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The Effectiveness of Incentives to Postpone Retirement: an Evaluation of the Italian "Super-Bonus" Reform

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Abstract

In this paper, we try to assess if financial incentives may be used as an effective device to induce workers to postpone retirement by evaluating the Italian so called "super bonus" reform. The bonus consisted in economic incentives given for a limited period to private sector workers who had reached the requirements for seniority pension but who chose to postpone retirement. Crucially for this study, public workers were not entitled to the bonus. Using data from the Bank of Italy Survey on Household Income and Wealth, and exploiting the DID-Probit strategy proposed by Blundell et al. (JEEA, 2004), we assess the effect of the bonus on the decision to postpone retirement, by comparing private and public workers before and after the reform. Results suggest a reduction of 12ppt in the proportion of private workers who decided to retire among those qualifying for retirement. Results also suggest, not trivially, that most of the effect of the reform is driven by low-income workers. Finally, we propose an estimate of the extensive margin elasticity of Italian older workers.

1 Introduction

In the recent years, there has been increasing interest among both economists and policy makers in the possible consequences of population ageing, and in particular on how to make the social security system more sustainable in light of this. Among the many developments arisen from this interest,

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one developed within the literature on optimal taxation, and in particular within the Mirrlees optimal tax model. Under this model the optimal marginal tax rate at a particular income depends on the hazard rate of the income distribution, the elasticity of labour supply and the distribution of skills (Diamond, 2008). As old workers, like the young, have both high hazard rates and elastic labour supply relative to prime age workers, there is scope for age-related taxation.

Even before considering the potential benefits of age-related taxation, however, one should probably question the adequacy of pension systems. On this issue, a number of works show that there are strong implicit and explicit incentives to leave the labour market embedded in the pension systems of most developed economies.

First of all, the different labour market participation of old and young individuals has been noticed. D'Addio et al. (2010), for example, show that in OECD countries older workers (50-64) are less likely to be in employment than their prime-aged counterparts (aged 25-50), with high cross-country variability. At one extreme, there are countries like Japan and United States where older participation rates is over 70 per cent; at the other extreme there are countries, including Italy, where older participation rate is below 50 per cent.

Data show that older workers participation rate is higher now than in the seventies, but the authors suggest that this is mainly driven by increased labour force participation of women. Thus, the higher participation rate of older workers is due to catching up of women rather than to a trend towards increased older workers participation. Despite this, a sizeable gap in participation rates of older workers still persists, with Italy among the countries where the gap is larger.

Besides, in most OECD countries workers tend to leave the labour market before the pensionable age. Italy was the country with the lowest pensionable age for workers who retired in 2006 and one of the countries with the lowest average effective age of labour-market exit in the period 2002-07

(57 and 60 years respectively, for both men and women).

Some authors tried to provide estimates of the unused productive capacity of older workers in specific age ranges as a percentage of the total labour capacity at that same age range. Gruber and Wise (1999) calculated that in Italy the proportion of unused productive capacity in the 55-65 age range was almost 60% in 1996, one of the highest among the countries considered by the authors.[1] More recent results from the Survey of Health, Ageing and Retirement in Europe (Borsch-Supan et al., 2005) show that there is potentially huge unused labour capacity of healthy individuals in some countries. In Italy, for example, 50% of Italian healthy respondents above 55 were not in the labour force.[2]

There is now a lot of evidence explaining why this is happening and describing the incentives to leave the labour market embedded in the pension system. First, analysts who have recently examined cross-national differences in pension incentives generally find they have predictable and significant effects on labor force withdrawal (Gruber and Wise, 1999). Second, countries with early pension ages, generous income replacement, and heavy implicit taxes on earnings in old age tend to have earlier exit from the labor force than countries with pension systems that provide fewer work disincentives (Burtless, 2004).

The incentives to leave the labour market embedded in pension systems have been measured in various ways. The level of pension wealth, defined as the discounted present value of the lifetime flow of pension benefits, may be important but what is crucial is the change in pension wealth. The change in pension wealth measured between two consecutive periods is called one-year accrual. The literature on the "option value" of retirement, however, has shown that an even better measure of the incentive to retire should take into account all future wealth accruals.

[1] The countries with the lowest and highest unused productive capacity were Japan (22%) and Belgium (67%), respectively.

[2] In particular, 21.5% of good health individuals in the 50-60 age range are retired and not working; this percentage reaches 69.3% for individuals above 60 years.

Probably the most striking estimate of effects of the implicit social security tax on earned income was uncovered by a group of international economists, coordinated by Gruber and Wise (1999). The authors compared labour force withdrawal rates of older workers with the accrual from keeping working an additional year. Italy was one of the countries with the highest implicit taxes together with the highest withdrawal rates.

Of course this evidence, even if suggestive of a possible causal relationship, can not be interpreted as a causal effect of pension incentives on retirement. However, a number of works try to uncover exactly this type of relationship. Alessie and Belloni (2009), for example, use a quasi-reduced form of the option-value model on Italian data and find that financial incentives do in fact have a strong effect on retirement: the change in financial incentives experienced by workers when they become eligible for pension determines a 30 percentage points increase in their retirement probability.

In general, the great majority of the available evidence points in this direction [3]. This is quite surprising, in light of the well-documented issue of increasing risk of non-sustainability of pension systems around the world. Rather, one would probably expect the diffusion of incentives to induce older workers to delay retirement. This raise a question which is of course important for policy reasons: are incentives to postpone retirement as effective as those embedded in pension systems that induce workers to retire early?

In this paper, we will try to answer this question. We will evaluate the so called "super bonus" reform, implemented between 2004 and 2007 in Italy and involving financial incentives directed to older workers who decided to delay seniority retirement. A difference-in-differences strategy will allow us to interpret the results causally. Besides, we will exploit a new approach to diff-in-diffs estimation in probit models proposed by Blundell

[3] See, among the others, the series of papers on within countries, micro-econometric analysis coordinated by Gruber and Wise (2004).

et al. (2004) which accounts for the fact that the marginal effects on interaction terms cannot give a difference-in-differences measure analogous to the coefficients from a linear model. Finally, we will relate the change in participation to the change in the financial incentives to retire implied by the reform to get a taste of individuals' response to monetary incentives.

The structure of the paper is as follows. In section II, we briefly describe the Italian institutional setting and in particular the characteristics of the "super bonus" reform. In section III, we describe the data and provide some descriptive statistics on retirement in Italy and on the characteristics of our sample of workers. In section IV, we describe the estimation strategy and in section V we show our results. In Section VI we relate the change in participation to financial incentives changes. Section VII concludes.

2 The "Super Bonus" Reform

Italy underwent three major reforms of the social security system in the nineties, with the aim of increasing the financial sustainability of the system.[4] The main features of the reforms were an increase in the retirement age and minimum years of contributions for pension eligibility, the gradual passage from a defined benefit system towards a contribution based system, indexation of pension benefits to prices rather than to wages and the introduction of complementary social security. Besides, they abolished seniority pensions for all those who started working after 1995, where seniority pension in Italy consists in the possibility of early retirement for workers who possess a minimum number of years of contributions.

These three main reforms were followed by other minor measures up until the Maroni reform of 2004. The aim of this reform was twofold: first of all, increasing retirement age, mainly on voluntary basis, and second the development of complementary social security next to the usual public

[4]Riforma Amato in 1992, riforma Dini in 1995 and riforma Prodi in 1997.

social security system. It provided also for further increases in pensionable age and contribution requirements and was partly modified in 2007.

It should be mentioned that in 2011, given the persistence of the Italian financial problems, a new reform of the pension system (the so called "Fornero" reform) intervened in order to accelerate the effects of previous reforms. In particular, it introduced the contribution based system for everybody starting from 2012, further tightened age requirements for old age pension and the definitive abrogation of seniority pension [5].

The focus of this study will be on the so called "super bonus", which was indeed part of the 2004 reform, to study its effect on the decision to delay retirement. The bonus consisted in economic incentives, given for a limited period (2004-2007) to private workers who had reached the age and contribution requirements necessary for seniority pension. The bonus was directed to private sector workers who had reached seniority pension requirements in between October 2004 and the end of 2007 (but who had not reached requirements for old age pension yet[6]) and who chose to continue working. Crucially for our study, public workers were not entitled to the bonus. The age and contribution requirements in the reform years were the same for both public and private workers and for both men and women and amounted to either 57 years together with 35 years of contributions or 38/39 years of contributions independently from age. The effects of the bonus ceased either voluntarily if the worker decided to retire, or compulsorily by reaching old age pension requirements or with the end of 2007. After this date, the worker could decide to continue working with no incentives, thus going back to the pre-bonus compensation net of social security contributions.

The amount of the incentive to postpone retirement corresponded to the pension contributions that the employers normally pay to the social security system and that they had now to pay directly to the employees who

[5] Actually, seniority pension was substituted by early retirement, with similar characteristics but stronger requirements in terms of years of contributions.

[6] Old age pension requirements consisted of 65 years for men and 60 years for women.

applied for the bonus. The gross salary increase then amounted to the salary fraction normally devoted to social security contributions, that is 32.70% for most workers (33.70% on earnings above 37,884 Euro). Clearly, this implies that in absolute terms the incentive increased as the gross salary increased, but the percentage increase with respect to gross earnings was almost constant among different earners.

However, as the extra salary was untaxed and due to the progressivity of labour income taxes, the percentage increase with respect to net earnings was even bigger than the nominal contributions value as it increased more than proportionally with net earnings. An example will help visualizing the implications of the incentive (see Table 1): a worker earning a gross yearly salary of 20,000 Euro would earn a net salary of 15,153 Euro with no incentive and of 21,693 Euro with the incentive, while at the other extreme one individual earning a gross salary of 100,000 Euro would earn 56,813 Euro with no incentive and 90,134 Euro with the incentive, meaning that for this individual the increase exceeds 60% of the net salary, versus a 43% increase for the former worker.

As the worker was not contributing anymore to his own pension during the three years of incentives, the pension she was entitled to remained fixed to the level cumulated up until the moment she joined the super bonus (it was only increased by cost of living adjustments). Related to this, it should be also taken into account that every working year with no incentive determines a pension increase equal to 2% of last working years average salary, percentage that progressively decreases to 0.90% for salaries above the 37,884 Euro pensionable limit. This is an additional reason making the incentive more convenient for high-income workers.

3 Data and Descriptive Analysis

The data I will use to investigate the super bonus effects on retirement decisions are taken from the Bank of Italy Survey on Household Income

Table 1: The Size of the Incentive by Earnings

Gross Earnings	After Tax Earnings without Incentive	After Tax Earnings with Incentive	Difference	Difference as proportion of net earnings
20,000	15,153	21,693	6,540	43.16
30,000	20,752	30,562	9,810	47.27
40,000	26,295	39,396	13,101	49.82
50,000	31,358	47,829	16,471	52.53
60,000	36,557	56,398	19,841	54.27
70,000	41,921	65,132	23,211	55.37
80,000	47,165	73,746	26,581	56.36
100,000	56,813	90,134	33,321	58.65

Own calculations based on Ipsoa, 2004

and Wealth (SHIW), as to our knowledge this is the only dataset that includes information on both private and public workers and on the number of years of contributions. The SHIW started in the 1960s, it is realized approximately every two years and microdata are available starting from the 1977 survey. Up to 1987 the survey was conducted with time-independent samples (cross sections) of households but since 1989 part of the sample has comprised also households interviewed in previous surveys (panel households). The sample size in the most recent surveys comprises about 8000 households, corresponding to around 24000 individuals. The questionnaire focuses on perceived wellbeing, the situation of the household of origin, payment instruments and financial information.

In our empirical analysis, we will exploit data from 2002 to 2008, as we will be interested in comparing retirement behaviour during reform years and in pre-reform years. We said above that the reform took place in between October 2004 and the very end of 2007. However, because of the peculiar exit mechanism involved once one individual formally applies for retirement, we need to redefine reform and pre-reform years. In particular, individuals who reached pension requirements and ask to retire in a given quarter of the year have then to wait the first "exit window" to actually retire. This window falls two quarters after the time of the retirement request, thus the individuals we see retiring in 2005 are individuals who took their decision to retire at the end of 2004, and individuals who joined the reform up until the end of 2007 could retire only in 2008 [7]. For this reason, pooled data from 2002 and 2004 surveys will give us information on pre-reform behaviour, while data gathered from the 2006 and 2008 surveys will inform us on individuals' behaviour during the reform period.

Our sample of individuals will be made up of those who reached the age and contributions requirements necessary for seniority pension, and our outcome of interest will be the percentage of retired among these individuals. As we will rely on a difference-in-differences evaluation method, we will need to compare the behaviour of individuals not only through time (before and during the reform) but also between individuals who were affected by the reform (private workers) and individuals who were not affected (public workers).

Figure 1 shows the hazard rate of retirement (the percentage retired at a specific age conditional on not being retired at any prior age) averaged over pre-reform years (1998 to 2004). It is possible to notice a clear tendency towards retirement before old age (60 years for women and 65 years for men). This is also apparent from the red bars in the graph, representing sample medians. The average age of retirement is 58 years for women and 59 for men.

In Table 2 and 3 we show the results of two questions that appeared only in 2002 survey. Specifically, the questions asked to those retired before

[7] It must also be taken into account that the survey defines as retired those whose main condition in the year was retirement, thus presumably individuals who retired in the first semester of the year.

maximum retirement age (Table 2) and to those expecting to retire before maximum pensionable age (Table3) if they would have worked longer, or would work longer, under some conditions. These comprise economic incentives, part-time or more flexible work and the possibility of cumulating pension and earned income. We also split the results by sex and work sector (public, private or self-employed). The percentage of retired who claim they would have not worked longer is higher than the same percentage among workers who expect to retire early. However, for both categories economic incentives seem to be the most appealing condition for postponing retirement, followed by the possibility of cumulating pension and earned income and by part-time or more flexible work. Males are more prone to continue working under certain conditions than females. Finally, while economic incentives and part-time are preferred by private and public workers and retired relatively to self-employed, the possibility of cumulating pension and earned income seems relatively more appealing for the self-employed.

Figure 1: Hazard Rates, 1998-2004

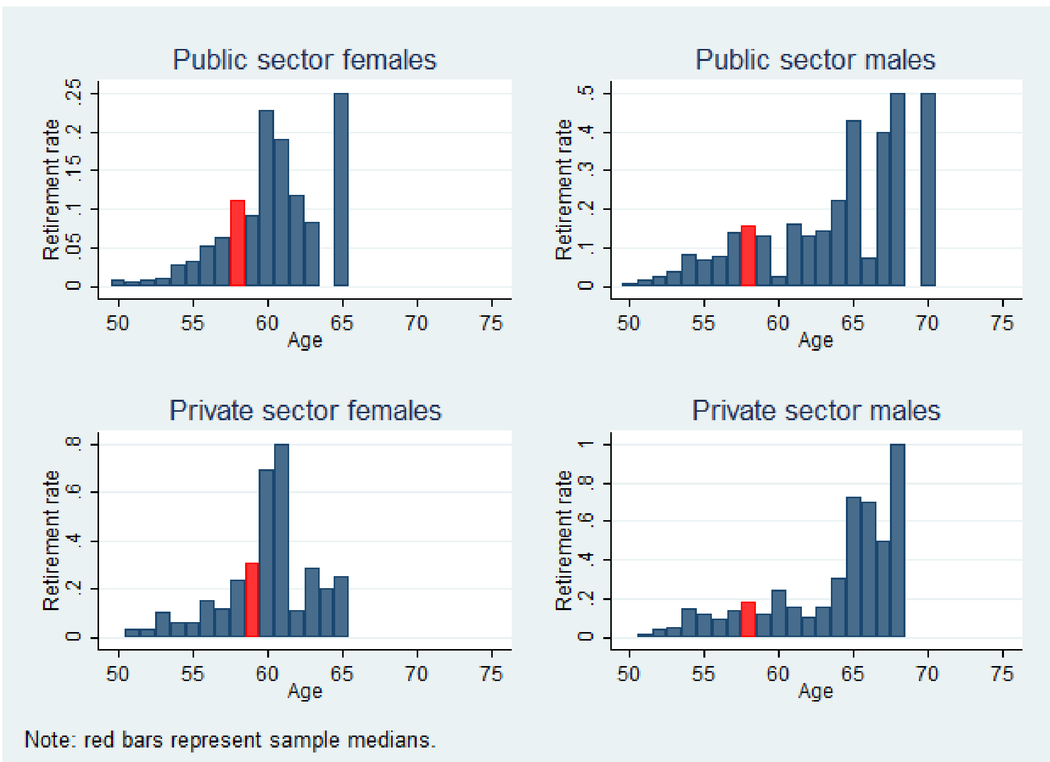


Table 2: Early Pensioners (retired before maximum retirement age): in what conditions would he\she have worked longer?

