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Spillovers in pension incentives and the joint retirement behavior of Spanish couples

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Spillovers in pension incentives and the joint retirement behavior of Spanish couples*

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Abstract

This paper explores how husbands' and wives' retirement behavior is influenced by their own financial incentives from Social Security and private pensions and by "spillover effects" from their spouses' incentives. Spillover effects are possible due to income effects and complementarity of leisure; if significant, their omission will bias estimates of the effect of changing Social Security policy on retirement. We estimate conditional and unconditional (to the status of the partner) reduced-form models and document some key results. First, married men are more responsive to their incentives than married women: a ten percentage point higher marginal tax on working results in a 0.9% increase in the baseline probability to exit the labor force for men and a 0.1% for women. Second, men are very responsive to their wives' financial incentives but that women are not responsive to their husbands' incentives. Policy simulations, however, indicate that omitting spillover results in very moderate biases when estimating the effect of a policy change on the probability of working.

Keywords: Social Security, retirement, couples
JEL Codes: J26, D10

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1 Introduction

Continued improvements in life expectancy, together with declining fertility rates, have contributed to moving the sustainability of public old-age pensions to one of the top priorities of public policy. Many countries are introducing policy changes, such as tightening the eligibility criteria and generosity of public pensions, to encourage later retirement. Analyzing the effects of pensions' characteristics on labor force participation of older workers is now more relevant than ever.

Numerous studies have established the impact of Social Security and public pensions' incentives on retirement. The cross-national research published in the volumes edited by Gruber and Wise (1999, 2004) substantiated the strong negative correlation between labor force participation at older ages and pension generosity. A significant amount of more recent literature established the causality of this relationship.[1] These studies, however, tend to neglect the effects of pension eligibility and generosity of one spouse on the other. This is an important limitation since a couple is likely to coordinate retirement dates (Hurd 1990; Blau 1998). The presence of interdependences in spouses' retirement decisions implies that pension policies aimed at the individual level can potentially impact the behavior of both partners. Given that the typical worker approaching retirement age is married, policies should consider both partners.

In this study, we use the European Community Household Panel (ECHP) and the European Union Statistics on Income and Living Conditions (EU-SILC) to analyze the impact of financial incentives provided by the Spanish Social Security system on couples' retirement choices from 1994 to 2016. We estimate semi-structural models of the effect of one individual's retirement incentives on their own and their partner's retirement decisions.

The starting point of this paper is the setup laid-out in Gruber and Wise (2004). In their model, workers are assumed to be forward-looking. At each age, individuals compute their

[1] See, for example, the work by Hanel 2010, Brown 2013, García-Pérez et al. 2013, Staubli and Zweimüller 2013, Lalive and Staubli 2014, and Chalmers et al. 2014.

(present value) total pension wealth (TPW). Due to an income effect, the higher their TPW, the higher their retirement probability. Furthermore, from their expected earnings and the expected features of the pension system, individuals compute the marginal incentives (MI) of their pension entitlement if they were to retire at alternative future ages. Their expected TPW and MI together determine retirement choices. The model is dynamic since the retirement choice is reconsidered each year as new information affecting financial incentives becomes available. This decision procedure continues until the worker reaches seventy, the age at which we assume that retirement is an absorbing state.

Calculating individual incentives requires long panels of data, as pension entitlement and, thus, pension wealth and marginal incentives depend on individual wage histories. In most countries, however, long panels are not available, or they frequently lack information that is essential to estimate retirement models. This is the case in Spain, where Social Security records provide information on the complete earnings histories of around 4 percent of the population, but they lack crucial elements affecting retirement decisions, such as household characteristics and health information. To overcome this limitation, we follow an instrumental varibles strategy, which can be described as follows. First, we use data from the Social Security records to construct *representative* wage histories, by taking the median earnings of individuals by their year of birth, gender, education level, and region. That is, we construct forty-two *representative* wage histories per each cohort born between 1924 and 1966. We predict backward and forward to ensure that each *representative* wage history covers ages fifty to seventy for each cohort, by assuming a 1 percent real growth in wages and a 2.5 percent inflation from 2018 onward. For ages sixty and above, we assume constant real wages.

We attribute to all individuals in the ECHP and EU-SILC sample a *representative* wage profile that matches their characteristics. We then construct the pension wealth and marginal incentives measures for all individuals, based on their age of entry in the labor force and the matched *representative* wage profiles. The resulting incentive measures are akin to instruments of the individual pension incentives. We run several tests that prove the strength and support the validity of these instruments.

The main purpose of this paper is to assess the extent to which retirement incentives faced by one of the spouses have "spillover effects" on the labor supply decisions of the other. Such spillover effects are likely, due both to income effects and to complementarity of leisure between the spouses. If spillover effects are important, the failure to estimate household models of retirement decision-making may lead to significant errors in predicting the effect of a change in Social Security policy on retirement behavior.

This paper adds to the literature analyzing the determinants of retirement behavior, in particular, the effects of pensions' rules and generosity (See Blundell et al. (2016) for a recent summary). Our paper is closest to work by Boldrin et al. (1999, 2004), in which the authors simulate the incentives of the Spanish Social Security system in 1985 and analyze their impact on retirement decisions. We extend their work by modeling the Spanish pension system to measure its incentives for over two decades (1994 to 2016). The Spanish system underwent five reforms during this period, which greatly increases the variation in our incentives measures and allows us to make policy recommendations on how reforming some aspects of the pension system may affect the incentives to retire.

Our work adds to the previous work studying the retirement decisions of couples (Blau 1998; Gustman and Steinmeier 2004; Banks et al. 2007; Stancanelli and Van Soest 2012; Hospido and Zamarro 2014). This work provides evidence of joint retirement, defined as the coincidence in time of spouses' retirement dates regardless of their age difference. Our work is closest to Coile (2004), who simulates the retirement incentives of couples from the US Social Security. She finds modest but significant responses of husbands to different measures of their wives' Social Security and private pension accrual. In particular, her results show that the stronger the financial incentive for a wife to delay retirement, the less likely her husband is to retire. She interprets this as evidence of complementarities in leisure: the value of leisure falls for a husband whose wife remains employed, which makes him more likely to remain employed himself.

There are several key findings on the determinants of labor force exit. First, we find that married men tend to respond more to pension incentives than married women. A 10 percentage point higher marginal tax on working results in a four percentage point increase on the probability to exit the labor force for men, compared to a one percentage point increase for women. We attribute this difference to the low rate of pension entitlement of Spanish women, which implies that for many women in our sample, the decision to exit the labor force is detached from pension incentives, thus biasing the estimates towards zero. When accounting for the actual pension entitlement of workers, the gender differences in responses significantly decrease. Second, we find sizable spillover effects from wives' pension incentives on husbands' decisions to exit the labor force, but not vice-versa. Larger pension disincentives of wives tend to increase the probability to exit the labor force of husbands, indicating that there is a complementarity effect in the leisure of both partners. These results are in line with the estimates presented by Coile (2004), who shows that men are very responsive to their wives' financial incentives but that women are not responsive to their husbands' incentives.

Regarding health, we find that having a poor health status increased the probability to exit the labor force in around 17 percentage points for both men, and in around six percentage points for women. We do not find evidence of spillovers from one partner's health on the other.

The remainder of the paper is organized as follows. Section 2 provides an overview of the Spanish pension system and its reforms over the past two decades. In Section 3, we describe the data used for our analysis and the measurement of pension incentives. Section 4 formalises the joint retiremen problem. Section 5 analyses the direct and spillover effects of pension incentives on retirement decisions, and provides several robustness checks to our results,and section 6 concludes.

2 Background

2.1 Old-Age Pension System

The old age pension program in Spain is of defined benefit, pay-as-you-go type. Contributory pensions can be divided into four types (old-age, disability, survivor, and orphanhood), and are mainly organized around three basic schemes: the general regime (mainly private sector employees), the central government and civil servants scheme, and the special regimes (among which the self-employed scheme represents the largest program). In this paper, we focus on the general scheme, which represents a 74.5 percent of public pensions (SS, 2017). In what follows, we characterize its main current features and briefly mention the reforms of the system since the 90s.

Financing. The general scheme is financed through contributions from employers and employees. Contributions are a fixed proportion of gross labor income between a lower and upper limit (in 2016, €858.6 and €3,751.2, respectively), which are annually fixed and vary by professional category. The current contribution rates are 23.6 percent for the employer, and 4.7 percent for the employee.

Pension eligibility. Eligibility to the old-age pension scheme requires fifteen years of contributions. The statutory eligibility age (SEA) is sixty-five for workers with over 38.5 years of contributions. The SEA has been gradually increasing from sixty-five in 2013 to reach sixty-seven by 2027 for those with less than 38.5 years of contributions. The earliest eligibility age (EEA) follows the increase in the SEA and is set to be two years earlier than the SEA for voluntary retirement, and four years for involuntary retirement. Eligibility does not require the full withdrawal of the labor force, as flexible and partial retirement is allowed.

Pension formula. The initial pension amount is the result of multiplying a benefit base by a replacement rate. The benefit base of an individual is the average of his contributions in the seventeen years immediately before retirement (increasing to twenty-five by 2020). Upon reaching the SEA, the replacement rate of a worker with n years of contributions is calculated as follows:

$$\text{Replacement Rate} = \begin{cases} 0, \text{ if } n < 15 \\ 0.5 + 0.023(n-15), \text{ if } 37 > n \geq 15 \\ 1, \text{ if } n \geq 37 \end{cases}$$

Individuals can collect their pension upon reaching the EEA under an annual 8-8.5 percent penalty, depending on the years of contributions. These working past the SEA receive a four percentage point increase in replacement rate per year above the SEA, conditional on having contributed at least thirty-seven years The initial pension level is indexed by a Pension Revaluation Index (PRI), which fixes a budgetary constraint on the economic cycle. The minimum yearly increase in pensions is 0.25 percent, effective if Social Security revenues are insufficient to cover pension costs, and the maximum is CPI + 0.25 percent.[2]

Maximum and minimum pensions. There are lower and upper limits on the pension benefit. The minimum pension is set to 34 percent (32 percent) of the average earnings without dependent a spouse[3], and 42 percent (39 percent) with dependent spouse when claiming the pension at the SEA (EEA). The maximum pension is 153 percent of the average earnings.

