2. Partial Retirement	Yes. No replacement of working hours.	Yes. No replacement of working hours.	

[a] The retirement age of 67 will be reached in 2027. From 2013 to 2018, retirement age will increase in one month per year. From 2019 to 2026, retirement age will increase in two months per year.

Table A5: Summary of key parameters of DI

	Ordinary Illness	Work Related Accident	Work Unrelated Accident	Non Contributory
A. Eligibility Conditions				
	Incapacity to perform current job (IPT), workers older than 55 (IPTC)			
	Age ¿26: contributed 1/4 time between 20 y.o and disabling condition, ¿5 years **Age ≤26:** contributed 1/2 time between 16 y.o and disabling condition	No contributive requirement	No contributive requirement	Non eligible for Contributory Disability Insurance Means-tested
	Full incapacity (IPA) and Severe incapacity (GI) 15 years of contribution			
.5 *B. Benefit Calculation*				
B1. Regulatory Base	0.86*wage of last 8 years of work	Last year of work	0.86*highest wage of 24 months within last 7 years	
B2. Replacement Rate	**IPT:** 55%, **IPTC:** up to 75%, **IPA:** 100%, **GI:** 150%	Id.	Id.	55% of minimum wage
B3. Income Tax Rules	**IPT** & **IPCT**: General Income Tax reg.[a] **IPA** & **GI**: Tax exempted	Id.	Id.	

[a] There are tax deductions for IPT beneficiaries who are employed at the same time than receiving benefits. Precisely, there is a reduction in the earnings used to calculate the income tax of 2,800 Euros/year if their degree of disability is low (between 33% and 65%) or 6,200 if the disability level is higher (more than 65%) or if the disabled has reduced mobility.

Classification of degrees of disability:

Incapacity to perform current job (IPT and IPTC): The individual is impaired to develop all or the fundamental tasks of his/her usual job or professional activity, but he/she is still capable of developing a different job or professional activity.

Full incapacity (IPA): the individual is impaired for the development of any kind of job or professional activity.

Severe incapacity (GI): Individuals who, as a result of anatomic or functional loses, need the assistance of a third person to develop essential activities of daily living.