	All	Males	Females	Public	Private	Self-employed
Economic Incentives	8.03	9.75	6.21	9.91	8.48	4.76
Part-time or more flexible work	4.10	3.52	4.70	8.04	3.42	1.79
Possibility of cumulating pension and earned income	5.08	7.19	2.85	2.62	5.35	6.94
Other	4.00	4.96	5.04	5.98	4.70	4.76
None	78.34	75.14	81.70	74.77	78.47	81.75
Total	2442	1251	1191	535	1403	504

Table 4 reports descriptive statistics for our sample of individuals, separately for public and private workers (respectively, the control and the treatment groups) and pre- and post-reform periods (2002-2004 and 2006-2008 respectively). The share of women is higher in the public sector than in the private sector. The distribution of workers among educational levels seems quite different, with a higher share of individuals with at least high school diploma in the public sector than in the private one. Despite the small sample size, there seems to be a larger presence of public workers and pensioners in the Centre-South of Italy and of private workers and pensioners in the North of Italy. Both the age and the years of contributions are evenly distributed among sectors. The same seems true about marital status. As regards working categories, most private workers are blue collars (more than 60%), a smaller fraction is composed by office workers (around 25%) and the remaining consists of junior and senior manager or similar positions. As for public workers, the biggest share is composed of office workers (more than 40%), followed by school teachers, blue collars and managers. Finally, at the bottom of the table retirement

Table 3: If expect to retire before maximum pensionable age: in what conditions would he\she have worked longer?

	All	Males	Females	Public	Private	Self-employed
Economic Incentives	14.89	17.67	10.45	16.73	16.67	10.64
Part-time or more flexible work	6.30	6.71	5.65	6.08	8.06	4.26
Possibility of cumulating pension and earned income	10.33	11.31	8.76	9.51	8.06	14.18
Other	7.07	7.95	5.65	6.08	3.76	12.41
None	62.72	57.95	70.34	63.88	64.52	59.22
Total	920	566	354	263	372	282

percentages of public and private workers, before and after the reform, are presented. These show that while the average percentage of retired among public workers qualifying for seniority pension increases of something more than 5pps in the post-reform period, the same percentage decreases of around 5pps for private workers.

To better analyse the characteristics related to retirement, in Table 5 we show the results of a linear probability model regression for the probability of seniority retirement on the pre-reform sample of individuals. The probability of seniority retirement is 7pps higher for private than for public workers and, as expected, it is positively correlated with age. It is also negatively correlated with having at least high school diploma, while it is not correlated with sex, with being married or with having only children who left parental home. However, the probability of seniority retirement seems to be correlated with being male and not having children at home, as we see from the significance of the coefficient of the interaction of these two variables.

Table 4: Descriptive statistics

	Public pre-reform	Public post-reform	Private pre-reform	Private post-reform
Variable	Mean	Mean	Mean	Mean
Women	30.60	37.02	18.34	19.56
High education (high school or higher)	56.03	62.98	23.96	25.07
Centre-South	59.48	57.02	40.10	40.22
Age	56.36	57.65	55.86	56.46
Years of contributions	36.45	36.78	36.81	36.84
Blue collars	18.53	14.04	62.84	63.64
Office workers	43.97	41.28	25.92	24.24
School teachers	21.98	27.66	0.00	0.00
Junior manager/cadre	7.43	9.36	6.85	6.34
Manager, senior official, principal, headmaster, university teacher or magistrate	9.05	7.66	4.40	5.79
Married	83.62	82.13	86.55	88.98
Observations	232	235	409	363
Percentage retired	14.22	19.57	26.16	21.21

4 The Estimation Strategy

Under certain assumptions, we will be able to compare the behaviour of Italian workers regarding seniority pension before and after the reform, so to study the efficacy of the reform in delaying the retirement decision of private workers, as we would expect given the sizeable economic incentive involved. As we can clearly identify individuals who were affected by the reform (private workers) and individual who were not affected (public workers), we can rely on a difference-in-differences (DID) technique.

The classical linear DID is based on an additive structure for potential outcomes in the no-treatment state: in our case, this means assuming that in the absence of the super bonus, retirement decisions are determined by the sum of a time invariant effect specific to each category of workers (public/private) and a time effect capturing the common trend. The common trend assumption may be expressed as:

$$E[Y^0_{i2} - Y^0_{i1}|X, T] = E[Y^0_{i2} - Y^0_{i1}|X]$$

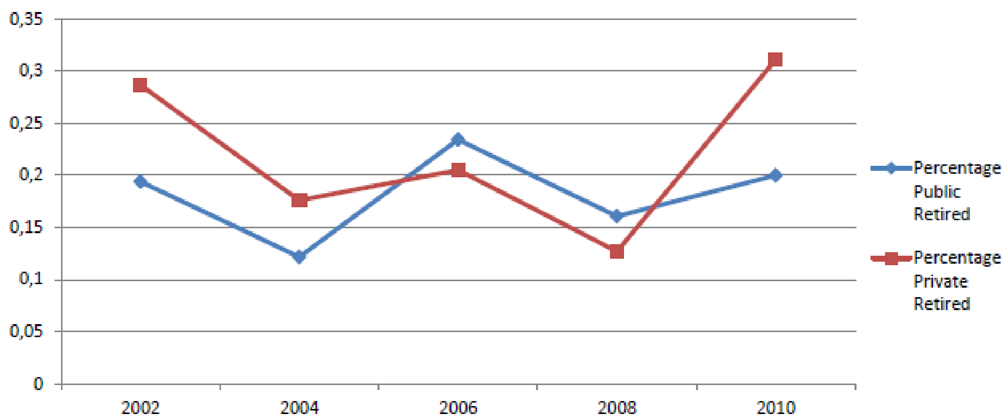
where Y^0_{it} is the outcome in the no-treatment case, i is the individual, t is time ($t = 2$ in the post-treatment period, $t = 1$ in the pre-treatment period), X is a set of covariates and T a treatment dummy. This assumption is of course non testable, but we can at least gain some insight by looking at seniority retirement percentages through time for public and private workers. These are shown in Figure 2 and 3. In Figure 2 we report seniority pension percentages for individuals at the contributions threshold while Figure 3 presents retirement percentages for individuals at or above contributions threshold. We present both because, as graphs themselves seem to suggest, we believe the effect to be stronger for individuals who just reached pension requirements than for those who already decided to continue working despite having reached pension requirements.

Table 5

Linear Probability Model for retirement, pre-reform period	
	(1)
VARIABLES	y2
priv	0.0742**
	(0.035)
age	0.3334***
	(0.102)
agesq	-0.0028***
	(0.001)
male	-0.0380
	(0.050)
married	0.0697
	(0.043)
childout	-0.0886
	(0.058)
Centre South	-0.0526
	(0.032)
diploma	-0.1178***
	(0.036)
male*childout	0.1536**
	(0.070)
Constant	-9.6800***
	(2.828)
Observations	641
R-squared	0.0809

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 2: Percentage retiring among workers qualifying for seniority pension at the age/contributions threshold



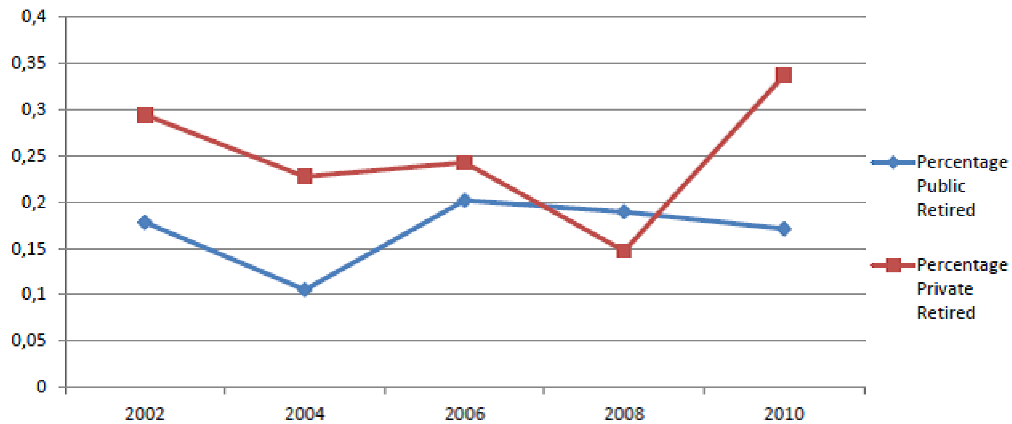
Although these graphs cannot be interpreted as evidence that the common trend assumption is true, they seem to support it.

Following Disney et al. (2010), we can write a general model of retirement decision of individual i at time t, where Y_{it}^* can be interpreted as a latent variable measuring the utility from retiring once seniority pension requirements have been reached. This utility depends on a set of individual characteristics like age, years of contributions, working sector, earnings, career history and on a vector of time dummies to capture trends over time:

$$Y_{it}^* = \beta' X_{it} + \tau' d_t + \epsilon_{it} \tag{1}$$

We do not observe Y_{it}^* but a dichotomous variable taking up value one if the individual decides to retire (when $Y_{it}^* \geq 0$) or value zero if the individual postponed retirement (when $Y_{it}^* \leq 0$), suggesting the use of a probit or logit model. As we are interested in measuring if and how much the percentage of those retiring changed in response to the super bonus differently for those affected by the reform and those who were not, we need

Figure 3: Percentage retiring among workers qualifying for seniority pension



to define both a treatment and a post-reform variable. The former will be a dummy variable T_i equal to one for treated individuals, that is private workers, and equal to zero for public workers. The latter will be a dummy variable P_t equal to one for post-treatment observations, that is those observed in years 2006 and 2008, and equal to zero for year 2002 and 2004 observations.

If we knew Y_{it}^*, we could estimate the effect of the reform by looking at the coefficient α of the interaction between treatment and post-reform dummies:

$$Y_{it}^* = \beta' X_{it} + \tau' d_t + \varphi T_i + \alpha T_i P_t + \epsilon_{it} \tag{2}$$

However, as the outcome we observe is a dichotomous variable, we know we are in the presence of a non-linear model. Despite this, our strategy will be first of all to estimate a linear probability model of the type:

$$Y_{it} = \beta' X_{it} + \gamma' P_t + \varphi T_i + \alpha T_i P_t + \epsilon_{it} \tag{3}$$

In fact, the linear probability model has often proved to be a very good approximation of probit and logit models and it usually works well for values of the independent variables that are near the averages in the sample (see Wooldridge, 2008). The reason why it may be sometimes problematic is that we may get predictions outside the unit interval, as a linear relationship is assumed to hold between the probability and the independent variables.

Probit and logit models, however, are not free from drawbacks as well when used in a DID framework. Here the issue is that the marginal effects calculated on interaction terms do not have the same interpretation as in linear models (Blundell et al., 2004; Disney et al., 2008)[8]. However, we can circumpass this problem by assuming that the common trend assumption holds for a transformation of the expectations (retirement probabilities), rather than for the expectations themselves. Specifically, it is safe to assume that the common trend assumption holds for the inverse of the probability function (that we will assume to be Normal, as in the probit model) or, in other words, for the index rather than for the probability (Blundell et al. 2004):

$$\begin{aligned}\Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=1, I_t=1)] - \Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=1, I_t=0)] = \\ \Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=0, I_t=1)] - \Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=0, I_t=0)]\end{aligned} \tag{4}$$

Given this, the impact of the reform can be evaluated as:

$$\begin{aligned}I(X) = & E(Y_{it}|X_{it}; L_{it}=1, I_t=1) - \Phi\{\Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=1, I_t=0)] + \\ & \Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=0, I_t=1)] - \Phi^{-1}[E(Y_{it}|X_{it}; L_{it}=0, I_t=0)]\}\end{aligned} \tag{5}$$

Blundell et al. (2004) suggest to implement this estimator of the effect of

[8]Besides, it is worth remembering that commonly used software packages like Stata do not give a true measure of interaction effects (Ai and Norton, 2003).

a policy by estimating four different probit regressions for each of the four groups defined by the interactions of time and treatment. Doing so, we get an estimate of the behavioural patterns of the four groups, included that triggered by the reform. Then, by predicting the outcome of the treated using the untreated behavioural equations, one can get an estimate of how the treated would have behaved without the treatment, conditional on their observable characteristics. Finally, plugging these estimates in Equation (5) one can get the estimate of the impact of the treatment on the treated. This procedure is less restrictive than the usual DID in that it allows for the effect of the treatment to depend on observable characteristics of individuals [9].

5 Empirical Results

Table 6 reports the results of our DID linear probability model specification. In column (1) we exploit the entire sample and show the most basic result. This is obtained by regressing the dichotomous variable for retirement (y2) on a set of dummy variables. The results indicate that, if assumptions are true, the super bonus reform determined a 10pps reduction in the proportion of private workers who decided to retire among those qualifying for retirement. In column (3), we show a specification which includes controls for age, age squared, schooling, area and marital status. We obtain a significant reduction in retirement probability of 9pps, in line with previous result.

In column (2) we show results of the same regression performed on the subsample consisting of individuals just at the age and/or contributions necessary for seniority pension. In fact, we expect the effect of the bonus to be stronger on these individuals who are relatively younger (or with less

[9] Blundell et al. (2004), however, underlines that "Despite the similarity to the linear case, the non-linear assumption stated above entails two additional restrictions on the nature of the error terms: only group-effects are allowed for and between groups homoscedasticity is required".

working years on the shoulders). Actually, what we are able to estimate is a lower bound of the effect on these individuals. This is due to the fact that, as workers joining the reform stop paying contributions, we are not able to separate individuals who just reached the contributions-only requirement of 38/39 contribution years from those who had already reached it. As our lower bound estimate (-11pps) is higher than the full-sample estimate, we can conclude that, as expected, the effect is actually stronger on relatively younger (by age or working years) workers.

Table 7 reports DID Probit results. They seem to be in line with LPM results and, if anything, they indicate an even bigger estimated impact of the super bonus (-12pps), even when including the controls (-11pps).

In column (4) of Table 6 we include a full set of interaction dummies for time, sector and economic condition. Specifically, we divide the sample in two groups of similar size: low-income workers (blue collar workers or blue collars retired as this is the category with the lowest average income), and high-income workers (the four remaining working categories as defined by the SHIW survey, broadly: office workers, school teachers, junior managers and managers). Probably due to the small sample we are dealing with, we are not able to get significant results for the interactions of interest (post*priv and post*priv*high), which nevertheless are sizeable in their magnitude and coherent with our previous results. In particular, we obtain that most of the effect of the reform is driven by low-income workers (-11pps), while it is much less effective for high-income workers (-4pps).

6 Elasticity of Participation

In previous section we showed that the reform had a sizeable and significant effect on retirement decisions. However, this result does not allow

Table 6

DID Linear Probability Model

VARIABLES	(1) y2	(2) y1	(3) y2	(4) y2
post	0.0535	0.0440	0.0263	0.0169
	(0.035)	(0.048)	(0.034)	(0.102)
priv	0.1194***	0.0777*	0.0945***	0.0205
	(0.032)	(0.040)	(0.033)	(0.072)
post*priv	-0.1030**	-0.1131*	-0.0898**	-0.1114
	(0.046)	(0.059)	(0.045)	(0.109)
age			0.3317***	
			(0.074)	
agesq			-0.0027***	
			(0.001)	
diploma			-0.0931***	
			(0.026)	
Centre South			-0.0398*	
			(0.024)	
married			0.0405	
			(0.031)	
high				-0.1394**
				(0.071)
post*high				0.0499
				(0.109)
priv*high				0.1000
				(0.084)
post*priv*high				0.0729
				(0.126)
Constant	0.1422***	0.1560***	-9.7543***	0.2558***
	(0.023)	(0.031)	(2.071)	(0.067)
Observations	1,239	765	1,239	1,239
R-squared	0.0106	0.0070	0.0624	0.0185

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Diff-in-Diff Probit

Predicted level after treatment	Estimated impact of the reform
(1) Full sample	
Predicted level after treatment	Estimated impact of the reform
21%	**-12ppt** **
	(0.0583)
(2) Threshold Individuals	
Predicted level after treatment	Estimated impact of the reform
16%	**-12ppt** *
	(0.0749)
(3) Controls	
Predicted level after treatment	Estimated impact of the reform
22%	**-11ppt** *
	(0.0674)
(4) Low-income Individuals	
Predicted level after treatment	Estimated impact of the reform
18%	**-11ppt**
	(0.1153)
(5) High-income Individuals	
Predicted level after treatment	Estimated impact of the reform
27%	**-7ppt**
	(0.0804)

to draw general conclusions on individuals' response to monetary incentives. If we want to infer predictions on workers' behaviour, we need to put this result in relation to the change in economic incentives implied by the reform.