Reforms of the system. The key elements of the Spanish old-age pension system were set back in 1985. Over time, the system has taken its current form through some reforms (in 1997, 2002, 2007 and 2011) that changed parameters of the system but not its structure, and a structural reform (in 2013). Figure 1 shows the evolution of the system's key parameters

[2]As a result of numerous protests, the government has approved in June 2018 a revision of the budget, that sets an increase of pension benefits of 1.75 percent for 2018, instead of the 0.25 percent increment.

[3]A dependent spouse is defined as a partner who is not working and does not have any Social Security benefit entitlement

due to the reforms.[4]

Panel A shows the evolution of the EEA and SEA. The SEA was set to sixty-five in 1985 and remained unchanged until the latest reform of the system in 2013. Before the reform in 2002, the EEA was set at age sixty and was only available for workers whose first contribution was before 1967. The 2002 reform introduced early retirement at age sixty-one for workers whose first contribution was on or after 1967. The reform in 2013 increased the EEA and tied up early retirement eligibility rules to the reason for retirement (voluntary or involuntary).

Panel B shows the number of years of contributions (1) for pension eligibility, (2) for full pension, and (3) entering in the pension calculation. (2) was kept constant until the reform in 2013. The number of years entering in the pension calculation changed with the reform in 1985 (from 2 to 8), 1997 (from 8 to 15, by one year increase for each calendar year), and were otherwise constant until the pension system was reformed in 2013.

Panel C shows the evolution of the (real) minimum and maximum contributions and compares it to the average wage. We note that the trends in the average wage and maximum contribution were closer to one another in the 90s, until the 1997 reform. From that point, the maximum contribution increased more steeply than the average wage, highlighting the increasing generosity of the system for high earners. The minimum contribution, linked to the minimum wage, was flatter through the observed period.

2.2 Other Benefits at Older Ages

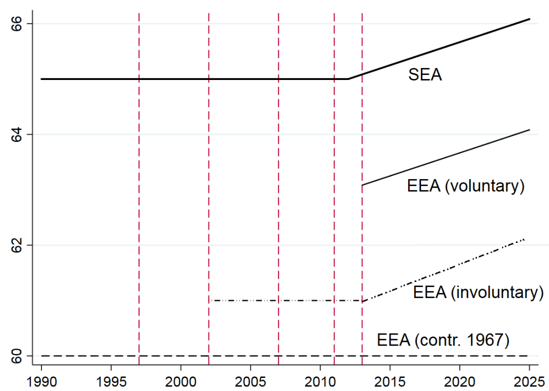
This paper focuses on the retirement incentives of old-age public pensions. Nonetheless, we briefly discuss in this section other sources of public pensions at older ages.

Disability insurance. The disability insurance (DI) program is organized such that permanently disabled claimants transition automatically to the old-age program upon reaching

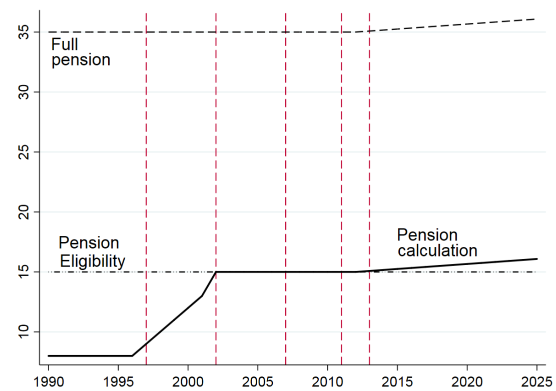
[4]For a detailed description of the reforms of the Spanish old-age pension system, we refer the reader to Section A.1 in Appendix A. For a definition of the old-age pension system parameters at each reform period, see Tables A2 and A3 in Appendix A.

Figure 1: Time Trends of Key Parameters

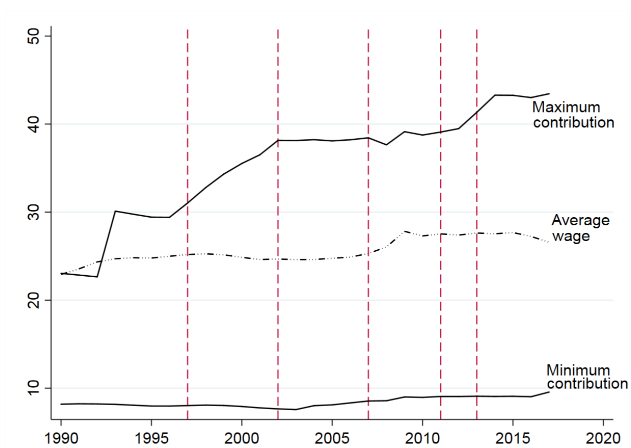
A. Earliest and Statutory Eligibility Age



B. Contributive Years in Benefit Calculation



C. Yearly Minimum and Maximum Contribution (x1000€, 2015=100)



the SEA. As a result, the program provides important labor supply disincentives at older ages.[5] In Spain, permanent disability benefits were used extensively as an early retirement mechanism for workers in restructuring industries (such as shipbuilding, steel, mining, etc.) or as substitution for long-term unemployment subsidies in depressed regions during the late 1970 and 1980 (OECD, 2001), which resulted in an increase in the inflows into the disability system and permanent disability benefits.

Unemployment insurance. The unemployment insurance (UI) program contains a special provision for workers aged over fifty-two, who are allowed to receive unemployment assistance benefits until the claiming age. To receive these benefits, individuals have to satisfy the entitlement requirements of the retirement pension, except for the age. The subsidy pays 75% of the minimum wage until reaching the SEA, at which point the worker will be transferred to the old-age pension system. Furthermore, the years spent unemployed under this special scheme are counted as contributive years towards an old-age benefit.[6]

2.3 Private pensions

The fraction of active population covered through private pensions has increased from 8% in 2008, to 18.3% in 2017 (OECD, 2008, 2017). Rosado Cebrián et al. (2015) illustrate that the loss in purchasing power of the retired due to the recent reforms, together with a fiscal reform in 2014 that increased incentives to invest in private pension plans, led to the higher use of private retirement instruments. Due to the complexity of modeling private pensions, we omit them from our calculation of incentives, although we acknowledge that the role of private pensions on retirement decisions will be crucial in the future.

[5] See Autor and Duggan (2003, 2006).

[6] Although not central to our analysis, we separately model the DI and UI systems in the calculation on Social Security incentives to retire to compare the retirement behavior of workers transitioning to retirement from DI and UI to that of workers retiring from the general regime. See Table A5 in Appendix A for a summary of the reforms in the DI and UI system during the period of observation.

2.4 Retirement from a Couple's Perspective

A growing body of literature characterizes retirement as a decision concerning the couple, rather than the individual (Hurd 1990; Bound et al. 1999; Coile 2004; Gustman and Steinmeier 2004; Banks et al. 2007; Stancanelli and Van Soest 2012; Lalive and Parrotta 2017). There are numerous reasons for interdependence in retirement decisions. First, household consumption and wealth can have an impact on the behavior of each household member. Thus, one of the channels linking spouses' retirement decisions operates through the household budget constraint. Within household budget constraints interdependences could increase the distance in retirement date across partners. That is, if the retirement of one partner causes a dip in the household budget constraint, as is often the case since old-age pensions are generally lower than the labor earnings immediately before retirement, the other partner may increase her labor supply upon their partner's retirement.

Another aspect is that the valuation of leisure may depend on the spouse's leisure. If leisure is complementary across spouses, the value of leisure increases upon the retirement of the partner, indirectly increasing the incentives to retire (Maestas 2001).

Social Security incentives for one spouse may depend on the labor market activities and work history of the other. In Spain, individual pension entitlement is detached from the partner's earnings history. The only special consideration for married or cohabiting individuals is that the minimum and maximum pensions are higher in case of having a dependent spouse.[7] Also, incentives through taxation are small.[8]

At the individual level, health is one of the major determinants of the decision to retire (Bound et al. 1999, Disney et al. 2006), García-Gómez et al. 2013). For partnered individuals, poor health of their spouse may increase their need for care, thereby increasing their

[7]The Spanish system considers the entitlement of a survival pension in case of death of one of the spouses, but we abstract from this modeling its incentives in this paper.

[8]The Spanish tax system is organized such that tax allowances of a dual-earning couple are always larger when they declare their income separately. An exception is when one of the partners is not employed, in which case declaring income jointly maximizes the allowances. However, the additional incentive for declaring jointly is small, and most likely has a non-significant impact on the labor supply decisions of couples.

likelihood to retire (Jimenez-Martin et al. 1999; Gustman and Steinmeier 2004). On the other hand, having a partner in poor health could have the opposite effect of requiring a worker to remain in the labor force in order to meet the couple's financial needs (Denaeghel et al., 2011).

3 Data, financial incentives and retirement behavior

3.1 ECHP and EU-SILC

To study the retirement behavior of older couples in Spain, we combine 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 in which a sample of individuals and households are interviewed yearly from 1994 to 2001 (8 waves). From 2004 onward, the EU-SILC replaces the ECHP, but with a different sampling design: instead of surveying all households yearly, the panel component of the EU-SILC surveys households over a four-year period, with a rotational design that includes new households every year. At the time of writing, the latest panel released for Spain includes 2016, which combined with the ECHP allows us to construct a sample from 1994 to 2016, with a two-year gap in 2002 and 2003.

We select a sample of couples by keeping only those individuals who we successfully match to their partner (34,108 couples, or 120,696 couple/years). In addition, we keep only couples in which both partners are 50 to 70 years old at the time of the survey, that are surveyed at least twice, and that remain together through the period of observation.[9] The final sample is of 9,303 couples (35,175 couple/years).

The ECHP and EU-SILC classify the labor status of its respondents as employed, unem-

[9] Separations only occur in 2.7 percent of couples, of which 0.36 percent due to death, so our choice does not have large implications. For couples in the ECHP, 37.4% of them appear the 8 survey waves. Only 4% of the couples are interviewed only once. For couples from the SILC survey, we follow 63.3% of them over the four-year period, and 8.2% are interviewed only once.

ployed, retired, disabled, in housework, or another type of inactivity.[10] Our main definition of retirement considers transitions from the labor force to out of the labor force. We classify individuals employed and unemployed searching for a job as in the labor force. Instead, we classify disability insurance claimants and individuals doing housework as out of the labor force.[11] We will assess the robustness of our results to other labor force definitions.