Thus, in the spirit of Manoli and Weber (2014), we will try to provide an estimate of the extensive margin intertemporal labour supply elasticity. As Manoli and Weber, we shall also stress that this is a reduced-form elasticity that do not correspond to any of the structural parameters that can be derived in a theoretical framework. Besides, differently from Manoli and Weber, we exploit the shock created by a temporary reform, which makes the comparison with elasticities found studying expected and permanent reforms not trivial.

The main advantage of estimating the extensive margin elasticity in our setting is given by the quasi-experimental framework which allows identification of the causal effect of the bonus. However, the SHIW dataset does not allow a full reconstruction of workers' career histories, making the formulation of assumptions to derive individuals' social security wealth inevitably necessary.

In an option value framework, workers in each period evaluate the choice between continue working and retire by comparing current and future benefits from these two choices. For this reason, the incentive measure should be a forward-looking measure that takes into account the trade off between labour income and changes in social security wealth, net of taxes and benefits.

As in Manoli and Weber (2014), we construct the incentive of retiring measure as the implicit tax rate τ on gross annual earnings, defined such that after-tax income is equated to gross earnings net of all taxes and retirement benefits:

$$(1-\tau)y = y(1-\tau_{SS})(1-\tau_E) - b(1-\tau_b) + \Delta SSW \tag{6}$$

where τ_{SS} denotes social security contribution, τ_E denotes income taxes,

b denotes annual pension benefits, τ_b denotes taxes on pension benefits and ΔSSW denotes the change in social security wealth. $(1-\tau)$ is the net-of-tax rate.

Given the characteristics of the super-bonus reform, the implicit tax rate on gross earnings with the bonus is given by τ such that:

$$(1-\tau)y = y(1-\tau_{SS})(1-\tau_E) + y\tau_{SS} - b(1-\tau_b) \tag{7}$$

Thus, the change in the net-of-tax rate may be written as:

$$-\frac{\Delta(1-\tau)}{(1-\tau)} = \frac{y\tau_{SS} - \Delta SSW}{(1-\tau)} \tag{8}$$

as it involved the suspension of due contributions, as well as a freeze of social security wealth at the pre-reform level.

In order to obtain τ, we need to perform a series of operations. First of all, we need to gross up wages by using information on tax rates, deductions due to family composition and social security contributions. Then, in order to calculate social security wealth, we need to make a few assumptions on individuals' working history, in particular on the number of years individuals contributed to the social security system and on the earnings average of the last working years. Due to the cross-section nature of our data, we need to assume that individuals who are observed working did not experience unemployment spells and thus contributed continuously to social security. Finally, we estimate the growth rate of earnings as in Bottazzi et al. (2006) [10]. Social security wealth is then calculated by using the rules in force at the time of the reform.

The average over individuals implicit tax rate τ that we estimate amounts to almost 0.80, meaning that on average there is a huge incentive to postpone retirement of one year [11].

[10] Specifically, growth rates are obtained from a median regression of log-earnings of 50 to 65 years old individuals (SHIW, years 2002-2008) on sex, employment dummies and full interaction of age with a college dummy.

[11] However, it is possible that the incentive to postpone retirement of more years is

In Figure 4 we depict the relationship between the bonus (defined as $\Delta(1-\tau)y$) and earnings. The graph clearly shows that the bonus grows with earnings. Interestingly, it also shows that the bonus is actually negative for low-income workers. This result is surprising in light of the findings of previous section, where we have shown that the effect of the reform is driven by low-income workers.

We believe there are a number of potential explanations for this. First of all, it has been shown that some workers lack information to fully understand pension rules (Bottazzi et al., 2006), and this may well be related to education and income. Second, it is possible that low-income workers are credit constrained and see in the (negative) bonus an opportunity for borrowing against future pension. Third, it is possible that low- and high-income workers discount future differently and that low-income ones have a shorter life expectancy.

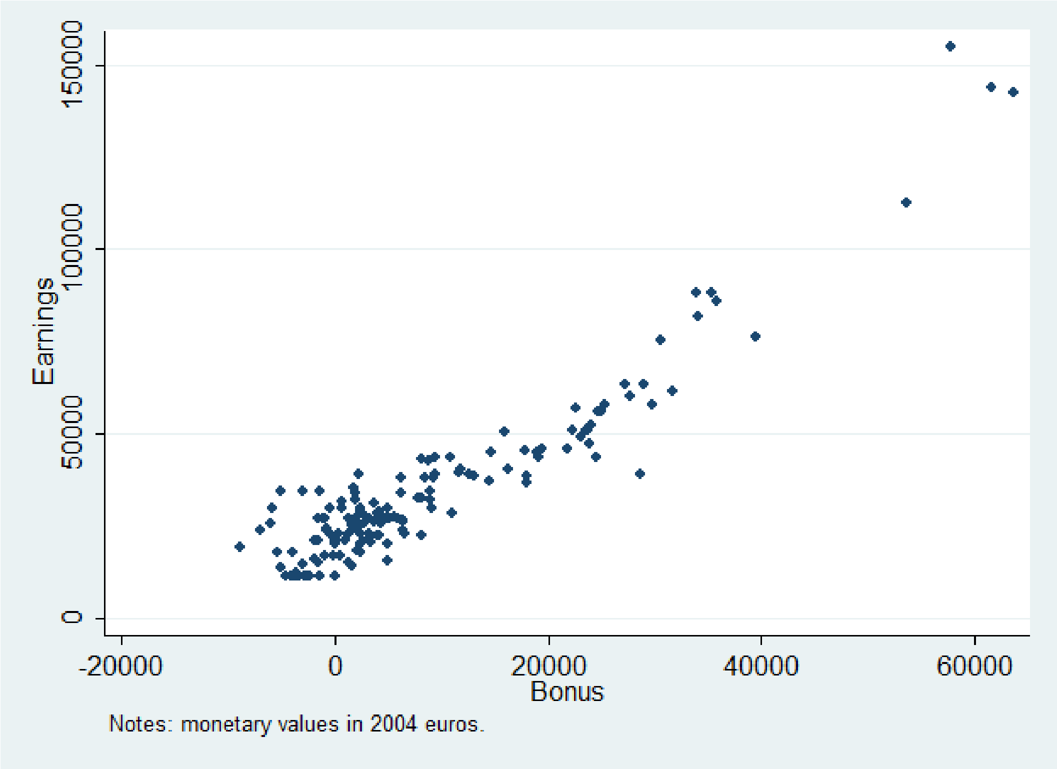
Finally, we can get a reduced-form participation elasticity to quantify how retirement decisions respond to a temporary financial incentive. This elasticity is obtained by comparing the situation with the bonus with the counterfactual situation of no bonus through the following formula:

$$\epsilon = -\frac{\Delta p/p}{\Delta(1-\tau)/(1-\tau)} \tag{9}$$

where p denote the probability of participation and Δp is the change in participation due to the reform that we estimated in previous paragraphs by exploiting the quasi-experiment characteristics of the reform. Given that the average retirement rate in the reform years was 21% and that we estimate the bonus to have caused a 12pps increase in participation (implying a counterfactual retirement rate equal to 33%), and given that we estimate the change in net-of-tax rate to be around 0.76, we finally get a

higher than the incentive of postponing retirement of just one year. As suggested in the option value theory of retirement, the incentive of retiring today should be compared with the incentive of retiring at any future date. This analysis, however, is beyond the scope of this work.

Figure 4: Size of the bonus with respect to earnings



participation elasticity $\epsilon = 0.48$. However, we have seen above that the effect of the reform was driven by low-income eligible workers. If we restrict our elasticity analysis to these individuals, we obtain a much higher elasticity $\epsilon = 1.2$. The reason for this is that low-income workers face both a lower bonus and lower implicit taxes on earnings.

7 Conclusion

Policymakers are often interested in policies that are able to delay retirement and/or increase labour income at older ages. Only very recently, however, taxes have been started to be thought as a possible instrument to do that. This interest, however, is relegated to the economic literature, as in practice younger and older individuals are treated in a similar manner. Social security contributions are an example of tax that could be used for this purpose; however, there is limited evidence of the effect of incentives on retirement behaviour.

In this paper, we want to contribute to this limited evidence by evaluating the effectiveness of the Italian so called super bonus reform, that provided economic incentives to older workers eligible for seniority pensions who decided to postpone retirement. As the reform was directed to private workers only, we are able to use public workers as counterfactual group. Thus, we can exploit the difference-in-differences approach and compare retirement rates of private and public workers before and after the reform to assess the effect of the reform.

A problem with interaction terms in probit models, however, is that they do not have the same straightforward interpretation as in linear models. Thus, we employ the estimation strategy proposed by Blundell et al. (2004), where the common trend assumption holds for the index rather than the probability.

Our results show that old workers responded to the incentives offered by the reform, as retirement rates among those eligible decreased by 9ppt-12ppt depending on the specification and method used. Results also suggest that the reform was particularly effective among the low-income workers, despite the incentives were disproportionately growing with earnings, maybe due to the predominance of substitution effect for these workers. If assumptions are correct, this means around 35% of those who would have retired chose not to because of the reform.

We also estimate the true size of the bonus, by taking into consideration the trade-off between current gain and changes in social security wealth, and estimate a participation elasticity of 0.48 for the overall eligible population, and 1.2 for low-income workers, who are the individuals who mainly responded to the incentive of the bonus.

This is a sizeable effect, but of course we cannot say anything on the efficiency of the reform from this partial analyses. In fact, it is possible that the cost to the social security system in terms of lost contributions from the workers who would have continued working even in the absence of reform exceeds the gain from those who delay retirement because of the reform. The fiscal cost of the super bonus, however, may have been offset also by other factors, like taxes paid on labour income and taxes generated by additional spending of those who postponed retirement.

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The Determinants of Retirement in Italy: an Option-Value Model Estimation with SHARE Data

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Abstract

This study estimates a structural reduced form of the "option value" model developed by Stock and Wise (1990) using Italian data from the Survey of Health, Ageing and Retirement in Europe (SHARE). These data offer great advantages over previous research (mainly based on administrative data), due to the heterogeneity of the sample, the number of individual and job characteristics and a retrospective panel which allows to derive the complete earning profiles of workers. Exploiting exogenous changes in social security wealth (SSW) results show a significant effect in the expected direction of SSW and of marginal incentives to retire. Results are robust even after controlling for individual heterogeneity and its correlation with financial incentives. Using detailed information on individuals, the results also highlights the importance of individual and job characteristics, which have been very little explored by this literature, as determinants of retirement. This suggests the potential of "tagging" in the design of social security incentives in order to reduce choice distortions and improve the overall efficiency of the system.

1 Introduction

The financial sustainability of pension systems around the world is jeopardised by increased longevity, lower fertility and low growth. This issue has generally been tackled with policies aimed at increasing average retirement age. These usually work through financial incentives and a large literature has supported the idea that financial incentives embedded in pension systems do in fact influence retirement choices. [1]

The analysis of retirement behavior based on micro-data in each of twelve countries coordinated by Gruber and Wise (2004) shows a sizeable effect of social security incentives on retirement. This result is pretty uniform across countries. Another recurrent empirical fact, which is not completely explained by financial incentives even in very sophisticated models, is the large peak in retirement registered at early and normal entitlement age. Among the possible explanations for this, social norms and liquidity constraints due to small private savings have been mentioned.

However, other explanations of retirement have been overlooked. It makes sense to think that other characteristics of workers may matter for retirement, and that the same incentives may have different effects on different individuals. These characteristics may be observable, like health, job quality and family features, or unobservable, like heterogeneous taste for work or productivity. [2]

This is important for policy and efficiency reasons. If unobserved characteristics are important, it is more difficult to define an optimal (from a social welfare point of view) age of retirement, and individuals - under the assumption they know their own characteristics, like taste for work or productivity, better than the social planner - should be left freer to choose when to retire. This could reduce choice distortions and improve effi-

[1] Specifically, age of retirement. But what about other choices?

[2] Also wrong expectations, differently distributed among workers depending on characteristics like for example education (Bottazzi, Jappelli, Padula 2006), may influence retirement patterns.

ciency, avoiding for example the losses in productivity that could arise either by keeping unproductive workers at work or by inducing workers who are still productive to retire.

At the same time, if individual characteristics unobserved by the policy maker are important, he may want to narrow the window of retirement possibilities, otherwise a system that would be actuarially fair in the case of no unobservables could result in being costly for the state.

Another argument that makes the analysis of older workers' response to incentives important is what is known as "tagging". In general, the impossibility for tax authorities to observe individuals' potential earning capacity and needs complicates tax design, in that taxes distort individuals' labour supply choices. This in turn determines social welfare losses from taxation. However, "the more the government can make the tax system contingent on observable factors closely related to abilities and need, the smaller the welfare losses from taxation" ("Tax by Design", The Mirrlees Review, 2011). So, by analysing which groups of individuals are more responsive to incentives, we are able to understand which characteristics could be used to adjust incentives and make the social security system more efficient. In general, age itself is an observable and immutable characteristic that could be linked to taxation if, as existing literature seems to suggest, people become more responsive to financial incentives around retirement age.

This paper estimates a structural reduced form of the Option Value model of retirement behaviour first developed by Stock and Wise (1990) by using the Italian data of the Survey of Health, Ageing and Retirement in Europe (SHARE), which offer great advantages over previous research. First, they allow to increase the heterogeneity of the sample by considering private, public and self-employed workers, while previous works have mainly used administrative data on private workers. Besides, they allow to control for a number of individual characteristics which are not available in an administrative dataset. Finally, the dataset includes a retrospective survey which allows to derive the complete earning profile of workers, which is fundamental for a correct evaluation of social security wealth.

After controlling for a number of significant individual and job characteristics, as well as for the potential correlation of incentives and unobserved individual effects, results suggest that workers are responsive to the financial incentives embedded in the Italian social security system. Results also suggest that unobserved heterogeneity is small and not significant, and it totally disappears when many individuals and job characteristics are controlled for, meaning that there is sufficient information to explain heterogeneity among individuals.

The paper is organized as follows. Section 2 presents a brief description of existing literature on the option value model. Section 3 briefly introduces the evolution of the Italian social security system institutional features. Section 4 describes the option value model and its reduced form estimation. In section 5 the data and the strategies followed in the empirical analysis are presented. In section 6 the social security wealth and marginal incentives measures are defined and presented. Section 7 shows how control variables are constructed and describes them. In section 8, results are presented and discussed. Section 9 concludes.

2 Related Literature

The option value model was developed by Stock and Wise in 1990. In its original form, this was a structural model of retirement with the aim of capturing the forward-looking behaviour of individuals who compare the value of retiring today with the value of retiring at any future date. Since then, however, most of the applications of the option value model have not provided structural estimates of the parameters of the model, but rather have developed reduced form estimations of the model.

This empirical literature has probably received the most attention with a number of papers, collected by Gruber and Wise (2004), that estimate reduced forms of the option value model to data of 12 countries using a common econometric methodology to allow comparability among them. In general, the results show a strong causal effect of social security program retirement incentives on labour force participation and a large magnitude of these effects. However, evidence on Italy (Brugiavini and Peracchi, 2004) seems much weaker. The authors use a random sample of administrative records from INPS (Italian Social Security Institute) on private sector employees to estimate a probit model with financial incentives and other explanatory variables. Seniority, a crucial element of financial incentives of retirement, is not known and imputed from the Bank of Italy's Survey of Household Income and Wealth (SHIW). Their results are mixed, and sometimes present unexpected signs or non-significance of the financial incentives measures.

Previous results were not satisfactory either (see e.g. Ranzani 2006, Brugiavini and Peracchi, 2003). They relied on the SHIW dataset, which does not allow to reconstruct the entire working history of individuals, which matters for seniority and earnings history, key elements of retirement incentives calculation. Besides, none of the above mentioned works exploited the panel data structure of data nor tried to account for heterogeneity of individuals and endogeneity of the financial incentives measures.

The only exception is Alessie and Belloni (2009), who use a correlated random effect approach to address this issues. This is also the first work able to find significant results in the expected direction. The authors claim that the reason previous works were not able to find equally convincing results lies in the quality of data available and in the number of assumptions needed to construct financial measures. However, the use of administrative data on private workers (the Working History Italian Panel (WHIP), and an additional pension file that provides information on seniority) noticeably reduces the possibility to control for individual characteristics and casts doubts on the causal interpretation of results.

3 Italian Institutional Framework

Italy underwent many reforms and smaller changes of the social security system in the last couple of decades. Before the reforms, the social security system was a pay-as-you-go system based on a defined benefit mechanism. The main reason for this bloom of reforms was the clear financial non-sustainability of the social security system before the nineties, mainly due to the generosity of pensions, the possibility of early retirement and low pensionable ages. Besides, it was considered unfair from a redistributive point of view because of the different treatment of different categories of workers and because the form of actuarial adjustment with respect to the choice of the age of retirement

Three major reforms were implemented in 1992, 1995 and 1997. The main provisions of the 1992 reform consisted in the increase of pensionable age, to be implemented gradually, from 60 to 65 years for men and from 55 to 60 years for women for private workers (public workers and self-employed pensionable age were already 65 and 60 for males and females respectively). The minimum number of years of contributions was gradually increased as well from 15 to 20 years. The number of working years used to calculate the pensionable wage in the defined benefit formula increased up to the last ten or to all working years, depending on seniority: the more wage profiles were upward sloping, the more this change penalised workers. Finally, indexation of pension benefits changed from wage-based to price-based.

The 1995 reform was more radical as it changed the social security system from defined benefit to "notional defined contribution", with the aim of increasing the link between contributions actually paid and benefits received[3]. However, workers were divided into three categories depending

[3]Notional defined contribution systems mimic the characteristics of funded defined

on seniority, and the new mechanism only applied fully to the youngest workers (those who started working after 1995) and partially to middle-aged workers (those with less than 18 years of contributions by the end of 1995). The reform also marked the beginning of complementary pension systems.

The 1997 reform further tightened requirements for seniority pension and also reduced the heterogeneity of treatments between different categories of workers. Age requirements were again tightened by 2004 and 2007 laws; the latter also changed the coefficients used in the contribution-based formula. A 2010 law linked the age of retirement of workers to the gain in life expectancy at age 65, starting from 2015.

The final step of this long period of reforms is represented by the 2011 "Fornero" reform, which is not analysed in the paper as the panel dataset covers years up to 2011. [4]. This reform was induced by the financial crisis and new concerns about the sustainability of the social security system. It accelerated the transition to the notional defined contribution system by applying the contribution-based formula to all workers, independently from seniority, for the contributions accrued after 2011. Besides, it increased old-age pension to reach equality of treatment between males and females, as well as minimum contributions requirements for old-age pension and minimum contributions and age requirements for early retirement. Finally, the reform provides for disincentives for those who claim early retirement before 62 and some flexibility for those retiring between the age of 62 and 70.

contribution systems but are actually not funded.

[4] However, when new panel data become available, it would be interesting to extend the analysis and look also at the effect of this reform.

4 Theoretical Framework

The approach followed in the paper requires an introduction to the "Option-Value" model developed by Stock and Wise (1990). This model has typically been contrasted to dynamic programming models, and in particular to life-cycle models, which are able to better represent the complexity of reality, but with the drawback of computational complexity.

Nevertheless, it has been shown (see Belloni (2008) for a review) that the option value model provides predictive validity in line with that of dynamic programming models, thus it is also claimed that a real trade-off between the two does not exist, as the option value model combines computational tractability with predictive validity.

Actually, this paper will adopt a strategy involving a reduced-form version of the original option value model developed by Stock and Wise (1990). While in the structural model a maximum likelihood method is used to estimate the parameters of a value function that yield the best fit to data, in the reduced-form the expected gain from postponing retirement is used as a regressor in a retirement probability model. This has the advantage of being easy to implement, which explains the recent popularity of this approach. On the contrary, attempts to estimate the structural model are few and have sometimes been unable to identify all the parameters, or have found implausible estimates and bad fit (Alessie and Belloni, 2013) [5].

In the following, the original option value model will be introduced. Then, the reduced-form version will be presented and it will be shown how, under certain assumptions, this is equivalent to the original Stock and Wise's option value.

[5] For example, Samwick (1998) writes: "In my attempts to estimate the parameters of the option value model on the SCF sample, the parameters for the value of leisure in retirement (k) and the discount rate (δ) could not be simultaneously identified with any precision". Alessie and Belloni (2013) represents a recent exception.

4.1 The option value model

Stock and Wise (1990) developed an "option value" model of retirement that has the advantage of taking into account both current and future retirement wealth accruals, differently from the one-year accrual that only measures the change in social security benefits from working one additional year. The model starts with an indirect utility function:

$$V_t(R) = \sum_{s=t}^{R-1} \beta^{s-t} \pi(s|t) E_t(y_s^{\gamma}) + \sum_{s=R}^{T} \beta^{s-t} \pi(s|t) E_t[kB_s(R)^{\gamma}] \tag{1}$$

In this expression, β is the discount factor, γ is the parameter of relative risk aversion, $\pi(s|t)$ is the survival probability to year s of someone of age a in year t, and the expectation $E_t(\cdot)$ denotes the expected value of future income $\{y_s\}$ and retirement benefit streams $\{B_s(R)\}$. The factor k expresses the idea that one income unit received while retired is worth more than one income unit received while working; this may be interpreted as value of leisure or distaste for working and is expected to be larger than one. An individual chooses the optimal date of retirement R^* that maximises the right-hand side of (1). Then the option value is defined as the gain in indirect utility deriving from retiring at the optimal date rather than at the current date t:

$$\begin{aligned} OV_t(R^*) =& V_t(R^*) - V_t(t) \\ =& \sum_{s=t}^{R^*-1} \beta^{s-t} \pi(s|t) E_t(y_s^{\gamma}) + \sum_{s=R*}^{T} \beta^{s-t} \pi(s|t) E_t[kB_s(R^*)^{\gamma}] \\ & - \sum_{s=t}^{T} \beta^{s-t} \pi(s|t) E_t[kB_s(t)]^{\gamma}] \end{aligned} \tag{2}$$

The first term represents the present discounted value of income received from current date t and the date of retirement R^*. The second term represents the utility of retirement benefits received between the date of retirement and the date of death T. The option value is then obtained by subtracting the present discounted value of the benefits you would receive from current date to death if you retired at current date. This way, one can measure the excess of indirect utility of retiring at R^* instead of t. As long as the option value is positive, the worker will continue to work.

The authors' estimation strategy was a maximum likelihood estimation of the parameters of the above measure, allowing for serial dependence and age-related heteroskedasticity in the error terms.

4.2 Reduced form version of the option value model

As an alternative, the option value of retirement can be assessed imposing parameter values and using it as an explanatory variable in a reduced form version model of retirement, together with SSW in level.

SSW is supposed to capture an income effect: the expectation is that, all else equal, workers with greater SSW are more likely to retire [6]. The incentive measure variables (the option value, but we will see that also others may be exploited) capture instead the substitution effect on retirement decision from foregone future labour income. Thus, a negative coefficient attached to the incentive measure means that the greater the foregone opportunities, the less likely workers are to retire.

The Option Value is not the only marginal incentives measure that has been exploited in the literature. Actually, other measures are most commonly used which, under certain assumptions, may be shown to be equivalent to the OV. In the following, these measure will be briefly introduced:

- **Peak value**: Coile and Gruber (2000), following Stock and Wise's insight that a one-year forward measure may be misleading, developed a measure called "peak-value" which has the characteristic of

[6] Gruber and Wise (2004) underline that:"In principle, total wealth should be controlled for, but in most countries the data do not provide measures of other forms of wealth".

being more forward looking than the accrual. "This is the value of continuing to work until the future year when SSW is maximized, or the difference between the expected PDV of SSW at its highest possible value in the future, and the expected PDV of SSW if you retire this year. So this is like the typical accrual concept, except that the individual looks forward to the optimal year, rather than just to next year" (Coile and Gruber, 2000). They also normalize it by the present discounted value of wages to weight the value of reaching the year of maximal SSW relative to earnings expected in that period.

Samwick (2001, in Coile and Gruber) shows that the peak-value measure is actually equivalent to the option value under three parameter restrictions. The peak value is given by:

$$
\begin{aligned}
PKV_t(R^*) = & \sum_{s=R^*}^{T} \beta^{s-t} \pi(s|t) E_t[B_s(R^*)] \\
& - \sum_{s=t}^{T} \beta^{s-t} \pi(s|t) E_t[B_s(t)]
\end{aligned}
\tag{3}
$$

The first restriction is that the first term present in the option value (the present discounted value of future earnings) is dropped. However, this can be simply accounted for by adding the present value of earnings as a regressor in the reduced-form model, together with the peak value.

The second restriction is that there is no disutility of working relative to being retired ($k = 1$). As Samwick notices: "...peak value compares income flows only during retirement, so this assumption is without loss of generality". Besides, "...a value of k can be estimated in a simple regression as long as the first term from the option value calculation (the present value of future earnings) is included as a regressor along with peak value. The value of k would be the ratio of the coefficient on the peak value term to the coefficient on the earnings term" (Samwick, 2001).

The third restriction is that workers are indifferent to whether income and retirement benefit payments vary across years ($\gamma = 1$). Samwick notices that since the peak value calculation pertains only to income received in retirement, the choice of γ is less important [7].

What instead is different between the two concepts is the optimal retirement age R^* they deliver, due to the absence in the peak value of the present value of future earnings.

- **Accrual**: is the euro change in SSW from previous year (Coile, Gruber 2001). The appropriateness of this measure was called into question in the seminal work by Stock and Wise (1990) who noticed that a one-year forward measure may no be an adequate measure of private pensions as they often present high incentives to retire at specific ages, which implies high incentives or disincentives for retirement in future years. However, it may still be useful as workers may be not completely forward-looking or may not be willing to postpone retirement of too many years. For this reason, it is common in the literature to present the accrual together with the option value or other incentive measures that are closer to the concept of option value.

5 Empirical Strategy

5.1 Dataset

We will exploit the Survey of Health, Ageing and Retirement in Europe (SHARE). This is a cross-national panel database of micro data on health,

[7] Even if it is advisable to experiment with different values of $\gamma = 1$ to study the sensitivity of the estimates to income smoothness.

socio-economic status and social and family networks of more than 85,000 individuals from 19 European countries aged 50 or over. It consists of 3 waves (2004, 2006/07, 2010) plus SHARELIFE (2008/09) that reconstructs individuals life history and events.

This dataset presents many advantages for the study of retirement decisions with respect to other datasets used in previous literature, and contains information which is particularly useful given the characteristics of the Italian social security legislation.

First of all, it is a rich dataset in terms of individual, household and job characteristics. As will be made clearer later, a rich set of controls mitigate the endogeneity problem related to financial variables. Thus, it will be also possible to figure out if the effect of financial variables is still present once variables that may be correlated both with the choice of retirement and with financial incentives are controlled for. Besides in this work, differently from previous literature, we are explicitly interested in evaluating how the effect of financial variables on retirement compares with other determinants of retirement.

At least as importantly, the survey contains information on all type of workers (private, public and self-employed). As will be made clearer later, this is important from an empirical point of view because these workers are subject to different social security rules, and their presence allows to considerably increase the variability of the financial incentives measures.

Finally, a fundamental advantage is that the third wave (2008/2009) of SHARE, called SHARELIFE, focusses on individual's life histories, thus having the characteristics of a retrospective panel. Specifically, it contains retrospective information on children, partner, housing, childhood conditions, work history, work quality, financial history, health history and on general life. The work history section contains information on the start and end date of each spell of work, together with information on the first salary or income of each spell, first and final salary or income of the main work spell and, importantly, if contributions to the social security system were paid in that spell.

This is in contrast with previous literature that studied retirement in Italy. The first papers appeared used data from the Bank of Italy's Survey on Household Income and Wealth (SHIW) [8]. This dataset has a number of drawbacks in that it is not possible to reconstruct individuals' wage history without making strong assumptions on their career paths and on wage growth. Besides, seniority is asked to individuals only starting since 1995 and there is no information about the contributions paid in each spell of work. Finally, despite the availability of many individuals characteristics, they have not been exploited in a model together with the financial incentives measures.

The most recent works appeared (Brugiavini and Peracchi, 2004; Alessie and Belloni, 2009) instead use either the "O1M" or the "Working History Italian Panel" (WHIP) datasets, which are random sample of administrative data extracted from the National Institute of Social Security (INPS) archives. The advantage of these datasets are mainly the bigger sample size and, being administrative and not self-reported data, the precision with which wages are measured. Besides, Alessie and Belloni (2009) also complement the dataset with another INPS file containing information on seniority, which was not observed with precision in previous works, and show how the quality of this variable is important to get precise social security wealth (SSW) and marginal incentives (MI) measures.

However, these data are still problematic in many respects. First, they contain only basic information on workers' and jobs characteristics (gender, age, region of birth and industry). Second, the dataset covers only private workers, not public nor self-employed. As these workers are subject to different social security rules, the variability of incentives measures is greatly reduced. Besides, even if seniority is observed, the other fundamental element for the calculation of benefits, that is wage profile, must be estimated. Finally, seniority is available only if workers already retired

[8] Spataro 2005; Colombino 2003; Miniaci 1998

and is not available if they had interrupted careers or if they contributed for some periods to other schemes, like the one administered by the public sector. In conclusion, this selection makes the dataset not representative of the Italian working population.

The drawback is that it is a relatively small sample, so we cannot solve the problem of sample selection, for example, by looking at those younger than 50 in the first year and follow them towards their old age. However, it must be underlined that a number of authors simply make explicit that the analysis is conditional on being in the sample (see for example Stock and Wise, 1990 and Coile and Gruber, 2001).

5.2 Identification Issues

As put well by Gruber and Wise (2004), a crucial issue in the analysis of retirement "is identification - that is, determination of the separate effect of each variable on retirement, as distinct from each of the other variables". In fact, to determine the effect of social security or pension incentives on retirement we need to be able to separate the pure effect of economic incentives from the other determinants of SSW, like for example age and income. Controlling for these other characteristics is important if they are also independently correlated with retirement choices, otherwise we might be capturing their effect instead.

However, the authors also notice that there might be a trade-off to take into account when controlling for these other variables, as their estimated effect may capture part of the effect pertaining to financial incentives, rather than individual heterogeneity, thus leading to an underestimation of the incentives themselves. For this reason, exogenous variation of social security wealth is important for identification. Italy represents a particularly well-suited setting in this respect, given the various reforms and minor changes that affected social security in the last twenty and more years that were presented above.

Identification, as first observed by Hurd (1990) and then reiterated by

Coile and Gruber (2001), may also be reached "if there are significant non-linearities and interactions otherwise (likely) uncorrelated with retirement that primarily identify the impact of these incentive measures, one might feel more confident about retirement estimates" (Coile and Gruber, 2001). In this paper, the first year used in the panel will be 1993. Thus, all pre-1993 reforms (most noticeably, 1992 reform) will not be directly taken into account. However, these reforms differently affected private, public and self-employed workers, in ways that are exogenous to individual heterogeneity. As long as individuals do not change job as a consequence of these reforms, also this dimension of variation may be exploited [9].

Despite previous literature had been stressing the need for exogenous variation of SSW, not much effort has been done to address the problem of endogeneity that may arise from omitting other non-financial determinants of retirement and from the presence of individual heterogeneity.

As regards the second aspect, some of the most recent and cited works on reduced forms of the option value model were collected by Gruber and Wise (2004). Each of them studies retirement in 12 different countries using a common econometric methodology to allow comparability among results. However, despite the availability of panel data, all these works estimated pooled probit models which ignore the presence of individual heterogeneity and the endogeneity issues that this may rise. Taste for work is the typical example of unobserved individual characteristic that may determine retirement and be related with SSW.