In addition to measures of financial incentives, which we describe in the next section, we construct a variable measuring the health status of each partner. Both the ECHP and EU-SILC ask respondents to classify their health status in one of five categories, from very poor to excellent. We use the reported health status to construct a binary variable indicating poor and very poor health. A large amount of literature has cautioned against the potential biases from using self-reported health measures as explanatory variables of retirement decisions (See Bound et al. 1999). Although it is not the main goal of our work to explore the relationship between health and retirement, we worry that self-reported health may not be an appropriate control in our retirement model. The ECHP contains information on whether the respondent had been admitted to a hospital during the last twelve months. We use this variable to assess the robustness of our results to the inclusion of an objective health measure in the model.

Panels A to D of Table 1 show the descriptive statistics for the sample of analysis, separately for husbands and wives. We note some relevant differences across husbands and wives. First, women are on average two years younger than their husbands. Second, and aligned with this first observation, the proportion of husbands having retired is much higher than that of wives. However, the proportion of women out of the labor force is over a third larger than their husbands. One reason is that wives tend to have a higher home employment

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

[11]Disability insurance is a known pathway to exiting the labor force, and can be a response to the financial incentives from Social Security (Coile and Milligan, 2016). Instead, housework is not considered as contributory employment and thus should not be affected by Social Security.

rate.[12] Another reason is that wives generally have more limited employment histories that may not entitle them to old-age benefits[13]. Third, husbands have a higher employment rate than their wives, and if employed, work more hours and earn higher wages.

3.2 Measures of financial incentives

Social Security and pensions influence the decision to retire through two mechanisms. First, through the wealth from pensions individuals would receive if they were to retire now. Second, through the marginal financial incentives if they were to postpone their retirement. In this section, we discuss how we map the characteristics of the Spanish pension system to obtain these measures.

Total pension wealth. To capture the current value from retirement, we construct a measure of the *Total Pension Wealth* (TPW), which we define as the stream of future pension benefits the individual has earned based on its work to date, discounted for mortality risk and time preferences. For an individual i starting to claim the old-age pension at age R in time t, her total pension wealth is:

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

Where $\sigma_{t,a}$ is the survival probability at age a in year t, T end of life age, and β^{a-R} is a discount factor. $B_{t,a}(R,i)$ is the old-age pension entitlement, which depends on the total number of years contributed, the earnings while in the labor force, and the age at the time of retirement.

The reforms of the pension system over the past two decades change the eligibility and pension formula, which affects the parameters used in the pension entitlement calculation.

[12] Over a third of women in our sample report being a houseworker, compared to less than 1 percent of men.

[13] Although the interviewer does not ask whether the person is receiving an old-age pension, only 1 percent of wives and 3 percent of husbands describing themselves as retired do not receive a public pension.

Table 1: Descriptive statistics at sample entry

	Husband		Wife	
	Mean	S.D.	Mean	S.D.
A. Demographic characteristics				
Age	60.86	5.103	58.34	5.051
Primary education	0.413		0.469	
Completed secondary education	0.403		0.405	
Higher education	0.184		0.126	
B. Labour market characteristics				
Retired	0.38		0.074	
Public pension (cond., €/year)	13,220	7,962	9,107	7,141
Out of the labor force (incl. housework)	0.467		0.658	
Paid employment	0.453		0.276	
Labor earnings (cond., €/year)	19,094	14,120	14,247	11,176
Weekly hours worked (cond.)	43.764	10.127	36.724	12.560
Unemployed	0.106		0.077	
C. Health characteristics				
Bad or very bad health status (self-reported)	0.129		0.145	
Average health score (1-5)	2.472	0.855	2.527	0.876
Limiting health condition (self-reported)	0.566		0.546	
D. Couples' characteristics				
Region				
Northwest	0.160			
Northeast	0.166			
Madrid (Com.)	0.137			
Center	0.165			
East	0.152			
South	0.173			
Canary Islands	0.043			
Household size	3.131	1.155		
Total household income (€/year)	29,846	22,881		
E. Old age pension incentives				
Total Pension Wealth	369,442	52,525	301,178	61,077
Implicit Tax Rate	0.119	0.238	0.090	0.356
Years to Peak Value	-0.399	0.490	-0.609	0.488
Observations	35,175			
Couples	17,580			

Notes: Data from EU-SILC and ECHP. Couples are selected at sample entry, and only if they remain together thorough the observation period. Regions include the following autonomic regions: Northwest: Asturias, Cantabria, Galicia. Northeast: Aragon, Navarra, Pais Vasco, Rioja. Center: Castilla la Mancha, Castilla y Leon, Extremadura. East: Illes Balears, Catalunya, Comunitat Valenciana. South: Andalucia, Murcia.

Therefore, we carefully model the Spanish pension system and its changes over time, capturing the time-varying TPW that an individual would face at any particular year she would consider retiring.[14]

It may be worth summarizing here the main qualitative effects of working one more year beyond the EEA. The unambiguously positive wealth effects of working one more year beyond the EEA are: (1) the reduction of the penalty for early retirement, and (2) the increase in replacement rate if the worker has contributed for fewer than the years required for full pension eligibility. Postponing retirement may also affect the retirement incentives by changing the benefit base: it may increase (decrease) if earnings from the extra year of work exceed (fall behind) average earnings during the last years entering in the benefit base. Working an extra year also reduces by one year the expected period over which the worker will receive a pension. Finally, the marginal tax rate on labor income may turn out to be higher than the marginal tax rate on pension income, owing to the high progressiveness of the Spanish income tax schedule.

Marginal Incentives. The simplest measure of marginal retirement incentives is the one-year accrual, that is the change in TPW from working one additional year. We follow Diamond and Gruber (1999) in calculating the implicit tax/subsidy rate (ITAX) on an additional year of work, by normalizing the negative one-year accrual by the potential wage for that year. A positive ITAX implies that the old-age pension system causes a disincentive to work an additional year through foregone TPW. To measure the full tax wedge, we use the gross wage in the denominator. That is:

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

Another possible marginal incentive measure is the peak value, PV, which is defined as the value of continuing to work until the future year when total pension wealth is maximized,

[14] See Tables A2 and A3 for a comprehensive summary of the parameters entering the calculation of the benefit base, and how the reforms modify them.

or the difference between the expected present discounted value of total pension wealth at its highest possible value in the future and the expected present discounted value of total pension wealth if one retires this year.

$$PV_{t,a}(R,i) = \max_{h} \quad TPW_{t+h,a}(R+h,i) - TPW_{t,a}(R,i) \tag{3}$$

We construct a measure of the years between the current age and the age maximizing the peak value as our marginal incentive measure. The advantage of using this measure is its intuitiveness, as it allows us to interpret the effect of being one year closer to the age that maximizes the pension wealth on the probability to retire. That is, for each age a, we measure:

$$YPV_{t,a}(R,i) = R^{*}_{t,a}(R,i) - R \tag{4}$$

We expect the YPV to affect the probability to exit the labor force positively: larger values of the variable indicate a further distance to the age maximizing the peak value, and thus lower incentives to retire. As the relationship between the YPV and labor supply decisions is most likely non-linear, in our analysis, we include a second order polynomial of YPV and present the estimated effect from being one additional year further away from the age maximizing the peak value, evaluated at a distance of two years to this age.

3.3 Instrumenting financial incentives

The inclusion of individual pension wealth and marginal incentives in a model of retirement allows the estimation of reduced-form models of the effect of Social Security wealth and marginal incentives on retirement. Instead of including individual-level measures of pension wealth and marginal incentives, we instrument these by using measures constructed using on *representative* earnings profiles, and estimate a reduced-form model of retirement. There are two main advantages of this approach. First, it requires less data. Second, the assumption ESCRIURE AQUI AVANTATGE DE UNCORRELATED INCENTIVES TO RETIREMENT DECISION. We describe these aspects in more detail in what follows.

Data needs to construct the instruments. Instrumenting individual retirement incentives with measures constructed using representative earnings profiles imposes lower data demands. That is, computing individual pension entitlement, and thus constructing individual retirement incentives from public pensions, requires the full earnings profile of each individual. These data have to be complemented with other key demographic information and, for the purpose of our analysis on couple retirement, identification of partners. In the Spanish context, as is the case in most countries, it is not possible to have it all: administrative records can help recovering full individual earning profiles, but usually have limited demographic and health information. Survey data allow building a complete picture of a person, but the longitudinal dimension is missing. Our method overcomes this limitation by matching individuals from a survey sample to representative earnings profiles constructed from administrative records.

We construct representative earnings histories from individuals in the Social Security records sample (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).[15] That is forty-two subsamples per each cohort born in between 1924 to 1966, for which we construct the median earnings distribution for ages fifty to seventy (see the resulting profiles in Figure B1 in Appendix B). We predict backward and forward in order to obtain a complete year of birth-gender-region-education earnings profiles in the fifty to seventy age range. Earnings profiles are projected assuming one percent real growth if there is no information (with 2.5 percent inflation after 2018). Also, to solve the potential issues of selection at older ages, we assume constant real earnings for ages 60 and above for all cohorts.

[15] The MCVL database (Muestra Continua de Vidas Laborales (MCVL)) is a sample of Social Security records containing the complete earning histories for a 4 percent random sample of Spanish workers, pensioners, and unemployment benefit recipients.

To calculate the financial incentives, we match each individual in our sample to its corresponding representative earnings profile. We use the reported age of entry in the labor force for each individual in our sample to calculate the number of contributions accumulated at each potential age of retirement, under the assumption that individuals do not have career gaps. [16] Calculation of the TPW requires the specification of a time-varying survival probability at all ages considered, ideally at the year of birth-gender-education-region level. We obtain yearly data on population and mortality rates from the National Institute of Statistics (INE) for the period covered, per gender. We generate a life expectancy which is three years higher (lower) to reflect the difference in life expectancy across the three education levels (Van Baal et al. 2016 and Regidor et al. 2016). We attribute the same survival probability across regions, as differences are minimal, and the regional data available does not span all years covered.[17]

Panel E of Table 1 reports the calculated pension incentives for husbands and wives. The pension wealth of wives is significantly lower than that of their husbands, possibly as a consequence of the lower lifetime earnings of women than of men. The marginal incentives are lower for women, and by looking at the years to the peak value, we understand that this is the consequence of women being younger than men. However, there is substantial heterogeneity in all these figures, as is evident from the large standard deviations.