Alessie and Belloni (2009) are the first to address this problem by using a Correlated Random Effect model, but unfortunately the impossibility to control for individual and job characteristics (due to the administrative nature of their data) makes this approach not convincing either. In the following paragraph it will be shown how this paper deals with endogeneity.

[9] Both Brugiavini and Peracchi (2004) and Alessie and Belloni (2009) show that these job transitions in old age are very rare.

5.3 The Retirement Model

The binary nature of the outcome variable complicates the treatment of individual heterogeneity. Given these difficulties, different econometric models and specifications will be estimated and compared. In particular, we will follow Wooldridge (2010) in the way nonlinear panel data analysis is conducted. In general, no method is strictly preferable to another: it really depends on the assumptions one is willing to make and the structure one is willing to impose. However, the analysis will concentrate on models which, even if will not always allow to identify parameters, will always allow to identify at least partial effects (PE) or average partial effects (APE), which ultimately should be the quantities of interest.

Retirement is a binary choice and, as previous literature, we assume it is an absorbing state. This is coherent with the data as transitions from retirement back to work are virtually non-existent [10]. In its most general form, retirement probability can be expressed as:

$$p(\boldsymbol{x}_t, c) = P(y_{it}|\boldsymbol{x}_{it} = \boldsymbol{x}_t, c_i = c) \tag{4}$$

where y_{it} is a binary variable equal to 1 if the individual is retired, $\boldsymbol{x}_{it}$ is a set of observed explanatory variables and c_i is heterogeneity.

The analysis will start with a linear model, specifically an unobserved effects linear probability model estimated by fixed effect [11]. A linear model may deliver a poor approximation of partial effects, but this is the only way unobserved heterogeneity may be eliminated. Conditional MLE (used to eliminate heterogeneity) can in fact be applied only in special cases and does not allow to identify PEs nor APEs, while models where the fixed effects are treated as parameters to be estimated suffers from an incidental parameters problem which leads to inconsistent estimation. Of course, a FE model will drop also all time invariant explanatory variables.

[10] See Brugiavini and Peracchi (2004) and Alessie and Belloni (2009).

[11] A robust variance matrix estimator is necessary to account for serial correlation across t.

Another solution is the Unobserved Effects Probit model. The assumptions of this model are:

1. The model is:

$$P(y_{it} = 1|\boldsymbol{x}_{it}, c_i) = \Phi(\boldsymbol{x}_{it}\boldsymbol{\beta} + c_i), \quad t = 1, ..., T \tag{5}$$

   where Φ is the standard normal c.d.f.

2. Strict exogeneity conditional on c_i:

$$P(y_{it} = 1|\boldsymbol{x}_{i1}, ..., \boldsymbol{x}_{iT}, c_i) = P(y_{it} = 1|\boldsymbol{x}_{it}, c_i), \quad t = 1, ..., T \tag{6}$$

3.

$$c_i|\boldsymbol{x}_i \sim Normal(0, \sigma_c^2) \tag{7}$$

If one is not willing to make other assumptions (in particular conditional independence), one can consistently estimate APEs through a pooled probit model. Under assumptions 1, 2 and 3:

$$P(y_{it} = 1|\boldsymbol{x}_i) = P(y_{it} = 1|\boldsymbol{x}_{it}) = \Phi(\boldsymbol{x}_{it}\boldsymbol{\beta}_c) \tag{8}$$

where $\boldsymbol{\beta}_c = \boldsymbol{\beta}/(1 + \sigma_c^2)^{1/2}$ is a scaled coefficient which is sufficient to estimate the APE. This is clear from the APE formula for a continuous variable x_{tj}:

$$APE = [\beta_j/(1 + \sigma_c^2)^{1/2}]\phi[\boldsymbol{x}_t\boldsymbol{\beta}/(1 + \sigma_c^2)^{1/2})] \tag{9}$$

APEs are identified more often than PEs; in fact, the scaled coefficient is not sufficient to estimate PEs, for which we need the coefficients:

$$PE = \beta_j\phi(\boldsymbol{x}_t\boldsymbol{\beta}) \tag{10}$$

A robust variance matrix estimator is necessary to account for serial correlation across t.

If one is willing to add a fourth assumption:

4. $y_{i1}, ..., y_{iT}$ are independent conditional on $x_i = (x_{i1}, ..., x_{iT})$ and c_i.

then the parameters $\boldsymbol{\beta}$ and σ_c^2 can be identified through a conditional maximum likelihood approach. The likelihood function for each i may be recovered by integrating out c_i:

$$\begin{aligned} \mathcal{L}_i(\boldsymbol{\theta}|y_i, \boldsymbol{x}_i) &= f(y_1, ..., y_T|\boldsymbol{x}_i; \boldsymbol{\theta}) = \\ &= \int_{-\infty}^{+\infty} \prod_{t=1}^{T} \Phi(\boldsymbol{x}_t\boldsymbol{\beta} + c)^{y_t}[1 - \Phi(\boldsymbol{x}_t\boldsymbol{\beta} + c)]^{1-y_t}(\frac{1}{\sigma_c})\phi(\frac{c}{\sigma_c})dc \end{aligned} \tag{11}$$

Then, the log-likelihood for the entire sample may be maximised with respect to $\boldsymbol{\beta}$ and σ_c^2 to get consistent estimators. It is then possible to compare pooled MLE and MLE probit coefficients by multiplying MLE coefficients for the scale factor $\frac{1}{(1+\sigma_c^2)^{1/2}}$.

The Unobserved Effects Probit model described above does not allow for any correlation between unobserved heterogeneity and covariates. This would for example exclude the possibility for taste for work to be correlated with income and (consequently) social security wealth. As this may seem unrealistic, a Correlated Random Effects model has been proposed to relax this assumption. In this model, assumption 3 is changed to explicitly allow for correlation between c_i and some elements of $\boldsymbol{x}_{it}$. As in Alessie and Belloni (2009), financial incentives in the first year in which each worker is observed may be used to model the heterogeneity c_i. Of course, other functions of $\boldsymbol{x}_{it}$ may be used, like the average $\bar{\boldsymbol{x}}_i$ or its sample variances or covariances (see Mundlak, 1978; Chamberlain, 1980; Altonji and Matzkin, 2005). Thus, assumption 3 is changed to:

$$c_i|x_i \sim Normal(\psi + \boldsymbol{\omega}_{i1}\xi, \sigma_a^2) \tag{12}$$

where ω_{i1} is the first time observation of time-varying financial variables (in particular, SSW and MI), σ_a^2 is the variance of a_i in the equation $c_i = \psi + \omega_{i1}\xi + a_i$ and $a_i|x_i \sim Normal(0, \sigma_a^2)$.

The model above can be also seen as a latent variable model of the individuals' utility from retirement:

$$y^* = \psi + x_{it}\beta + \bar{x}_i\xi + a_i + e_{it} \tag{13}$$

where e_{it} are independent $Normal(0,1)$ and $a_i|x_i \sim Normal(0, \sigma_a^2)$, which now looks like a traditional random effects probit model. This can be implemented by simply adding the first time observation of financial variables to the regressors in the equation.

The CRE model allows to include time dummies and time-constant control variables, as long as we assume their coefficient in ξ is zero, otherwise their effect can not be distinguished from that of unobserved heterogeneity. As mentioned above, Alessie and Belloni (2009) are the first to use a CRE approach in a reduced form of the option value model. However, even if one believes that the individual effect is only correlated to financial variables in a retirement model, the lack of information on fundamental characteristics such as health, marital status or other non-social security wealth, likely makes their results subject to omitted variable biases.

As a final note, it should be mentioned that while in linear models one can deal with serial dependence of idiosyncratic error with robust standard error, in nonlinear models estimated by MLE conditional independence is necessary for consistency (Wooldridge, 2010).

6 Social Security Wealth

6.1 SSW Definition

In this part, notation is borrowed from Alessie and Belloni (2009), although with some noticeable differences. The most important are that, due to the different time span considered, different reforms will be considered.

Besides, given that SHARE data allow to know not only seniority, but also in which spells of work contributions were paid, some workers fall into the pro-rata system, where benefits are computed in part with an earnings-related system and in part with a contribution-related system. Finally, we don't need to make assumptions on marital status and on spouses as also spouses are observed in the data.

As previous literature, SSW is defined as the expected present discounted value of benefits, from which contributions that a worker would pay to the social security system in case of continued work are subtracted [12].

Social security wealth may then be calculated as:

$$SSW_{a,R} = \begin{cases} \sum\limits_{s=R+1}^{\Omega} \rho(s) B_R(s) & \text{if } R = a \\ \sum\limits_{s=R+1}^{\Omega} \rho(s) B_R(s) - \sum\limits_{s=a+1}^{R} \rho'(s) c(s) & \text{if } R > a \end{cases} \tag{14}$$

where:

$$\rho(s) = \beta^{s-a} \pi(s|a)[1 + \lambda 0.6 \beta q_{s+1} \sum_{\tau=s+1}^{\Omega} \pi(\tau - \epsilon | s + 1 - \epsilon) \beta^{\tau-s-1}] \tag{15}$$

$$\rho'(s) = \beta^{s-a} \pi(s|a) \tag{16}$$

$\rho'(s)$ is the discount factor referred to future contribution payments composed by the discount factor $\beta = 0.97$ (3% discount rate) and the survival probability (by gender) conditional to age a [13]. $\rho(s)$ is a discount factor that takes into account survivor's benefits: in case the of death of the pension recipient, the survivor spouse is entitled to 60 per cent of the

[12] See for example Borsch-Supan and Schnabel (1999), Blanchet and Pelé (1999) and Diamond and Gruber (1999)

[13] Conditional survival probabilities are derived from ISTAT tables and refer to year 2004. It will be assumed for now that conditional survival probabilities are constant in the years considered.

deceased's pension [14].

Benefits are due conditional on workers reaching eligibility, which consists in certain age and/or years of contributions requirements:

$$B_R(s) = \begin{cases} B_R(s) & \text{if } s \geq agemr(R) \\ 0 & \text{otherwise} \end{cases} \tag{17}$$

where $agemr(R)$ is the age when eligibility is reached.

As mentioned before, in the period under study (1993-2011) different benefit calculation rules are applied depending on the years of contributions accrued at the end of 1995. This is because Italian legislation, through a number of reforms started in the nineties, provided for a gradual change from an earnings model to a contribution based model.

Specifically, before 1992, all workers fell into a pure earnings model. A reform in 1992 ("Riforma Amato") gradually increased the number of years used to calculate pensionable earnings, defined as the average wage of the last years of work, with the aim of reducing the generosity of pensions. The pension was determined by a two-components formula, where the two components apply different rules to pre- and post-1992 years of contributions.

Specifically, "old" workers (those with at least 15 years of contributions before the end of 1992) fell under the earnings model.

The earnings-based formula used before year 1996 is then:

$$B_R(s) = PE \cdot \alpha \cdot sen_{92} + PE' \cdot \alpha' \cdot [min(sen_R, 40) - sen_{92}] \tag{18}$$

where PE and PE' are pensionable earnings; sen_{92} is seniority up to the end of 1992; sen_R is seniority at retirement (40 contribution years is the maximum allowed); α is the rate of return.

[14] Actually, the social security provision on survivors is more complicated than this and involves an increasing percentage of the deceased's benefits depending on the number of children, who however must be younger than 18 or financially independent from parents. We are implicitly assuming that all children comply with these characteristics.

Pensionable earnings for "old" workers (those with at least 15 years of contributions before the end of 1992) are defined as:

$$PE = \frac{\sum_{x=0}^{k-1} Y_{R-x}}{k} \tag{19}$$

$$PE' = \frac{\sum_{x=0}^{k'-1} Y_{R-x}\delta_t}{k'} \tag{20}$$

where $k = 5$ and $k' = 10$ (gradually) for private workers, $k = 1$ and $k' = 10$ (gradually) for public workers and $k = k' = 10$ for the self-employed. For "young" workers (those with less than 15 years of contribution at the end of 1992) instead k' gradually increases to the total of years of contributions. δ_t is the revaluation coefficient of salaries [15].

The rate of return α is decreasing in pensionable earnings:

$$\alpha = \begin{cases} 0.02 & PE \leq \theta_1 \\ 0.015 & \theta_1 < PE \leq \theta_2 \\ 0.0125 & \theta_2 < PE \leq \theta_3 \\ 0.01 & PE > \theta_3 \end{cases} \tag{21}$$

$$\alpha' = \begin{cases} 0.02 & PE' \leq \theta_1 \\ 0.016 & \theta_1 < PE' \leq \theta_2 \\ 0.0135 & \theta_2 < PE' \leq \theta_3 \\ 0.011 & \theta_3 < PE' \leq \theta_4 \\ 0.009 & PE' > \theta_4 \end{cases} \tag{22}$$

where the thresholds θ are fixed each year by law.

In 1995, a new reform ("Riforma Dini") changed again the rules and introduced a notional defined contribution system for younger workers. For "old-aged" workers (those with more than 18 years of contribution at

[15] Up to 1993 revaluation is based on ISTAT consumer price index, after 1992 is based on ISTAT consumer price index plus one percentage point for each contribution year.

the end of 1995), there was an acceleration towards the higher number of year of contributions that enter in the PE formula (k''):

$$PE'' = \frac{\sum_{x=0}^{k''-1} Y_{R-x}\delta_t}{k''} \tag{23}$$

"Middle-aged" workers (those with less than 18 years of contributions before the end of 1995) fall into the pro-rata model, where pension entitlement is calculated following the earnings model for contribution years before 1996 and the notional defined contribution model for after-1995 years [16]. The pro-rata model is thus composed by three parts, related to the contributions paid before 1993 (earnings model), between 1993 and 1995 (earnings model based on a longer salary history) and after 1995 (defined contribution model):

$$\begin{aligned} B'_R(s) =& PE \cdot \alpha \cdot sen_{92} + PE' \cdot \alpha' \cdot [sen_{95} - sen_{92}] + \\ & PE'' \cdot \tau \cdot \gamma \cdot [min(sen_R, 40) - sen_{95}] \end{aligned} \tag{24}$$

where τ is the contribution rate [17], γ is the coefficient (which depends on retirement age and life expectancy) transforming contributions into benefit flows and:

$$PE'' = \sum_{t=0}^{R-1} Y_t (1+g)^{R-1-t} \tag{25}$$

where g is a 5-year moving average of GDP growth rate. Other minor changes in later sample years are not reported, but provide further variation to the SSW measure.

[16]The contribution model alone applied to those who started working after 1995, so it is not relevant for our sample. Since 2012, the contribution model will apply to everybody, as provided for by the latest reform ("Riforma Fornero").

[17]In the time span considered, the contribution rate grew from 27% to 33% for private and public workers and from 14% to 20% for self-employed.

6.2 SSW Calculation

One of the main advantages of SHARE is the possibility of reconstructing individuals' wage and income profiles from SHARELIFE, the third wave of SHARE. In this wave, retrospective information on various aspects of respondents' lives are asked. As explained above, this is particularly useful for SSW calculation, where seniority and past earnings are needed. A typical issue with retrospective data is recall bias, a distortion arising from the inability or unwillingness to remember past events accurately. However, Havari and Mazzonna (2011), among others, show that recall bias seems not to be a threat to the validity of information contained in SHARELIFE [18]

In the working history section of SHARELIFE, respondents are asked to provide start and end dates of each job they held together with the first monthly wage after taxes (for self-employed, monthly income is asked instead). The current wage of employed respondents is also asked, as well as the final wage of the main job spell for those who are already retired [19].

Brugiavini et al. (2013) reshaped the working life information of respondents contained in SHARELIFE to build a (retrospective) panel [20], which will be exploited here as starting dataset. As it contains only basic information, all other variables of interest must be linked to this retrospective panel from SHARELIFE; besides, information contained in the fourth wave of SHARE will be used to fill the panel from 2008/2009 (the interview years) to 2011 [21].

[18] The authors compare consistency of answers on some specific events contained in SHARE (at the time of occurrence of the events) and SHARELIFE, and find less than 10% recall errors overall.

[19] Main job spell is defined as "the last job in the career or the occupation that took up most of your working life".

[20] SHARELIFE is in fact released as an individual level dataset where life events are organized in a flat file format. A few assumptions were needed in order to resolve some data inconsistency, see Brugiavini et al. (2013).

[21] The vast majority of workers worked continuously between the third and fourth waves, and for most of those who didn't the reason was retirement. Some assumptions were needed in the rare remaining cases, for example if industry and job title in 2011 are

From these information, wage and income profiles are derived using a strategy similar to Weiss (2012). First of all, in the total sample around 24% of first wages and incomes are missing, thus their values are imputed using predictive mean matching. This is an imputation method that works by estimating missing values through a regression. First, annual wages and incomes are regressed on a set of variables (cohort, decade start of the job spell, geographic area, education, type of job and working hours), separately for males and females. Then, rather then using directly these estimates, one or more neighbours who have similar estimated values are identified. Finally, the corresponding observed values are randomly chosen among the nearest neighbours and used as estimate for the missing values. [22]

By exploiting the information contained in SHARELIFE, a model for the logarithm of final wages y_f of the main job spell can be estimated using potential labour market experience, other covariates and their interactions as explanatory variables:

$$y_f = \beta_1 E_f + \beta_2 E_f^2 + \beta_3 E_f S + \beta_4 E_f X_f + \beta_5 S + \beta_6 X_f + \beta_7 W + U \qquad (26)$$

In this equation, potential labour market experience is defined as $E_f = (A_f - S - 5)$, where 5 is the age of school entry, S stands for years of education and A_f is age at the end of the spell. X_f is a set of individual characteristics specific of the job spell (white collar, self-employed, industry, geographic area), while W is a set of time-invariant characteristics like cohort and some characteristics of the individual when she was ten years old that should account for ability. These are an indicator of the number of books present at home when the individual was ten years old, whether

the same reported in the third wave, they are the same also in 2010.

[22]Five imputed values are estimated for each missing value, originating 5 different datasets. As stated in SHARE Release Guide 2-5-0, all datasets should be used for estimation of statistical models. However, as a first approximation, the average of the five imputations is used instead.

the individual was better compared to others in mathematics, whether she was better in language, the features of the accommodation and an indicator of house size [23].

Estimated coefficients and the logarithm of starting (observed or imputed) wage y_{t0j} are then used to predict the logarithm of final wage y_{t1j} for each spell j:

$$\begin{aligned}\hat{y}_{t1j} =& y_{t0j} + \hat{\beta}_1(E_{t1j} - E_{t0j}) + \hat{\beta}_2(E^2_{t1j} - E^2_{t0j}) + \\ & \hat{\beta}_3(E_{t1j}S - E_{t0j}S) + \hat{\beta}_4(E_{t1j}X_j - E_{t0j}X_j)\end{aligned} \tag{27}$$

where E_{t1j} and E_{t0j} denote potential experience at the beginning and at the end of each spell. Finally, the annual growth of earnings is computed as $(\hat{y}_{t1j} - y_{t0j})/len_j$, where len_j is the length of the employment spell, and used to generate annual wage profiles.

Generated wage and income profiles are shown in Figure 1 and Figure 2, for males and females respectively. Similarly to Weiss (2012), the accuracy of the procedure is checked by applying it to current (in 2011) and final wage/income of the main job spells and testing statistical difference from their observed values. Means and predicted errors are reported in Table 1 and Table 2, for males and females respectively. Using final wages, predicted values are not statistically different from their observed counterparts; using current wages, predicted values are not statistically different from observed ones only for males.

[23] As in Weiss (2012) the indicator for books takes value one if less than ten books are reported. The indicators for mathematics and language take value one if the individual report being better or much better than others. The indicators for the features of the accommodation are dummies for the presence of fixed bath, cold running water supply, hot running water supply, inside toilet and central heating. The indicator for house size takes value one if the number of rooms occupied divided by the number of people living in the household is equal or higher than one.

Figure 1: Imputed Wage Profiles, Males

Figure 2: Imputed Wage Profiles, Females

Table 1: Prediction error for current and main wage, males

Variable	Sample size	Mean	Std. Dev.
Log current income	124	9.4720	1.0916
Predicted log current income	124	9.5832	1.8846
Prediction error	124	0.1112	2.1136
Log main income	707	9.4841	1.4557
Predicted log main income	707	9.5516	1.8511
Predicted error	707	0.0676	2.1353

Table 2: Prediction error for current and main wage, females

Variable	Sample size	Mean	Std. Dev.
Log current income	116	9.0979	1.0785
Predicted log current income	116	9.1439	1.2236
Prediction error	116	0.0460	1.3479
Log main income	567	8.7048	1.6491
Predicted log main income	567	9.0066	1.7402
Predicted error	567	0.3018	1.8439

Expected wages and income are estimated in a similar fashion. In each year from 1993 to 2011 and for each age, remaining years up until age 70 (which is assumed to be the maximum age for risk of retirement) are treated as a final employment spell. Final wage and income are predicted as for any other spell, assuming that the worker does not change occupation. Finally, as pension benefits are based on gross wages and income, while values asked in SHARELIFE are net of all taxes and contributions, wages and incomes are grossed up using information on tax rates and releases due to family composition [24].

Medians of SSW, accrual and peak value by age are shown in Table 3 and 4, for males and females respectively. It clearly emerges from the tables that the marginal incentives are negative for most ages, but as expected less so for the peak value than for the accrual.

[24]Due to difficulties find information on taxation before year 1974, profiles are grossed up only starting from this year. This does not represent a problem, however, due to the fact that social security rules are not based on very past away wages or incomes.

Table 3: Financial Incentives, Males

Age	SSW		Accrual		Peak Value	
	Median	S.D.	Median	S.D.	Median	S.D.
50	24.6150	26.6655	0.0370	2.5122	0.4142	7.7071
51	25.0862	28.0688	-0.0105	5.9872	0.2397	9.1551
52	23.5864	28.2562	-0.0106	5.7575	0.2490	8.5980
53	24.4424	31.6363	-0.0422	2.0994	0.1304	6.2018
54	24.9829	31.8274	-0.2474	2.6111	-0.1602	6.3311
55	25.3952	33.9326	-0.1763	2.6386	-0.0682	6.2933
56	27.9680	36.1362	-0.3121	2.2033	-0.1891	6.5864
57	30.6207	37.2755	-0.2871	1.7483	-0.2089	5.3964
58	31.2187	37.8003	-0.2543	5.7787	-0.2088	7.7714
59	28.5849	36.3384	-0.2938	1.6821	-0.2175	4.7761
60	29.3388	37.2161	-0.3178	2.1644	-0.2401	4.5547
61	26.3433	38.5049	-0.2979	2.6056	-0.2832	4.2787
62	23.5594	39.5353	-0.3777	3.1128	-0.3487	4.0074
63	17.4790	36.3892	-0.3152	1.6327	-0.2827	4.0407
64	17.8395	37.3620	-0.4574	4.6839	-0.3404	5.4152
65	17.0729	39.7816	-0.3222	4.6412	-0.3092	4.7760
66	17.2503	34.0953	-0.2776	1.3565	-0.2733	1.4939
67	29.9629	39.3680	-0.5272	1.9864	-0.2911	2.0510
68	26.0505	41.6922	-0.6661	2.0698	-0.6661	2.0698
69	34.8642	43.7335	-0.8315	2.6558	-0.8315	2.6558
70	12.9968	41.6823	-1.0181	1.8980	-1.0181	1.8980

Notes: monetary values in 2011 Euro. SSW, ACC and PV are divided by 10000.

Table 4: Financial Incentives, Females

Age	SSW		Accrual		Peak Value	
	Median	S.D.	Median	S.D.	Median	S.D.
50	15.8468	36.8136	-0.0094	4.1472	0.2915	8.4661
51	16.9408	39.2218	-0.0559	1.7863	0.4600	7.0963
52	17.6495	41.3531	-0.1034	2.3012	0.5325	7.2680
53	18.3033	41.8625	-0.0708	2.0261	0.4675	6.2025
54	18.5433	38.4162	-0.1296	5.3876	0.5106	7.6553
55	18.4315	40.2780	-0.1167	2.0100	0.6279	5.2324
56	18.9457	40.5536	-0.1290	2.3954	0.3501	4.4124
57	21.6397	40.8610	-0.0973	2.0098	0.3330	3.0429
58	20.3712	43.9714	-0.1636	1.8392	0.0320	2.6097
59	19.4118	42.0245	-0.1555	1.7580	-0.0071	2.7137
60	15.9009	42.9227	-0.2268	1.6631	-0.1967	2.4849
61	14.5973	36.3561	-0.2148	2.1609	-0.1771	2.3749
62	18.4248	28.4328	-0.3544	3.3303	-0.3524	3.3801
63	13.1113	26.3397	-0.4056	1.0721	-0.3792	1.2233
64	11.0022	33.8016	-0.4994	1.1245	-0.4994	1.2380
65	15.9884	35.8265	-0.5245	1.2674	-0.5245	1.2903
66	14.4972	8.9726	-0.4012	0.4039	-0.4012	0.4039
67	14.1989	8.7220	-0.4825	0.2574	-0.4825	0.2574
68	9.4695	5.0880	-0.3214	0.2074	-0.3214	0.2074
69	9.0788	5.0068	-0.2803	0.2055	-0.2803	0.2055
70	13.0738	5.4837	-0.1991	0.3552	-0.1991	0.3552

Notes: monetary values in 2011 Euro. SSW, ACC and PV are divided by 10000.

7 Control Variables

As already stressed above, one of the advantages of SHARELIFE over administrative data is the possibility to control for individual and job characteristics that may be important for the decision to retire and that are likely correlated with social security wealth. Omitting them could bias estimated values of the social security financial variables. In the following paragraphs, the choice of control variables will be briefly discussed.

In Table 5 and Table 6 descriptive statistics of the variables used in the econometric analysis are presented, for males and females respectively. The average age of the sample (that is, conditional on being older than 50 and in the labour force) is 57 for males and 56 for females. More females then men reside in the North of Italy. More males than females are self-employed, while the opposite holds true for the public sector. The proportion of white collar and managers are instead similar[25]. Almost all individual-year observations in the sample are married, 33% of males and 44% of females have a working spouse.

The wealth, health and work quality variables are separately presented in the next paragraphs.

[25]White collars are ISCO (International Standard Classification of Occupations) codes 3, 4 and 5 (technicians, clerical support workers and service and sales workers), while managers are ISCO codes 1 and 2 (managers and professionals). All other workers are blue collars.

Table 5: Descriptive Statistics, Males

Variable	Mean	Sd	Min	Max	N
Age	0.35	0.48	0	1	3867
North	56.34	4.45	50	70	3867
Self employed	0.35	0.48	0	1	3867
Public	0.18	0.38	0	1	3867
Industry: agriculture	0.08	0.27	0	1	3867
Industry: manufacturing and construction	0.36	0.48	0	1	3867
Industry: trade	0.16	0.37	0	1	3867
Industry: transport and communication	0.07	0.25	0	1	3867
Industry: credit and insurance services	0.03	0.16	0	1	3867
Industry: general government	0.08	0.27	0	1	3867
Industry: other services	0.23	0.42	0	1	3867
White Collar	0.33	0.47	0	1	3867
Manager	0.08	0.27	0	1	3867
Married	0.96	0.19	0	1	3867
Working spouse	0.34	0.47	0	1	3849
Home owner	0.75	0.43	0	1	3586
Real house value	133418	132004	0.12	1188743	1682
Stock	0.15	0.36	0	1	3867
Fund	0.12	0.33	0	1	3867
Individual retirement account	0.10	0.30	0	1	3867
Illnesses after 50	0.08	0.26	0	1	3867
Control	0.50	0.50	0	1	3626
Effort	0.49	0.50	0	1	3626
Reward	0.61	0.49	0	1	3594
Imbalance	2.51	0.67	1	4	3594

Notes: real house value in 2011 Euro. Individual-year observations, 1993-2011.

Table 6: Descriptive Statistics, Females

Variable	Mean	Sd	Min	Max	N
Age	0.49	0.50	0	1	1816
North	55.14	3.81	50	70	1816
Self employed	0.33	0.47	0	1	1816
Public	0.23	0.42	0	1	1816
Industry: agriculture	0.09	0.29	0	1	1816
Industry: manufacturing and construction	0.19	0.39	0	1	1816
Industry: trade	0.19	0.39	0	1	1816
Industry: transport and communication	0.00	0.06	0	1	1816
Industry: credit and insurance services	0.01	0.09	0	1	1816
Industry: general government	0.07	0.26	0	1	1816
Industry: other services	0.45	0.50	0	1	1816
White Collar	0.33	0.47	0	1	1816
Manager	0.09	0.29	0	1	1816
Married	0.95	0.23	0	1	1816
Working spouse	0.46	0.50	0	1	1782
Home owner	0.78	0.42	0	1	1790
Real house value	153527	129548	0.17	751415	764
Stock	0.09	0.28	0	1	1816
Fund	0.10	0.30	0	1	1816
Individual retirement account	0.07	0.25	0	1	1816
Illnesses after 50	0.06	0.24	0	1	1816
Control	0.50	0.50	0	1	1732
Effort	0.44	0.50	0	1	1732
Reward	0.63	0.48	0	1	1714
Imbalance	2.40	0.69	1	4	1714

Notes: real house value in 2011 Euro. Individual-year observations, 1993-2011.

7.1 Wealth

As already noticed by Gruber and Wise (2004): "In principle, total wealth should be controlled for, but in most countries the data do not provide measures of other forms of wealth". SHARELIFE, on the contrary, includes a financial history section and an accommodation section.

In the financial history section, information is collected about investments individuals may have made during their life. These questions only regard the types of investment, not the amount invested. Specifically, respondents are asked if they ever invested in either stocks (or shares) or mutual funds, if they ever had a retirement account, if they have ever taken out a life insurance policy or if they ever owned any business. For each of these items, the year they were first acquired is also asked.

These information are used to construct three dummy variables taking up value one in the year the individuals report having acquired stocks or shares, funds, a retirement account or a life insurance policy. As shown in Table 5, around 16% of females invested in stocks or shares, 13% in mutual funds and 9% have an individual retirement account. In Tables 6 it is shown instead that around 8% of females invested in stocks or shares, 11% in mutual funds and 5% have an individual retirement account.

Another section of SHARELIFE contains instead information about the different places individuals have lived in during their life. In particular, respondents are asked about the residences they lived in for more than six months, the year they started living in the accommodation, if they owned it and, if they purchased it, the price of the property [26]. It is not possible to know the market value of residences that were received as a gift or bequest, but it is still possible to control for home ownership[27].

Market house value has been calculated by using house prices growth

[26]In case any property is sold, the sale price is asked as well. Besides, in each wave respondents are asked how much, in their opinion, would they receive if they sold their property.

[27]The observations for which house value is not known because the house was received as a gift or bequest will be treated as missing observations.

for Italy, derived from residential property price statistics collected from national sources of various countries by the Bank for International Settlements. Here the long series on nominal residential property prices is exploited, which is available for Italy at a quarterly frequency starting in 1971 [28]. Finally, as for the other monetary values, house value is expressed in 2011 Euro. In Table 5 and 6 it is shown that around 73% of men and 78% of women are home owners and that the average real house value is around 133000 Euro for men and 148000 Euro for women.

7.2 Health

A substantial number of studies show that health is an important determinant of labour market status (see, for example, Haan and Myck (2009)) and retirement choice (Blundell et al., 2002; Disney et al., 2006). As is well-known, health measures, especially if self-assessed, suffer from various problems. For example, two identical individuals could perceive their health differently and thus self-assess health differently. A poor health condition may also influence other labour outcomes, like wages: this means that a shock to health may determine both income and substitution effects on labour supply, which complicates the effect of health on labour market status (Disney et al., 2006). Besides, reverse causality is possible between health and labour market status.

One possibility is to substitute self-assessed measures with more objective measures of health. These, most of the times, are still self-reported and usually refers to specific health conditions or difficulties in performing certain tasks. As noted by Bound (1991) and reiterated in Disney et al. (2006), "we cannot be sure that such proxies are any better predictors of (in)activity than self-reported health status, as the researcher thereby assumes some link between work status and these other health measures" (Disney et al., 2006). However, the information available in SHARELIFE

[28]Due to unreported values and to the fact that the price index is available only starting from 1971, around 18% of observations are lost when controlling for real house value.

only allows to follow the "objective" approach.