Relevance of the instruments. Our calculated wealth and incentives measures are relevant instruments to individual pension wealth and incentive measures if representative earnings profiles are sufficiently correlated to individual earnings histories. To formally assess the relevance of our instrument, we construct individual-level incentives (TPW, ITAX, and YPV) calculated on a random subsample of 40,000 individuals from the MCVL, for whom we have individual-level earnings histories, and compare them to the incentives resulting from

[16] We acknowledge that career gaps can have a crucial effect on pension entitlement, implying that our measures are potentially overstating pension wealth. In fact, in the MCVL sample, 47 percent of individuals had at least one gap in their earnings histories. The median gap-years was 3 for men, and 4 for women. We (partially) assess the implications of this assumption in the robustness section.

[17] Our results are very robust to changes in the survival function, so we are quite confident that this simplification will not cause any significant bias.

using our representative earnings profiles approach on this subsample. Specifically, we estimate a model with the individual measure as the dependent variable, and the representative measure, or instrument, as the explanatory variable. That is, for every financial incentive measure of individual i in region r and at time t, FI_{irt}, we define:

$$FI_{irt} = \alpha + \beta FI_{irt}^{S} + \gamma_t + \mu_r + \epsilon_{irt}$$

Where γ_t and μ_r are a full set of year and regions 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 β is statistically different from zero. Table 2 reports the resulting coefficients, and we cannot reject that the coefficients are different from zero, thus confirming the relevance of our set of instruments.[18]

Table 2: Comparison of individual and synthetic incentive measures

	TPW	ITAX	OV	Years to Peak
Point estimate (β)	1.018***	.961***	1.078***	.996***
	(.013)	(.008)	(.116)	(.012)
Adj. R^2	.484	.591	.062	.051
F-stat	520.94	923.39	37.15	68.03
F-test, p-value	<.01	<.01	<.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.

Identifying assumptions and sources of variation. The identifying assumption is the exogeneity of the marginal incentive measures. In particular, these must be exogenous to individual tastes for retirement. Part of the heterogeneity in marginal incentive is determined

[18]Table B1 in Appendix B reproduces the same exercise by gender, also confirming the relevance of our instruments when the sample is split by gender. For a graphical comparison of the observed pension entitlement to the calculated pension entitlement using representative earnings profiles and individual-level earnings histories see Figure B2 in Appendix B. To further investigate our choice of using synthetic earnings histories, Figures B3 and B4 in Appendix B report the distribution of the benefits as well as the prediction errors of observed and simulated benefits using synthetic earnings profiles. We observe only limited errors from using synthetic earnings profiles, of around 1%.

by the old-age program parameters such as retirement ages, percentage benefit increases after early retirement age, the number of years of earnings used in the computation of benefits, among others. These are clearly exogenous from the individual's perspective. On the other hand, there is some scope for forward-looking individuals to time their marginal incentive according to their taste for early retirement. We argue that the numerous reforms that the Spanish system underwent during the last two decades make it difficult for individuals to anticipate the optimal timing of their retirement.

Identification of the effects of incentives on retirement behavior requires its measures to vary across individuals and over time, conditional on the socio-demographic covariates that would be included in a model of retirement. There are several potential sources of variation in pension wealth and forward-looking marginal incentive measures. The TPW, but not the MI, will be affected by earnings histories of individuals, while projected average earnings in the future will have an impact on expected total wealth and the MI.

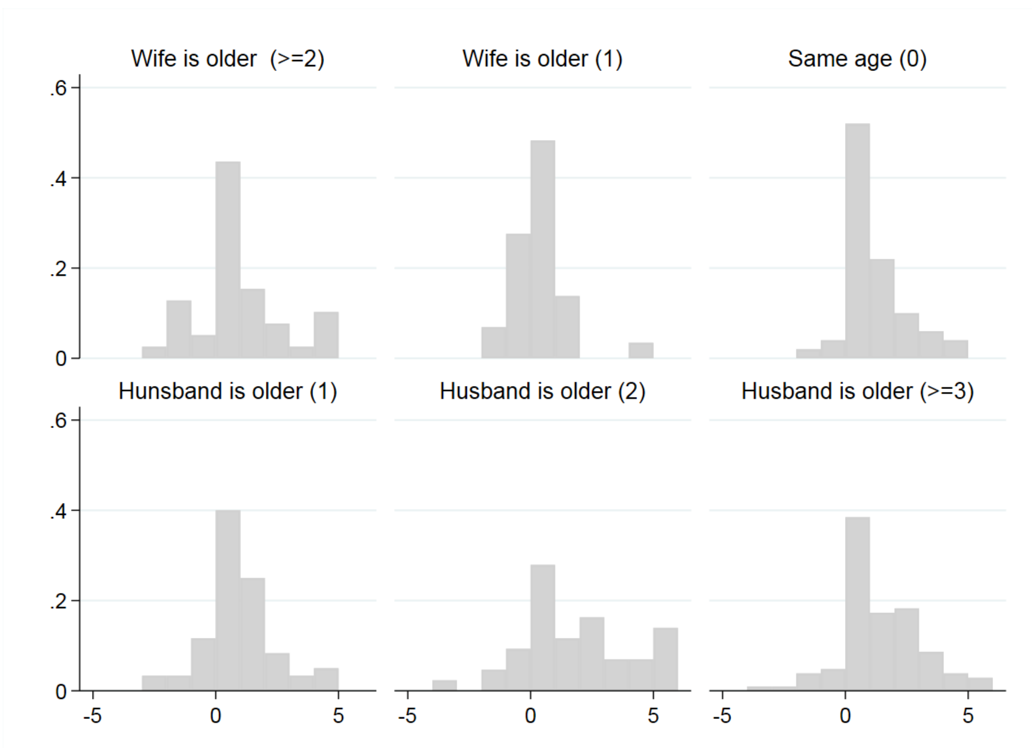
Another important source of variation is the year of birth of workers, since different cohorts face different eligibility criteria and benefit formula. This has an impact both on pension wealth and accruals. It is a source of variation that previous work has abstracted from, as it has focused on cross-sectional analyses of retirement incentives.

4 Joint retirement

The previous section demonstrated that financial incentives of wives have a role in the retirement decision of husbands. One could argue that this is in line with husbands timing their retirement to the optimal retirement time of their wives. However, the previous result does not allow us to make inferences on the preferences for and the incidence of joint retirement. In this section, we develop a joint retirement model that will allow us to do that.

First, we descriptively explore the coincidence in the date of exit from the labor force date across partners in our sample, which we define as joint retirement. Figure 2 analyzes joint retirement by presenting density graphs of the difference (in years) in dates of exit from the labor force between husbands and wives, by the difference in age between them. Positive values in the histogram indicate that the husband retired at a later calendar date than the wife. Positive values in the age difference indicate an older husband. Hence, the first graph shows the distribution of retirement date differences for couples where the husband was at least two years younger than the wife; the second graph shows the distribution of retirement date differences for couples where the husband was exactly one year younger than the wife; and so on. In all of the six graphs, the highest frequency corresponds to an exit date difference of zero, that is, to spouses exit the labor force on the same calendar year.

Figure 2: Difference in date of exit by age difference between partners



Notes: Data from EU-SILC and ECHP. Figures in parentheses reports (absolute) age difference across partners. The x-axis measures the difference in retirement date between husbands and wives, measured in years. Sample size is 9,303 couples.

An approach to exploring joint retirement is to characterize both partners' labor supply as a unique state. As such, we characterize the joint labor force status of the couple in a given year by four possible states:

1 → Both partners are out of the labor force;

2 → Husband is in the labor force, wife is out of the labor force;

3 → Husband is out of the labor force, wife is in the labor force;

4 → Both partners are in the labor force.

Table 3 shows the distribution of couple-year observations by origin and destination state and the average yearly transition probabilities among states (in parentheses). We report only a few cases in which the wife was in the labor force, and the husband was OLF. The majority of year-couples were in the state where both partners were OLF, followed by the state where the husband was LF, and the wife was OLF. There were few cases of joint retirement within the same year (i.e., transitions from both LF to both OLF). However, we note that husbands exited the labor force more often when their wives were OLF (0.137) than when their wives were LF (0.069). Similarly, for wives, the labor force exit rate was 0.222 when their husband was OLF, and 0.112 when the husband remained LF.

In our sample, we note that there was a sizable proportion of cases where the exit from the labor force was reversed. Of the wives exiting the labor force, 8 percent seemed to re-enter it, compared to a 5 percent for husbands. This proportion was less than 1 percent when considering the simultaneous re-entry of both partners in the labor market. This result is driven by partners that were younger than sixty, as we see a much smaller proportion of older husbands and wives re-entering the labor force. Also, the re-entry rate when analyzing the EU-SILC sample was larger than for the ECHP sample. A potential explanation would be a large number of discouraged workers during the economic crisis in Spain, that may have reentered the labor force as the economic outlook improved.[19][20]

We now formally calculate the effects of financial incentives on joint retirement, by condi-

[19]The large number of re-entry in the labor force for women is not an artifact from the construction of our labor force definitions, as when excluding housework from the OLF state, the number of transitions from OLF to LF changes only slightly.

[20]Another potential reason for the gender differences could be that women re-entered the labor force frequently to compensate for the job loss of their husbands, as the economic crisis affected men more strongly (?). We observe that the gap of re-entry in the labor force widened by 2 percentage points during the period of the economic crisis (2008 to 2012). This provides support to our hypothesis, although it seems that other structural gender differences are of greater importance.