In the health section of SHARELIFE, respondents are asked how many periods of ill health or disability they experienced in adulthood that lasted for more than a year (including serious illnesses that lasted less than one year, but influenced the respondent's daily life for more than a year). Then, the year when the illness periods started and ended is asked, as well as the type of illness among a number of conditions.

This information may be exploited in various ways. First, a dummy could be created that takes value one for the length of each illness period. However, it seems more reasonable to assume that serious illness periods experienced in adulthood have long term effects on the probability of retirement, which is something that has been overlooked in the economic literature. An example in epidemiological literature is Avedano and Mackenbach (2011): the authors measure the effect of experiencing at least one period of illness in adulthood on survival time in the labour market, and illness is treated as a time-varying variable taking up value one from the year the first illness was experienced.

The approach followed in this paper will be to construct a dummy variable for the experience of illness periods taking up value one from the year the first illness was experienced. Besides, as illness periods closer to the ages at risk of retirement may be more important for the choice of retirement than illness periods experienced much earlier in life, another dummy variable will be created taking up value one from the start of any illness period experienced after the age of 50. Table 5 and 6 show that 8% of men and 7% of women experienced at least one serious illness after the age of 50.

7.3 Work Quality

The impact of quality of work on labour supply has been largely neglected by the economic literature. Two non-recent exceptions are Atrostic (1982) and Altonji and Paxson (1986). The former incorporates non-pecuniary job characteristics into a neoclassical consumer demand system, and shows that this leads to different wage and income elasticities of labour supply. The latter instead shows that the characteristics of specific jobs influence working hours of individuals. A more recent example is Kunze and Suppa (2013), who using Australian data (HILDA) show that elasticities differ systematically among individuals with good and bad job characteristics and that omitting job characteristics from labour supply models imply both larger wage and income elasticities.

Some evidence on the effect of quality of work using SHARE data may be found in the health literature in Siegrist et al. (2006) and in the economic literature in Schnalzenberger et al. (2014). The former work finds a strong relation between work quality and intention of early retirement for individuals older than 50, even after controlling for well-being. The latter studies the relationship of various measures of job quality with actual retirement and finds that there is some evidence (but not for all measures) that poor employment quality decreases retirement age, especially for women.

This is the first paper that uses some measures of work quality in an option value model of retirement, as all other papers in the literature only looked at the effect of financial incentives and job quality separately. This seems important because Schnalzenberger et al. (2014) find that there is a discrepancy in the effect of job quality measures on the intention to retire and on actual retirement. This may be due to the fact that retiring at specific ages implies costs or benefits that are not taken into consideration in their analysis. Besides, controlling for health when controlling for work quality seems important as evidence shows that poor quality of employment is associated with poor health (Siegrist et al., 2005), and the causal direction may hold both ways.

The questions about work quality in the work history section of SHARELIFE refers to the current (for those who are not yet retired) or main job. The 12 questions are taken from the original questionnaires of two work stress models that received most attention recently: the demand-control model (Karasek et al., 1998) and the effort-reward imbalance (ERI) model (Siegrist et al., 1996). The first model identifies stressful work by job task profiles that are characterized by high demand in combination with low control, while the second measures the imbalance between high efforts spent and low rewards received in turn, in terms of money, esteem, career prospects and job security (Siegrist et al., 2006). Not all items from the demand-control and effort-reward imbalance models have been included in the SHARE questionnaire: control has been favoured over demand, and as regards the ERI model two items for effort and five elements for reward were included. Here, effort is measured using measures of both physical and psychosocial demand and reward using both reward and social support at work items (see Siegrist and Wahrendorf, 2011). Table 7 show the items used as measures of quality of work as they appear in the SHARE-LIFE questionnaire.

Table 7: Measures of Quality of Work

Dimension	Item (strongly agree, agree, disagree, strongly disagree)
Control	1. I have very little freedom to decide how to do my work
	2. I have an opportunity to develop new skills
Effort	3. My job is physically demanding
	4. My immediate work environment is uncomfortable
	5. I am under constant time pressure due to a heavy workload
Reward	6. I receive the recognition I deserve for my work
	7. Considering all my efforts and achievements, my salary is adequate
	8. I receive adequate support in difficult situations

There are four possible answers ranging from strongly agree (indicator 1) to strongly disagree (indicator 4), that is, the 12 items are 4-point Likert scaled. As in Siegrist et al. (2006), low control is measured by the sum score of two items ranging from 2 to 8 (here, higher scores indicate higher control at work) and the upper tertile is taken as indicator of high control at work. ERI is instead defined by a ratio of the sum score of the "effort" items (nominator) and of the sum score of the "reward" items (adjusted for number or items, denominator). The ratio can then be transformed into a binary variable equal to 1 for those with higher effort than reward, or transformed in a continuous measure from which quartiles may be defined (see Siegrist et al., 2004) [29]. Descriptive statistics for control, effort, reward and imbalance variables are presented in Table 5 and 6 for males and females respectively.

8 Results

Each regression table in this section presents either four or five columns. Column (1) shows the linear probability model estimated by fixed effect and it appears only in the basic specification, as this method only allows time-varying controls. Column (2) shows a probit model estimated by pooled MLE. The implicit assumption of this model is that the individual effect c_i is independent of $\boldsymbol{x}_i$. Column (3) shows a probit model estimated by full MLE. The implicit assumptions here are both that the individual effect c_i is independent of $\boldsymbol{x}_i$ and conditional independence. Column (4) shows a correlated random effect probit model estimated by pooled MLE. This model assumes that the individual effect is correlated with financial incentives. Here, this correlation is modelled through the first observation of two financial variables, expected wage and pensionable earnings. This

[29] As noticed by Siegrist et al. (2004), transforming logarithmically the variable in a continuous measure provides more information and allows to construct quartiles or tertiles of the ratio. This may be done (see Pikhart et al., 2001) by placing the result 1 at the center of the scale. Then by using quartiles four categories emerge: 1 (effort-reward ratio of 0.25 to 0.5), 2 (ERI ratio 0.5 to 1), 3 (ERI ratio 1 to 2) and 4 (ERI ratio 2 to 4). Effort reward imbalance becomes stronger as the score increases.

is implemented simply by adding these two time constant variables to the specification. Then, one can test the random effect probit model by testing the joint significance of these two variables. Finally, column (5) shows a correlated random effect probit model estimated by full MLE, where the conditional independence assumption is also needed.

As mentioned above, what all these models have in common is the possibility of estimating average partial effects. Thus, in each table APEs are shown next to the coefficients. Besides, tables progressively present an increased number of controls, added on top of previous ones. Finally, results are presented separately for males and females.

First of all, SSW and the marginal incentive measures (ACC and PV) always have the expected signs: a positive change in SSW increases the probability of retirement while a positive change in ACC or PV reduces the probability of retirement. The only case that displays an unexpected sign is the linear probability model fixed effect model, where SSW assumes a negative sign. However, in this model SSW is almost never significant and the two incentives measures are never jointly significant. In all other models and throughout different specifications, incentives measures are significant in most of the cases and always jointly significant.

Table 8 and 10 for males and Table 18 and 20 for females shows the most basic specification where age enters linearly. However, specifications where age enters non-linearly through age dummies are to be preferred. The reason is that evidence shows that workers tend to retire at specific ages, generally at the age of benefit eligibility which sometimes also establishes social norm for retirement (see Gruber and Wise, 2004), and a linear age variable would fail to capture this effect. For this reason, all other specifications will include age dummies.

As regards males, in the basic specification (Tables 8 to 11), controls include expected wage, pensionable earnings, area, dummies for self-employed and public workers, industry dummies and dummies for white-collar workers and managers (in column (4) and (5) variables containing the first individual observation of expected wage and pensionable earnings are included as well). As indicated by the average partial effect of SSW, a €10000 increase in SSW increases the probability of retirement by 0.06 to 0.11 percentage points. Results for the marginal incentives indicate that a €10000 increase in the accrual reduces the probability of retirement by 0.12 to 0.19 pps, while the same increase in the peak value reduces the probability of retirement by 0.13 to 0.21 pps.

In Table 12 and 13 other wealth variables are added to SSW: specifically, dummies indicating ownership of house, stocks, funds and individual retirement account, as well as housing wealth. A dummy indicating if the spouse is currently working is added as well. The effect of the accrual and peak value variables is reinforced and determine a reduction in the probability of retirement up to 0.26 and 0.28 pps. Having an individual retirement account or a working spouse seems to have a significant effect in the direction of reducing retirement probabilities. The negative sign on retirement account may be explained by the fact that these plans are purely defined contribution (besides, contributions are deductible from total income), so that the final complementary pension depends on the amount of contributions paid and on the length of the contribution period. The negative sign on the dummy for having a working wife may indicate complementarity of leisure from the side of husbands.

Table 16 and 17 add, on the top of previous controls, a health variable and some job quality variables. SSW and marginal incentives variables are in line with previous results. Both having experienced a serious illness after the age of 50 and having a job which exerts effort are significant predictors of earlier retirement [30].

Table 18 to 21 show results for females in the basic specification, with

[30] In Table 14 and 15 results are presented for specifications which only adds the health and job quality variables to the basic specification. In this case, reward is significant as well and has a positive sign. However, significance disappears once wealth variables are added to the model, probably meaning that reward is already captured by financial variables.

and without age dummies. Females are more responsive than men to financial incentives: a €10000 increase in SSW increases the probability of retirement by 0.14 to 0.19 percentage points. Results for the marginal incentives indicate that a €10000 increase in the accrual reduces the probability of retirement by 0.34 to 0.69 pps, while the same increase in the peak value reduces the probability of retirement by 0.13 to 0.57 pps.

Table 22 and 23 show results when controlling for other wealth and having a working husband. Only stock ownership seems to have a positive effect on the probability of retirement. Besides, differently from males, females do not seem to be responsive to their husband working condition: this could suggest asymmetries in complementarity of leisure between males and females. The effect of marginal incentives measure gets stronger in this specification, up to 1.38 and 0.28 for accrual and peak value respectively. Table 26 and 27 add job quality measures to the specification, showing that reward seems to positively affect the probability of retirement for females.

In all the models estimated by full MLE, ρ, the proportion of the total variance contributed by the panel-level variance component is small, and becomes zero in the full specifications, meaning that the panel estimator is not different from the pooled estimator. This suggests that the controls introduced are sufficient to explain heterogeneity in the retirement choice among individuals.

Table 8: Estimates for retirement, males

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0023*	0.0094***	0.0010	0.0103***	0.0011	0.0095***	0.0010	0.0103***	0.0011
	(0.0014)	(0.0034)		(0.0036)		(0.0033)		(0.0036)	
ACC	-0.0035*	-0.0104	-0.0012	-0.0111	-0.0012	-0.0120	-0.0013	-0.0130	-0.0013
	(0.0019)	(0.0096)		(0.0091)		(0.0108)		(0.0096)	
Age	0.0199***	0.0878***	0.0098	0.1060***	0.0112	0.0888***	0.0096	0.1034***	0.0107
	(0.0022)	(0.0095)		(0.0215)		(0.0101)		(0.0207)	
Expected wage	-0.0017	0.0018	0.0002	0.0012	0.0001	-0.0325	-0.0035	-0.0328	-0.0034
	(0.0042)	(0.0231)		(0.0196)		(0.0269)		(0.0228)	
Pensionable earnings	0.0326***	-0.0514	-0.0057	-0.0542	-0.0057	0.0358	0.0039	0.0416	0.0043
	(0.0115)	(0.0386)		(0.0348)		(0.0606)		(0.0630)	
North		0.2028**	0.0232	0.2270**	0.0248	0.1848**	0.0206	0.2052**	0.0219
		(0.0867)		(0.0989)		(0.0870)		(0.0977)	
Self-employed		-0.5020***	-0.0492	-0.5640***	-0.0519	-0.5144***	-0.0490	-0.5630***	-0.0507
		(0.1101)		(0.1387)		(0.1116)		(0.1348)	
Public worker		0.2235*	0.0268	0.2554*	0.0294	0.2333*	0.0274	0.2595*	0.0293
		(0.1291)		(0.1495)		(0.1299)		(0.1466)	
Agriculture		-0.2936	-0.0280	-0.3473	-0.0307	-0.3807*	-0.0338	-0.4356*	-0.0360
		(0.2054)		(0.2232)		(0.2147)		(0.2268)	
Building		0.0424	0.0048	0.0370	0.0039	0.0426	0.0047	0.0372	0.0039
		(0.1221)		(0.1327)		(0.1229)		(0.1307)	
Retail		-0.0967	-0.0103	-0.1059	-0.0106	-0.0612	-0.0064	-0.0684	-0.0069
		(0.1639)		(0.1781)		(0.1629)		(0.1752)	
Transport		-0.2019	-0.0199	-0.1974	-0.0186	-0.1891	-0.0183	-0.1835	-0.0171
		(0.1846)		(0.1913)		(0.1853)		(0.1879)	
Credit services		0.2479	0.0322	0.2735	0.0341	0.2722	0.0350	0.2953	0.0366
		(0.1980)		(0.2540)		(0.1964)		(0.2498)	
General government		-0.1376	-0.0142	-0.1523	-0.0148	-0.1341	-0.0135	-0.1469	-0.0140
		(0.1708)		(0.2030)		(0.1696)		(0.1987)	
White collar		-0.2085**	-0.0224	-0.2531**	-0.0257	-0.2322**	-0.0243	-0.2723**	-0.0271
		(0.0940)		(0.1179)		(0.0955)		(0.1178)	
Manager		-0.3681**	-0.0334	-0.4452**	-0.0371	-0.3602**	-0.0321	-0.4243**	-0.0350
		(0.1537)		(0.2064)		(0.1522)		(0.2028)	
N	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945
Rho	0.47	.	.	0.11	0.11	.	.	0.10	0.10
Age dummies	No	No	No	No	No	No	No	No	No

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 9: Estimates for retirement, males

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0019	0.0082**	0.0009	0.0082***	0.0009	0.0065**	0.0007	0.0065**	0.0007
	(0.0014)	(0.0032)		(0.0031)		(0.0031)		(0.0030)	
ACC	-0.0036*	-0.0135	-0.0015	-0.0135	-0.0015	-0.0169	-0.0019	-0.0169*	-0.0019
	(0.0019)	(0.0092)		(0.0087)		(0.0120)		(0.0089)	
Expected wage	-0.0020	-0.0017	-0.0002	-0.0017	-0.0002	-0.0360	-0.0041	-0.0360	-0.0041
	(0.0041)	(0.0231)		(0.0183)		(0.0297)		(0.0220)	
Pensionable earnings	0.0325***	-0.0370	-0.0040	-0.0370	-0.0040	0.1048	0.0118	0.1048*	0.0118
	(0.0117)	(0.0386)		(0.0312)		(0.0641)		(0.0580)	
North		0.2284***	0.0255	0.2284***	0.0255	0.1713**	0.0198	0.1712**	0.0198
		(0.0863)		(0.0851)		(0.0801)		(0.0830)	
Self-employed		-0.4489***	-0.0433	-0.4489***	-0.0433	-0.3391***	-0.0348	-0.3391***	-0.0348
		(0.1080)		(0.1075)		(0.0993)		(0.1018)	
Public worker		0.2099	0.0244	0.2099	0.0244	0.2387**	0.0293	0.2387*	0.0293
		(0.1295)		(0.1296)		(0.1172)		(0.1250)	
Agriculture		-0.3203	-0.0294	-0.3202	-0.0294	-0.2801	-0.0270	-0.2800	-0.0270
		(0.2012)		(0.1948)		(0.2039)		(0.1902)	
Building		0.0241	0.0026	0.0241	0.0026	0.0304	0.0035	0.0304	0.0035
		(0.1205)		(0.1184)		(0.1112)		(0.1148)	
Retail		-0.1484	-0.0150	-0.1483	-0.0150	-0.1134	-0.0121	-0.1134	-0.0121
		(0.1610)		(0.1587)		(0.1504)		(0.1528)	
Transport		-0.2440	-0.0229	-0.2440	-0.0229	-0.2044	-0.0203	-0.2044	-0.0203
		(0.1848)		(0.1696)		(0.1632)		(0.1652)	
Credit services		0.2517	0.0318	0.2517	0.0318	0.2515	0.0333	0.2515	0.0333
		(0.1947)		(0.2187)		(0.1804)		(0.2140)	
General government		-0.1192	-0.0121	-0.1192	-0.0121	-0.1691	-0.0173	-0.1691	-0.0173
		(0.1675)		(0.1771)		(0.1588)		(0.1740)	
White collar		-0.1955**	-0.0205	-0.1954**	-0.0205	-0.2454***	-0.0265	-0.2453**	-0.0265
		(0.0933)		(0.0970)		(0.0897)		(0.0955)	
Manager		-0.4211***	-0.0363	-0.4211**	-0.0363	-0.3062**	-0.0290	-0.3061*	-0.0290
		(0.1497)		(0.1731)		(0.1516)		(0.1618)	
N	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945
Rho	0.47	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 10: Estimates for retirement, males