Table 3: Distribution of observations by origin and destination state and average yearly transition probabilities

	Destination				
	Both OLF	Husband LF wife OLF	Wife LF husband OLF	Both LF	*Couples*
Origin					
Both OLF	8,409 (0.929)	246 (0.027)	329 (0.036)	69 (0.008)	9,053
Husband LF, wife OLF	1,092 (0.137)	6,133 (0.771)	64 (0.008)	669 (0.084)	7,958
Wife LF, husband OLF	539 (0.222)	33 (0.014)	1,736 (0.716)	117 (0.048)	2,425
Both LF	143 (0.022)	719 (0.112)	441 (0.069)	5,091 (0.796)	6,394

Notes: Data from EU-SILC and ECHP. Figures in parentheses are the average yearly transition probabilities. OLF = out of the labor force; LF = in the labor force.

tioning retirement probabilities to the decision of the other partner. Following Blau (1998), we develop a discrete-choice model of employment, where the couple chooses the employment status of the husband and wife each period, accounting for the expected future consequences of current-period decisions.

Let k denote the current-period labor force status of the couple, and j the previous period status. With this definition, we define $s_k = 1$ if state k is chosen in period t, and $s_k = 0$ otherwise. The value of occupying employment state k in period t given that state j was occupied in period $t-1$ is

$$V_{jk}(t) = U_{jkt} + \epsilon_{kt} + \delta\, \mathbb{E}_t \max_n [V_n(t+1)|s_k(t) = 1] \tag{5}$$

where couple-specific subscripts are omitted; U is the period-t utility from occupying state k given that state j was occupied in period $t = 1$; ϵ_{kt} is a serially uncorrelated, mean-zero disturbance; δ is the discount factor; and $\mathbb{E}_t$ is the expectations operator based upon information available in period t.

This approach assumes that preferences are given by a household utility function, that takes into account household consumption and leisure of both husband and wife. In this model, wages, assets, income and pension entitlement of each spouse at every possible state space (i.e., for every possible sequence of joint spouse labor supply decisions) determine the optimal current labor supply decision[21].

At any given point in the state space, pension entitlement enters the optimization weighted by the probability that the given point will be chosen, which is a function only of the structural parameters (utility function, error covariances, discount factor) and data. We approximate this forward-looking aspect by including as regressors our simulated total pension wealth and accrual measures. Recall that our TPW measure corresponds to the net present discounted value of pension entitlement for an individual with characteristics d. Under the assumption that the TPW over subsample d is closely correlated to the individual TPW, our measure can be seen as an instrument of current old-age pension entitlement, that takes into account the variation over time of Social Security policies.

The inclusion of accrual measures captures an aspect of forward-looking behavior in a way that does not require solving the dynamic program laid out in (5). Our accrual measures depend on average or projected future wages of types d. This approach relies on the assumption that we project earnings correctly, as well as on the assumptions behind each accrual measure previously presented.

In spite of the necessary assumptions behind our incentive measures, our approach may be an improvement to Blau (1998). His approach is to control for Social Security benefits by including as a regressor the benefits of an individual working until the SEA and then permanently leaving the labor force. This specification is clearly misspecified if retirement is not an absorbing state. As presented in Table 3, it seems that in our context, about 5% of individuals (both men and women) re-enter the labor force. Blau (1998) approach relies on the assumption that couples do not take into account future benefits at all points in the state space. The construction of our option value and peak value measures rely on the evaluation

[21] Savings play a potentially important role in determining labor supply decisions. We assume, however, that saving behavior is exogenous, given the difficulty to model savings and labor supply jointly.

of pension entitlement at all future ages, with current knowledge of the pension system, and optimally select the retirement age that maximizes this comparison.

Taking a linear approximation of (5), we obtain:

$$V_{jk}(t) = X_t\beta_{jk} + \gamma_{jk}\mu + \delta_t\rho + \epsilon_{kt} \tag{6}$$

Where X are individual and spouses' controls (educational attainment and age of entry in the labor force) as well as household control variables (household composition, income, and assets). It also includes the TPW and MI, which we instrument using the ITAX measure. μ and ρ are couple and year fixed effects, and βs, γs, and δs are parameters.

In our analysis, we focus on the probability of transitioning to state k, conditional on being in state j in $t-1$. This probability is the result of an optimal decision, in which a couple will transition to a state if and only if $V_{jk}(t) \geq V_{jm}(t) \;\; \forall m \neq k$. Then, the probability of a transition can be written as:

$$\lambda_{jk}(t) = Pr(V_{jk}(t) \geq V_{jm}(t) \;\; \forall m \neq k | d_j(t-1) = 1) \tag{7}$$

From Table 3, it is evident that some combinations of origin and destination states have too few observations to be estimated using the previously described empirical specification. In particular, we explore the following transitions. The retirement of each partner regardless of the labor force status of the partner (marginal distribution); the retirement when the other partner is already retired; and, the retirement when both partners are initially employed.

In the empirical applications that follow, substituting (6) into (5), and assuming a logistic distribution of the error term, we estimate each transition using a multinomial logit model, with clustered errors at the individual level.

5 Direct and Spillover Effects of Pension Incentives on retirement

In this section we formalize the previous general model in an empirical model that accounts for the effect of financial incentives of one partner in the retirement decisions of the other partner. We quantify the spillover of financial incentives of one partner on the marginal effect of retiring of the other partner.

5.1 Marginal retirement

We consider first, the individual estimation problem regardless of the labor force status of the partner. For each individual i, we write $R_{it} = 1$ if the individual has retired in period t (conditional on being employed (E) in period $t-1$ and regardless of the labor force status of the partner). We then model the probability of this event as a function of observable household and individual characteristics, as well as the pension wealth and marginal incentives attributed to the individual and the spouse. Denoting the observable characteristics as X, the pension wealth as TPW and the marginal incentives as MI[22], our retirement model may be expressed as:

$$\begin{aligned} PR(R_{it} = 1|E_{it-1} = 1) = G(&\beta_0 + \beta_1 log(TPW_{it}) + \beta_2 MI_{it} + \gamma' X_{it} \\ &+ \beta_3 log(TPW_{st}) + \beta_4 MI_{st} + \xi' X_{st} + \theta' X_{hht} + \delta_t + \epsilon_{it}) \end{aligned} \tag{8}$$

Where i refers to the individual, s to the spouse, and hh to the household. $\delta_t \rho$ captures time fixed effects, and $G(.)$ is the cumulative distribution function of unobservables in the conditional exit model, the βs are unknown response coefficients and ϵ is an error term. We include individual and spouses' controls (a second order polynomial of age, educational attainment and age of entry in the labor force, and health status) as well as household control

[22]The years to the peak value are included as a second order polynomial, as we expect the effect not to be linear. Including a third order polynomial in the years to the peak value does not affect our results, as the third order variable is never statistically significant.

variables (household composition, income, and assets). We also include a quartic term of earnings for both spouses.[23] We estimate the response coefficients β using a logit model, with standard errors clustered at the individual level.[24]

Specification (8) is equivalent to a discrete duration model, in which we control for duration dependence by including a third-order polynomial age function. Our specification, however, does not account for unobserved heterogeneity. The necessary assumption for the estimation of this model is that the error term ϵ is i.i.d. in our sample of analysis, but not in the population (Jenkins, 1995).

Table 4 shows the marginal effects from estimating (8). The results are separated into two headers according to the MI: Implicit Tax Rate (Columns (1) and (2)) and years to peak value (Columns (3) and (4)). Focusing first on the direct effects of pension incentives, in the first two rows of Table 4, we note that in all cases, the pension wealth and incentive variables are jointly significant. In all specifications, the signs are as we would expect: positive effects of total pension wealth (TPW), the implicit tax rate (ITAX), and negative effects from the estimate of the marginal effect of working an additional year measured at two years before the peak value (YPV). These results are consistent with the presence of both income and substitution effects in retirement decisions. The positive coefficient on the TPW variable points to an income effect, whereby individuals who accumulate more in earlier years retire earlier.[25] Marginal incentives measure substitution effects. The positive coefficient of the ITAX indicates that the greater the marginal tax that the pension system imposes on working an additional year, the more likely individuals are to retire. For husbands, our results indicate that a ten percentage point increase in ITAX increases the probability to exit the labor force in 5.3 percentage points. The measure of the distance to the peak value provides an alternative intuitive interpretation of our labor supply model: going from

[23]Because Social Security benefits are a function of past earnings and lifetime earnings, they are likely correlated with retirement. It is thus essential to control for earnings in a flexible way (Coile, 2004).

[24]Results are consistent when using a probit model.

[25]We note that the estimated TPW is significantly smaller when using the years to peak value. This is possibly the result of the difficulty in separately identifying the income effect from benefit receipt to the substitution effects.

two years to one year before the peak value age increases the probability to retire in 12.3 percentage points.

A higher TPW of the spouse also represents a positive wealth effect on retirement from the pension wealth accumulated by the partner. The third row of Table 4 shows positive spillovers from wives' TPW on the probability of husbands to retire, but no effects on wives' retirement. The spillover in marginal incentives of each spouse's incentives on the other's retirement is explored in the fourth row. The sign of partners' marginal incentives is an empirical matter (Coile, 2004). On the one hand, an income effect may imply that if one spouse stays in the labor force, and thus increases the couple's retirement wealth, the other spouse may consume some of the additional wealth in the form of leisure and retire earlier. On the other hand, if leisure between partners is complementary, one spouse staying in the labor force may induce the other spouse to retire later.[26] For husbands, their wives' marginal incentives are positive when measured through the ITAX and YPV, indicating that the leisure complementarity effect dominates the income effect. The coefficients suggest that a ten percentage point increase in ITAX leads to a one percentage point increase in the probability to retire of husbands. Put differently, our coefficients measure that having a wife that is one year closer to her peak value of retirement increases the probability to retire of their husbands in 6 percentage points. Again, we do not observe any effect of husbands' marginal incentives on the probability of wives to retire.

The lack of effect of husbands' financial incentives on wives retirement is in line with previous work by Coile (2004). She argues that this is the result of leisure complementarities being stronger for men than for women, which she proves by showing that men and women who reported spending time with their partners as one of the priorities during retirement experienced similar spillover effects from their partners' incentives.

We finally discuss the effects of having poor or very poor health on the probability to retire. Individual poor health plays a key role in the retirement model. For men, the

[26]Substitution of leisure is also possible, however, the previous literature suggests that complementarity of leisure is more likely (Coile, 2004).

magnitude of the estimate is about 40% that of the own ITAX, and 60% for women. We do not see spillover effects from the wives' and husbands' health on the decision to retire of their partner.

Table 4: Effect of pension incentives on the probability to retire

	Implicit Tax Rate		Two years to peak value	
	Husbands	Wives	Husbands	Wives
TPW own	.341***	.148***	.184***	.093**
	(.039)	(.033)	(.036)	(.032)
MI own	.531***	.286***	−.123***	−.089***
	(.027)	(.019)	(.010)	(.012)
TPW spouse	.110***	−.022	.093***	−.040
	(.028)	(.034)	(.026)	(.032)
MI spouse	.147***	.031	−.066***	−.009
	(.021)	(.026)	(.012)	(.012)
Poor health (own)	.178***	.169***	.166***	.156***
	(.016)	(.015)	(.016)	(.016)
Poor health (spouse)	−.009	−.006	.0066	−.003
	(.014)	(.014)	(.014)	(.013)
Couples	*9,067*	*9,067*	*9,067*	*9,067*
Observations	*17,915*	*17,915*	*17,915*	*17,915*

Marginal effects from estimating specification 8 using a logarithmic regression model, and standard errors clustered at the individual level. All specifications include the following controls: third order polynomial of age, educational attainment, age of entry in the labor force, household composition, income, assets, as well as time and region fixed effects. ITAX is a ratio and years to peak value is in years. p-values: *<0.1, **<0.05, ***<0.01.

5.2 Joint conditional retirement

In this section we consider two cases. First, the retirement decision conditional on the fact that the other partner is already retired. Second, the joint retirement problem, conditional on both being employed in the previous period.

The first case can be represented by the following model:

$$\begin{aligned} PR(R_{it} = 1 | E_{it-1} = 1, E_{st-1} = 0) = G(&\eta_0 + \eta_1 log(TPW_{it}) + \eta_2 MI_{it} + \gamma_2' X_{it} \\ &+ \eta_3 log(TPW_{st}) + \eta_4 MI_{st} + \xi_2' X_{st} + \theta_2' X_{hht} + \delta_t + \epsilon_{it}) \end{aligned} \tag{9}$$

We report estimates of this equation by gender.

And, the joint retirement case, by the following equation:

$$
\begin{aligned}
PR(R_{it}, R_{st}|E_{it-1} = 1, E_{st-1} = 1) = G(\mu_0 + \mu_1 log(TPW_{it}) + \mu_2 MI_{it} + \gamma_3' X_{it} \\
+ \mu_3 log(TPW_{st}) + \mu_4 MI_{st} + \xi_3' X_{st} + \theta_3' X_{hht} + \delta_t + \epsilon_{3it})
\end{aligned}
\tag{10}
$$

As regard this equation we analyse marginal effect for three distinct probabilities: the probabilities that both jointly retire, $PR(R_{it} = 1, R_{st} = 1|E_{it-1} = 1, E_{st-1} = 1)$; and the probabilities that one spouse retires while the other not, $PR(R_{it} = 1, R_{st} = 0|E_{it-1} = 1, E_{st-1} = 1)$ and $PR(R_{it} = 0, R_{st} = 1|E_{it-1} = 1, E_{st-1} = 1)$.

Table 5 reports marginal effects from estimating (9) and (10) using our preferred specification, using the age to peak value measure as marginal incentives, to explain the decision to retire of wives and husbands when their partners are already retired (Columns (1) and (2)) and when they are both employed (Columns (3) to (5)). Overall, financial incentives (own and those of the partner) from pensions matter. When one of the partners is initially not employed, own marginal incentives to retire matter a lot: being one year closer to the optimal retirement age increases the probability of women to retire in 24.7 percentage points, and 32.8 percentage points for men. This is almost three times as large as the estimate we obtain in the unconditional analysis. Partners incentives

When both partners are initially employed, we differentiate three possible states: only the husband retires, only the wife retires, and both retire. In the decision of the husband to retire, only his own financial incentives and poor health appear to affect the decision. When only wives retire, the marginal incentives of the partner matter to a similar extent to their own. This suggests that the retirement of the husband will take place soon, so wives time their retirement with their husbands. Their own ill health is also a crucial factor in the decision to retire. Finally, we observe that marginal incentives of husbands and wives matter to a very similar extent in the decision to retire jointly, but only the pension wealth of wives matters in the decision, and the poor health of husbands.

Table 5: Joint retirement of partners

	Partner Initially NOT Employed		**Both Initially Employed**		
	Wife retires (1)	Husband retires (2)	Both retire (3)	Wife retires (4)	Husband retires (5)
TPW Husband	.013* (.007)	.014** (.005)	.006 (.020)	-.002 (.057)	.216*** (.063)
MI Husband	-.101** (.040)	-.328*** (.058)	-.081*** (.027)	-.079** (.038)	-.089*** (.041)
TPW Wife	.014** (.005)	.044*** (.009)	.056*** (.019)	.090** (.047)	-.047 (.041)
MI Wife	-.247*** (.001)	-.339*** (.001)	-.086*** (.033)	-.096* (.054)	-0.43 (1.08)
Poor health Husband	.001 (.002)	-.006 (.004)	.018* (.007)	-.031 (.035)	.066* (.033)
Poor health Wife	.001 (.001)	.001 (.003)	.006 (.006)	.034* (.019)	.049 (.033)
Couples	*1,214*	*497*	*903*		

Notes: Header identifies the joint employment state at $t-1$. Column title identifies the new joint employment state through the change relative to the pre-reform state transition.

5.3 Robustness checks: Accounting for career gaps

In this section we test the implications of not accounting for career gaps in the calculation of pension incentives measures. Our strategy to instrument pension incentives and possibly attributing pension eligibility to individuals who were not entitled to benefits could be the cause of a downward bias in the estimated effect of pension incentives. This is potentially a greater issue among women, who often experience more gaps during their careers than men. To better measure the benefit entitlement of each individual, we incorporate in the incentives calculation the years of career gaps for each individual. This has the potential to improve the correlation between the individual-level pension incentives and the instruments used.

As previously mentioned, SILC respondents were asked to give the number of years of contributions. We calculate the years of career gaps for each individual, using their age and their age of entry on the labor force. We use this information to calculate pension incentives. Table 6 reports the effects of the pension incentives on retirement when incentives are measured as described in section 3.2 (No Gaps) and when they are measured including the individual information on pension gaps (Gaps). Generally, the effect of husbands marginal incentives is somewhat larger when accounting for career gaps in the calculation of incentives for men. This difference, however, is small, indicating that our baseline results for men are not too biased from not considering them in the calculation of incentives. Instead, the estimated effect of wives' marginal incentives increases when accounting for career gaps, in line with the fact that women had more career gaps, and thus not accounting for them biased the estimated effects towards zero.

Note, however, that this test only addresses the issue partially, as we are not able to see the ages in which the gaps took place. The approach we take now is equivalent to assuming a later entry in the labor force, which implies that we remove some of the least productive years. If instead, individuals take career breaks during their most productive years, the resulting pension entitlement could be much lower, and the bias from not accounting for career breaks much larger.[27]

[27] This potentially so for women, who tend to take career breaks around the birth of their children. Previous work assesses the importance of these career gaps on pension entitlement (Boeri and Brugiavini, 2008). This issue merits further analysis, as it is one of the crucial underlying reasons behind the gender pension gap.

Table 6: Marginal effects of financial incentives on joint exit from the labor force- accounting for career gaps

	Both Initially IN Labor Force					
	No Gaps			Gaps		
	Both exit	Wife exits	Husband exits	Both exit	Wife exits	Husband exits
	(1)	(2)	(3)	(4)	(5)	(6)
MI Husband	-.043 (.022)	-.093* (.047)	-.073* (.045)	-.049 (.020)	-.096*** (.044)	-.075* (.043)
TPW Husband	.010 (.062)	.045 (.078)	.054 (.073)	.011 (.060)	.046 (.075)	.054 (.071)
MI Wife	-.035 (.034)	-.025 (.072)	-.035 (.073)	-.045 (.030)	-.032 (.065)	-.065 (.053)
TPW Wife	.052** (.026)	.043 (.047)	.077* (.045)	.065*** (.025)	.053 (.044)	.090*** (.041)
Poor health Husband	.028** (.012)	.007 (.023)	.070*** (.021)	.028** (.011)	.006 (.020)	.072** (.019)
Poor health Wife	.017 (.012)	.049* (.025)	-.004 (.024)	.015 (.010)	.048*** (.022)	-.003 (.022)
Couples	*803*					

Notes: Header identifies the joint employment state at $t-1$. Column title identifies the new joint employment state through the change relative to the pre-reform state transition.

6 Concluding remarks

This paper measures the spillover effects from partners' pension incentives on the decision to retire. In particular, we instrument individual pension incentives by constructing average incentives for each gender, education level, region and year of birth using Spanish administrative data, that we match to respondents of EU-level surveys. We, thus, estimate a reduced form model of the impact of own and spouses' pension incentives on the probability to retire. We find that in the decision to retire jointly, husbands and wives' retirement incentives matter equally, but only husbands' poor health seems to drive the decision.

The reduced form approach from this paper, albeit useful to overcome the need of long panels including earnings information, comes with its limitations. The principal limitation is that this approach misses variation from individual pension entitlement. We try to limit this by allowing the instruments to varying with individuals' age of entry in the labor force, and by including information on career gaps, but this only offers a partial solution to the issue, as we cannot precisely determine the age in which individuals did not contribute to their pensions. This issue is particularly relevant for women, who tend to have more frequent career gaps than men, thus biasing the effects of their incentives towards zero. Thus, one should be cautious when claiming that men tend to respond more than women to pension incentives, as it may be a construction from our approach.

Our paper provides first-hand evidence of the severity of these limitations, which we show to be only moderate, as well as providing approaches to reduce the bias of using synthetic earnings profiles.

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Appendices

A Appendix A: Background of the Spanish Social Security System

A.1 Reforms of the Spanish Old-Age pension system

The old-age pension system in 1985. Eligibility to the OA benefits was granted for workers with at least 8 years of contributions to the system, and complete withdrawal of the labor force. The benefit base was obtained by dividing by 112 the wages of the last 96 months (8 years) before retiring. The replacement rate of 100% of the benefit base could be obtained for a worker retiring at 65 with at least 35 years of contributions. Early retirement was possible at 60, with an annual penalty of 8% per year retired before reaching the SEA. There was a penalization for insufficient contributions of 2%. The purchasing of the initial benefit is kept constant according to the evolution of the CPI. The pension amount was capped from below by the minimum pension which is currently about the same level than the minimum wage and the maximum benefit (between 4 and 5 times the minimum wage).
The 1997 reform. 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 60 and 65 was reduced to 7% for individuals with 40+ years of contributions at the time of early retirement.
The 2002 reform. Before 2002, only individuals who had contributed to the system earlier than 1967 could benefit from early retirement at 60, while the rest had to wait until the SEA at 65. In 2002, early retirement at 61 was made available for the rest of the population. There was an impulse to promote partial and flexible retirement, with the possibility of combining income from work with OA benefits and the introduction of incentives for individuals to retire after the SEA (2% 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). The possibility to access retirement was extended to individuals who were involuntarily unemployed at 61, who have contributed for at least 30 years, and have been registered in the employment office for the previous 6 months.
The 2002 reform. The incentives to retire later than 65 were increased from a 2% over the full retirement benefit to a 3%. The 8% penalty applied to early retirees between the ages of 60 and 65 was reduced to 6-7.5%, depending on the number of years contributed, for those individuals with 30 years of contributions. In addition, the contributions for unemployed

workers older than 52 were increased so that they would receive a higher old-age pension when retiring.

The 2011 reform. 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 were 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).

The 2013 reform. 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 established 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 expectancies (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 PRI, as previously explained, fixes a budgetary constraint on the economic cycle and, as such, is relatively flexible in the short term.

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) - Intergerational Equity Factor - Pension Revaluation Index

Table A2: 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 A3: 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)**
B1. Contributions entering in Benefit Base [BB]	15 years	17 years. 25 years from 2022 onwards.	$IPR_{t+1} = \bar{g}_{l,t+1} + \bar{g}_{P,t+1} + \bar{g}_{s,t+1} + \alpha\left(\frac{I^*_{t+1} - G^*_{t+1}}{G^*_{t+1}}\right)$
B2. Replacement Rate	$\begin{cases} 0, \text{ if } n < 15 \\ .5 + 0.03(n-15), \text{ if } 25 > n \geq 15 \\ .8 + 0.02(n-25), \text{ if } 35 > n \geq 25 \\ 1, \text{ if } n \geq 35 \end{cases}$	$\begin{cases} 0, \text{ if } a < 15 \\ 0.5 + 0.023(n-15), \text{ if } 37 > n \geq 15 \\ 1, \text{ if } n \geq 37 \end{cases}$	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
B3. Minimum pension	32% average earnings w/o dependent spouse. 39.9% w dependent spouse	34% average earnings w/o dependent spouse. 42% w dependent spouse	Minimum: .25%.
Maximum: CPI + .50%			
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)**
C2. Actuarial reduction of benefits	$1 - \kappa(a-61)$, if $65 > a \geq 61$ where $\kappa \begin{cases} .075 \text{ if } 30 \leq n \leq 34 \\ .07 \text{ if } 35 \leq n \leq 37 \\ .065 \text{ if } 38 \leq n \leq 39 \\ .06 \text{ if } 40 <\leq n \end{cases}$	$1 - \kappa(a-63)$, if $67 > a \geq 63$ where $\kappa \in [0.08; 0.085]$	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. 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 A4: 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.

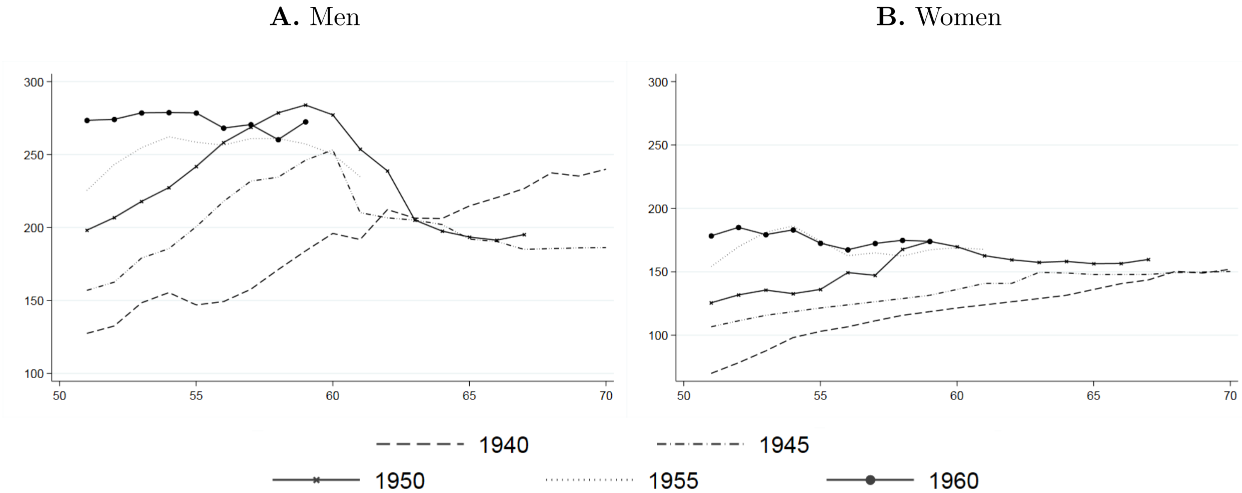
Severe incapacity (GI): Individuals who, as a result of anatomic or functional loses, need the assistance of a third person to develop essential activities of daily living.

Table A5: Main reforms since 1980 of the disability insurance and unemployment systems in Spain

Year of the reform	Program	Main changes
1984	**UI**	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	**DI**	Tightening eligibility criteria to DI
1989	**UI**	Extension of special provision for older workers to all **workers 52+**
1990	**DI**	Introduction of a **means-tested non-contributory disability pensions** for people aged 65+ and for disabled people aged 18+ who satisfy residency requirements.
1997	**DI**	**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	**DI**	Possibility for NISS doctors and mutual insurance companies to review health situation of beneficiaries.
2002	**UI**	- 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	**DI**	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	**UI**	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	**UI**	Replacement rate was reduced from 70% to 50% after the 180 days of unemployment spell– previously it was lowered from 70% to 60%– for all unemployment spells starting after the 15th of July 2012.

B Additional Descriptives

Figure B1: Median yearly earnings for men and women from ages 51-70 with secondary education



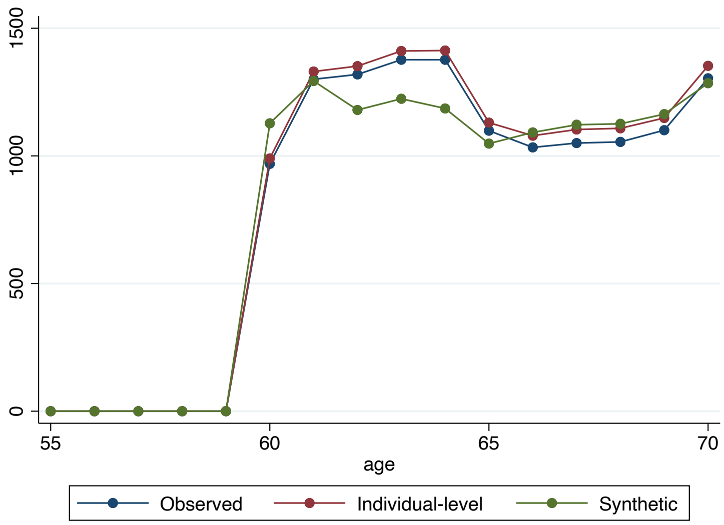
Notes: Median yearly earnings are constructed from MCVL data from 1980 to 2016. Reported here are earnings for men and women with completed secondary education for different cohorts. Quantities are real, expressed in ×100 2015 €.

Table B1: Comparison of individual and synthetic incentive measures by gender

	TPW		ITAX		OV		Years to Peak	
	Men	Women	Men	Women	Men	Women	Men	Women
Point estimate (β)	.946***	.877***	.974***	.948***	.937***	.949***	.999***	.994***
	(.010)	(.020)	(.012)	(.012)	(.035)	(.055)	(.001)	(.003)
Adj. R^2	.510	.339	.555	.647	.227	.250	.938	.914
F-stat	30.11	38.45	4.98	19.74	8.60	110.08	9.93	4.59
F-test, p-value	<.01	<.01	0.026	<.01	<.01	<.01	<.01	.03
Observations	21,728	18,256	21,728	18,256	21,728	18,256	21,728	18,256

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.

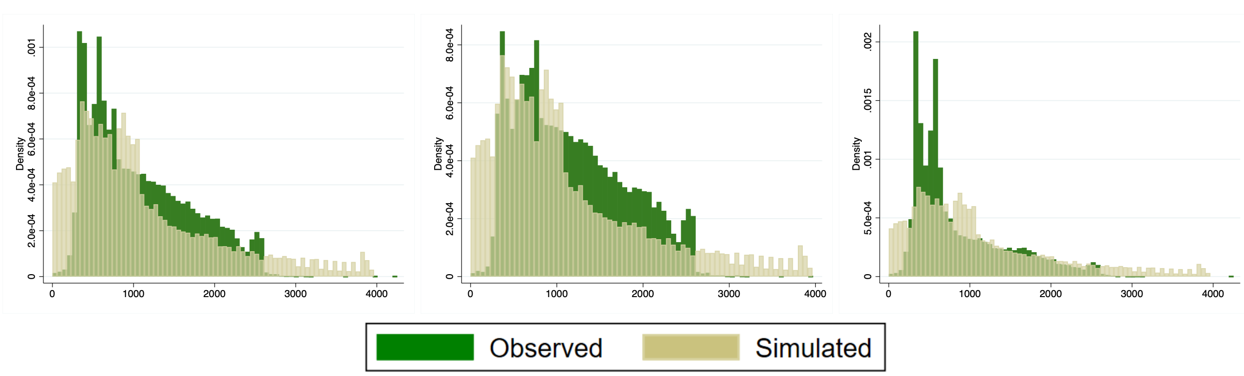
Figure B2: Observed and simulated monthly pension payments per age



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 €. Provide further details about benefit assumptions

Figure B3: Validation of pension benefit calculator

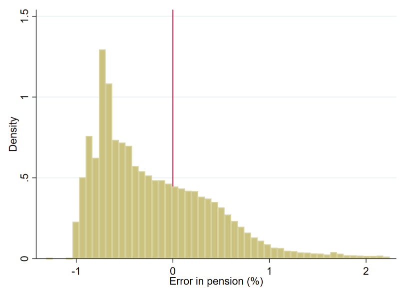
A. Sample average B. Men C. Women

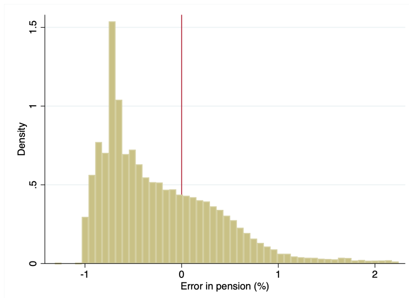


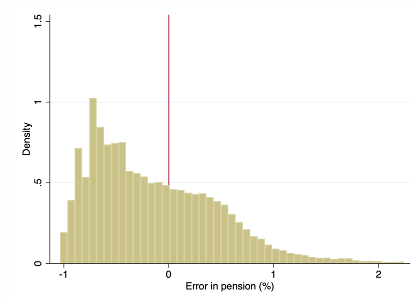
Notes: Observed pension in MCVL, simulated pension based on synthetic earnings histories. Mean observed pension is 1,082.5 (s.d. 633.6). Mean simulated pension is 1,107.2 (s.d. 882.5). For men, mean observed pension is 1,176.9 (s.d. 630.3), and mean simulated pension is 868.1 (s.d. 794.8). For women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

Figure B4: Error in pension calculation (%)

A. Sample average | B. Men | C. Women







Notes: See Notes from Figure B3. Error is calculated as simulated pension net of observed pension, divided by observed pension.

Table B2: Distribution of observations by origin and destination state and average yearly transition probabilities

	Destination state				
	Both OLF	Husband EMPL wife OLF	Wife EMPL husband OLF	Both EMPL	Observations
Both OLF	8,409 (0.9567)	156 (0.0177)	181 (0.0206)	44 (0.0050)	8,790
Husband EMPL, wife OLF	800 (0.1116)	5,931 (0.8277)	58 (0.0081)	377 (0.0526)	7,166
Wife EMPL, husband OLF	348 (0.1480)	41 (0.0174)	1,831 (0.7788)	131 (0.0557)	2,351
Both EMPL	76 (0.0165)	459 (0.0999)	403 (0.0877)	3,657 (0.7959)	4,595

Notes: Data from EU-SILC and ECHP. Figures in parentheses are the average yearly transition probabilities. OLF = out of the labor force; EMPL = employed.

C Simulations of pension incentives

C.1 Simulation of pension wealth

We present the results of simulating the TPW measure. It may be worth summarizing the main qualitative effects of working one more year beyond the EEA in the simulations that we are about to present. The unambiguously positive effect of working one more year beyond the EEA are: (1) the reduction of the penalty for early retirement, and (2) the increase in replacement rate if the worker has contributed for fewer than the years required for full pension eligibility. As previously explained, we shut down the latter channel by assuming that workers enter the labor force early enough so that they have cumulated sufficient contributions for full pension upon reaching the EEA. Nonetheless, we explore the implications of this assumption below.

Postponing retirement may also affect the retirement incentives by changing the benefit base: it may increase (decrease) if earnings from the extra year of work exceed (fall behind) average earnings during the last years entering in the benefit base. From Figure B1, we see that working an additional year at any point above 60 will decrease the benefit base in real term during periods of high inflation. Besides, working an extra year implies paying additional Social Security contributions. It also reduces by one year the expected period over which the worker will receive a pension. Finally, the marginal tax rate on labor income may turn out to be higher than the marginal tax rate on pension income, owing to the high progressiveness of the Spanish income tax schedule.

Figure C1 summarizes the distribution of TPW of men and women with completed secondary education by age, for birth cohorts 1940, 1944, 1949 and 1952. All figures are expressed in 2015 prices. The thick vertical line corresponds to the SEA, set at 65.[28] The EEA was specific to each cohort, as it evolved over time. We have used the same pattern in the vertical lines indicating the EEA than for the corresponding cohort it affected. This way, we can see that the 1940 and 1944 cohorts could have retired early at sixty (since their first contribution was before 1967, by construction), the 1949 cohort could have retired at sixty-three and the 1952 cohort at sixty-four.

Men and women born in 1940 showed a large sensitivity to the penalizations set for retiring early. Note that workers born in 1940 reached their EEA in 2000 and, by construction, had accumulated forty years of contributions. They were thus subjected to a penalization of 7% per each year retired before the SEA age (see Table A2 in Appendix A). From 2002 onwards, however, the early retirement penalization for this cohort was lowered to 6%. Correspond-

[28]To be precise, the 1949 cohort have their SEA set at 65 and 1 month, and the cohort of 1952 at 65 and 4 months.

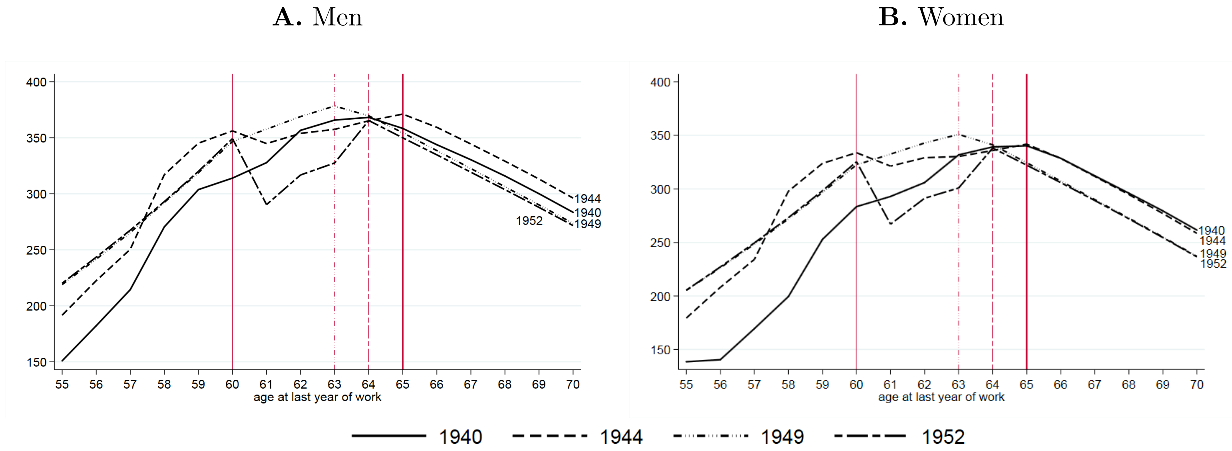
ingly, we see that the increase in the TPW between sixty and sixty-two was much milder than between sixty-two and the SEA. This cohort reached its maximum TPW at the ~~at the~~ SEA (i.e., sixty-five years old).

Figure C1 shows strong incentives to retire as soon as eligible for men and women born in 1944. This cohort reached their EEA in 2004, and was thus subjected to a penalization for early retirement of 6%. This amount was not large enough to incentivize postponing retirement, in light of an average yearly inflation of around 5% and the generosity of the Spanish system. The TPW for this cohort peaked at age sixty-five, following very closely the TPW of claimants born in 1940. This is interesting, as the reform of 2007 (affecting the cohort born in 1944 upon turning sixty-three) increased the incentives for late retirement from 2% to 3%. Our simulations indicate that this increase was not providing sufficient financial incentives to remain in the labor force beyond the SEA.

For men and women born in 1949, it was optimal to retire just upon reaching the EEA. At age sixty-three, workers born in 1949 could retire under the 2011 system. If they waited until sixty-four, then they could retire under the 2013 system. As previously described, the 2013 reform modified the fundamentals Spanish pension system, heavily reducing its generosity. It was thus optimal for individuals to retire as soon as possible before the new pension system enters in place.

Men and women born in 1952 were eligible to voluntarily retire early at sixty-four under the 2013 system. We see that their TPW peaks at that age, and then falls, following very closely the TPW of workers born in 1949. We note a dip in the TPW at age sixty-one, which is not related to their possibility to retire, but to the passing of the 2013 regulation, which caused a large drop in their expected wealth at retirement.

Figure C1: Total pension wealth by age for men and women



Notes: Simulation of TPW for the sample of men and women with completed secondary education. We report three cohorts (1944, 1949, and 1955) that reached the EEA and SEA under different pension regulations, to illustrate the changes in incentives from the reforms of the system. Quantity×1000€, reported in 2015 prices.

D Additional Results

Table D1: Marginal effects of financial incentives on joint exit from the labor force

	Both Initially IN Labor Force					
	Implicit Tax Rate			Two Years to Peak Value Age		
	Both exit	Wife exits	Husband exits	Both exit	Wife exits	Husband exits
	(1)	(2)	(3)	(4)	(5)	(6)
MI Husband	.028 (.020)	.005 (.032)	-.016 (.031)	-.047* (.025)	-.099** (.045)	-.071* (.043)
TPW Husband	.016 (.043)	-.001 (.064)	-.008 (.071)	.006 (.052)	.035 (.068)	.059 (.067)
MI Wife	-.005 (.007)	-.039 (.022)	.029 (.021)	-.033 (.027)	-.018 (.068)	-.030 (.067)
TPW Wife	.037 (.019)	.015 (.052)	.097* (.039)	.042** (.016)	.023 (.037)	.063 (.035)
Poor health Husband	.023* (.009)	.003 (.023)	.074*** (.021)	.022* (.009)	.005 (.023)	.075*** (.021)
Poor health Wife	.013 (.009)	.045** (.017)	-.001 (.024)	.013 (.009)	.044* (.017)	-.001 (.024)
Couples	*1,303*					

Notes: Header identifies the joint employment state at $t-1$. Column title identifies the new joint employment state through the change relative to the pre-reform state transition.

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