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0022	0.0087**	0.0010	0.0096***	0.0010	0.0089***	0.0010	0.0097***	0.0010
	(0.0015)	(0.0035)		(0.0037)		(0.0033)		(0.0036)	
PV	-0.0025*	-0.0115	-0.0013	-0.0129	-0.0013	-0.0124	-0.0013	-0.0138	-0.0014
	(0.0014)	(0.0081)		(0.0083)		(0.0085)		(0.0086)	
Age	0.0197***	0.0864***	0.0095	0.1055***	0.0110	0.0877***	0.0094	0.1031***	0.0106
	(0.0022)	(0.0097)		(0.0217)		(0.0101)		(0.0208)	
Expected wage	-0.0019	0.0093	0.0010	0.0094	0.0010	-0.0246	-0.0026	-0.0244	-0.0025
	(0.0046)	(0.0264)		(0.0216)		(0.0294)		(0.0244)	
Pensionable earnings	0.0301***	-0.0540	-0.0059	-0.0567	-0.0059	0.0260	0.0028	0.0323	0.0033
	(0.0116)	(0.0405)		(0.0353)		(0.0603)		(0.0629)	
North		0.2010**	0.0227	0.2265**	0.0243	0.1821**	0.0201	0.2033**	0.0214
		(0.0867)		(0.0997)		(0.0870)		(0.0983)	
Self-employed		-0.5007***	-0.0483	-0.5674***	-0.0512	-0.5149***	-0.0484	-0.5672***	-0.0502
		(0.1103)		(0.1404)		(0.1119)		(0.1364)	
Public worker		0.2246*	0.0266	0.2575*	0.0291	0.2351*	0.0274	0.2623*	0.0293
		(0.1292)		(0.1509)		(0.1301)		(0.1479)	
Agriculture		-0.2792	-0.0263	-0.3331	-0.0291	-0.3669*	-0.0324	-0.4234*	-0.0347
		(0.2077)		(0.2256)		(0.2162)		(0.2289)	
Building		0.0493	0.0055	0.0446	0.0047	0.0496	0.0054	0.0447	0.0046
		(0.1224)		(0.1340)		(0.1234)		(0.1318)	
Retail		-0.0936	-0.0098	-0.1024	-0.0101	-0.0552	-0.0058	-0.0618	-0.0061
		(0.1644)		(0.1796)		(0.1637)		(0.1766)	
Transport		-0.1974	-0.0192	-0.1910	-0.0178	-0.1846	-0.0178	-0.1773	-0.0164
		(0.1849)		(0.1928)		(0.1857)		(0.1893)	
Credit services		0.2455	0.0314	0.2713	0.0332	0.2697	0.0343	0.2930	0.0359
		(0.1967)		(0.2558)		(0.1952)		(0.2512)	
General government		-0.1449	-0.0146	-0.1605	-0.0153	-0.1403	-0.0139	-0.1542	-0.0145
		(0.1709)		(0.2048)		(0.1694)		(0.2001)	
White collar		-0.2033**	-0.0216	-0.2498**	-0.0249	-0.2261**	-0.0235	-0.2680**	-0.0263
		(0.0943)		(0.1188)		(0.0958)		(0.1185)	
Manager		-0.3528**	-0.0319	-0.4305**	-0.0355	-0.3445**	-0.0306	-0.4089**	-0.0336
		(0.1561)		(0.2081)		(0.1548)		(0.2044)	
N	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945
Rho	0.46	.	.	0.12	0.12	.	.	0.10	0.10
Age dummies	No	No	No	No	No	No	No	No	No

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 11: Estimates for retirement, males

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0017	0.0074**	0.0008	0.0074**	0.0008	0.0054*	0.0006	0.0054*	0.0006
	(0.0015)	(0.0033)		(0.0031)		(0.0031)		(0.0030)	
PV	-0.0024*	-0.0144*	-0.0015	-0.0144*	-0.0015	-0.0192**	-0.0021	-0.0192**	-0.0021
	(0.0013)	(0.0078)		(0.0079)		(0.0095)		(0.0078)	
Expected wage	-0.0023	0.0071	0.0008	0.0071	0.0008	-0.0224	-0.0025	-0.0224	-0.0025
	(0.0046)	(0.0265)		(0.0203)		(0.0326)		(0.0235)	
Pensionable earnings	0.0295**	-0.0398	-0.0043	-0.0398	-0.0043	0.0884	0.0099	0.0884	0.0099
	(0.0115)	(0.0406)		(0.0315)		(0.0644)		(0.0579)	
North		0.2267***	0.0250	0.2267***	0.0250	0.1684**	0.0192	0.1683**	0.0192
		(0.0863)		(0.0852)		(0.0803)		(0.0831)	
Self-employed		-0.4462***	-0.0424	-0.4463***	-0.0424	-0.3412***	-0.0346	-0.3412***	-0.0346
		(0.1083)		(0.1074)		(0.0997)		(0.1019)	
Public worker		0.2118	0.0243	0.2118	0.0243	0.2422**	0.0294	0.2421*	0.0294
		(0.1296)		(0.1301)		(0.1176)		(0.1258)	
Agriculture		-0.3015	-0.0275	-0.3015	-0.0275	-0.2574	-0.0249	-0.2574	-0.0249
		(0.2036)		(0.1960)		(0.2057)		(0.1917)	
Building		0.0326	0.0035	0.0326	0.0035	0.0436	0.0049	0.0436	0.0049
		(0.1210)		(0.1187)		(0.1123)		(0.1153)	
Retail		-0.1456	-0.0145	-0.1456	-0.0145	-0.1030	-0.0109	-0.1030	-0.0109
		(0.1616)		(0.1589)		(0.1520)		(0.1533)	
Transport		-0.2391	-0.0222	-0.2391	-0.0222	-0.1957	-0.0193	-0.1957	-0.0194
		(0.1852)		(0.1696)		(0.1642)		(0.1652)	
Credit services		0.2485	0.0309	0.2485	0.0309	0.2494	0.0326	0.2493	0.0326
		(0.1936)		(0.2186)		(0.1792)		(0.2140)	
General government		-0.1284	-0.0128	-0.1285	-0.0128	-0.1781	-0.0179	-0.1780	-0.0179
		(0.1676)		(0.1773)		(0.1587)		(0.1741)	
White collar		-0.1902**	-0.0197	-0.1903*	-0.0197	-0.2359***	-0.0253	-0.2358**	-0.0253
		(0.0936)		(0.0971)		(0.0903)		(0.0956)	
Manager		-0.4046***	-0.0347	-0.4046**	-0.0347	-0.2820*	-0.0268	-0.2819*	-0.0268
		(0.1521)		(0.1743)		(0.1552)		(0.1634)	
N	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945	2,945
Rho	0.46	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 12: Estimates for retirement, males

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0102***	0.0011	0.0102***	0.0011	0.0076**	0.0008	0.0076**	0.0008
	(0.0039)		(0.0038)		(0.0039)		(0.0037)	
ACC	-0.0133	-0.0014	-0.0133	-0.0014	-0.0235	-0.0026	-0.0235**	-0.0026
	(0.0145)		(0.0116)		(0.0161)		(0.0119)	
North	0.3161***	0.0347	0.3161***	0.0347	0.2550**	0.0284	0.2550**	0.0284
	(0.1093)		(0.1076)		(0.1000)		(0.1042)	
Expected wage	-0.0124	-0.0013	-0.0124	-0.0013	-0.0613*	-0.0067	-0.0613**	-0.0067
	(0.0275)		(0.0232)		(0.0363)		(0.0280)	
Pensionable earnings	-0.0286	-0.0031	-0.0286	-0.0031	0.1697**	0.0186	0.1697**	0.0186
	(0.0408)		(0.0383)		(0.0853)		(0.0838)	
Self-employed	-0.3250**	-0.0320	-0.3250**	-0.0320	-0.2226*	-0.0229	-0.2226	-0.0229
	(0.1360)		(0.1424)		(0.1212)		(0.1357)	
Public worker	0.3911***	0.0476	0.3911**	0.0476	0.3731***	0.0465	0.3731**	0.0465
	(0.1452)		(0.1583)		(0.1349)		(0.1535)	
Agriculture	-0.4285	-0.0367	-0.4285	-0.0367	-0.5658*	-0.0452	-0.5657**	-0.0452
	(0.2832)		(0.2772)		(0.3109)		(0.2813)	
Building	-0.1055	-0.0110	-0.1055	-0.0110	-0.1369	-0.0145	-0.1369	-0.0144
	(0.1532)		(0.1463)		(0.1399)		(0.1429)	
Retail	-0.2385	-0.0232	-0.2385	-0.0232	-0.1758	-0.0178	-0.1757	-0.0178
	(0.1928)		(0.1911)		(0.1760)		(0.1830)	
Transport	-0.5749***	-0.0456	-0.5749***	-0.0456	-0.4868***	-0.0407	-0.4868**	-0.0407
	(0.2090)		(0.2121)		(0.1837)		(0.2033)	
Credit services	0.4111**	0.0554	0.4111	0.0554	0.3892**	0.0534	0.3892	0.0534
	(0.1830)		(0.2685)		(0.1797)		(0.2650)	
General government	-0.3184	-0.0291	-0.3183	-0.0291	-0.3230	-0.0298	-0.3230	-0.0298
	(0.2125)		(0.2297)		(0.2071)		(0.2258)	
White collar	-0.2056*	-0.0215	-0.2056*	-0.0215	-0.2574**	-0.0273	-0.2573**	-0.0273
	(0.1190)		(0.1207)		(0.1142)		(0.1189)	
Manager	-0.9222***	-0.0618	-0.9222***	-0.0618	-0.7747***	-0.0558	-0.7746***	-0.0557
	(0.2383)		(0.2766)		(0.2347)		(0.2559)	
Home owner	0.1409	0.0165	0.1409	0.0165	0.1667*	0.0203	0.1667	0.0203
	(0.1042)		(0.1084)		(0.0975)		(0.1064)	
Housing wealth	-0.0011***	-0.0000	-0.0011	-0.0000	-0.0009*	-0.0000	-0.0009	-0.0000
	(0.0003)		(0.0026)		(0.0005)		(0.0039)	
Stock	-0.0375	-0.0040	-0.0375	-0.0040	-0.1081	-0.0113	-0.1081	-0.0113
	(0.1629)		(0.1579)		(0.1556)		(0.1565)	
Fund	0.2362	0.0281	0.2361	0.0281	0.2618*	0.0324	0.2617*	0.0324
	(0.1606)		(0.1505)		(0.1506)		(0.1488)	
Retirement fund	-0.3725**	-0.0329	-0.3725*	-0.0329	-0.4142**	-0.0362	-0.4141**	-0.0362
	(0.1714)		(0.2020)		(0.1617)		(0.1979)	
Working spouse	-0.2028*	-0.0192	-0.2028*	-0.0192	-0.2795***	-0.0254	-0.2794**	-0.0254
	(0.1118)		(0.1137)		(0.1081)		(0.1102)	
N	1,988	1,988	1,988	1,988	1,988	1,988	1,988	1,988
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 13: Estimates for retirement, males

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0093**	0.0010	0.0093**	0.0010	0.0064*	0.0007	0.0064*	0.0007
	(0.0039)		(0.0039)		(0.0037)		(0.0037)	
PV	-0.0154	-0.0016	-0.0154	-0.0016	-0.0257**	-0.0028	-0.0257**	-0.0028
	(0.0116)		(0.0100)		(0.0128)		(0.0100)	
North	0.3140***	0.0341	0.3140***	0.0341	0.2520**	0.0277	0.2519**	0.0277
	(0.1096)		(0.1078)		(0.1010)		(0.1045)	
Expected wage	0.0011	0.0001	0.0011	0.0001	-0.0383	-0.0041	-0.0383	-0.0041
	(0.0337)		(0.0266)		(0.0398)		(0.0300)	
Pensionable earnings	-0.0341	-0.0036	-0.0341	-0.0036	0.1421	0.0153	0.1421*	0.0153
	(0.0443)		(0.0390)		(0.0872)		(0.0822)	
Self-employed	-0.3144**	-0.0306	-0.3144**	-0.0306	-0.2181*	-0.0221	-0.2180	-0.0221
	(0.1365)		(0.1422)		(0.1224)		(0.1359)	
Public worker	0.3967***	0.0478	0.3966**	0.0478	0.3865***	0.0477	0.3865**	0.0477
	(0.1453)		(0.1591)		(0.1344)		(0.1549)	
Agriculture	-0.3973	-0.0342	-0.3973	-0.0342	-0.5221*	-0.0419	-0.5221*	-0.0419
	(0.2863)		(0.2789)		(0.3119)		(0.2840)	
Building	-0.1048	-0.0108	-0.1048	-0.0108	-0.1330	-0.0139	-0.1330	-0.0139
	(0.1534)		(0.1467)		(0.1403)		(0.1437)	
Retail	-0.2403	-0.0230	-0.2403	-0.0230	-0.1690	-0.0170	-0.1690	-0.0170
	(0.1929)		(0.1913)		(0.1783)		(0.1838)	
Transport	-0.5746***	-0.0452	-0.5746***	-0.0452	-0.4840***	-0.0400	-0.4840**	-0.0400
	(0.2091)		(0.2120)		(0.1846)		(0.2035)	
Credit services	0.4019**	0.0532	0.4019	0.0532	0.3780**	0.0509	0.3780	0.0509
	(0.1841)		(0.2684)		(0.1817)		(0.2650)	
General government	-0.3360	-0.0301	-0.3360	-0.0301	-0.3469*	-0.0312	-0.3469	-0.0312
	(0.2139)		(0.2303)		(0.2077)		(0.2263)	
White collar	-0.2044*	-0.0212	-0.2044*	-0.0212	-0.2529**	-0.0265	-0.2529**	-0.0265
	(0.1195)		(0.1208)		(0.1142)		(0.1190)	
Manager	-0.9125***	-0.0609	-0.9124***	-0.0609	-0.7531***	-0.0540	-0.7531***	-0.0540
	(0.2429)		(0.2780)		(0.2460)		(0.2592)	
Home owner	0.1467	0.0170	0.1467	0.0170	0.1741*	0.0210	0.1741	0.0210
	(0.1043)		(0.1084)		(0.0978)		(0.1066)	
Housing wealth	-0.0011***	-0.0000	-0.0011	-0.0000	-0.0009*	-0.0000	-0.0009	-0.0000
	(0.0003)		(0.0027)		(0.0005)		(0.0043)	
Stock	-0.0453	-0.0047	-0.0453	-0.0047	-0.1211	-0.0124	-0.1211	-0.0124
	(0.1639)		(0.1583)		(0.1569)		(0.1570)	
Fund	0.2377	0.0280	0.2376	0.0280	0.2660*	0.0325	0.2660*	0.0325
	(0.1600)		(0.1503)		(0.1499)		(0.1485)	
Retirement fund	-0.3750**	-0.0328	-0.3750*	-0.0328	-0.4175**	-0.0360	-0.4175**	-0.0360
	(0.1710)		(0.2014)		(0.1629)		(0.1974)	
Working spouse	-0.2070*	-0.0193	-0.2070*	-0.0193	-0.2794**	-0.0251	-0.2794**	
	(0.1125)		(0.1142)		(0.1088)		(0.1108)	
N	1,988	1,988	1,988	1,988	1,988	1,988	1,988	1,988
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 14: Estimates for retirement, males

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0079**	0.0008	0.0079**	0.0008	0.0059*	0.0006	0.0059*	0.0006
	(0.0032)		(0.0032)		(0.0032)		(0.0031)	
ACC	-0.0184*	-0.0020	-0.0184**	-0.0020	-0.0259**	-0.0028	-0.0259***	-0.0028
	(0.0100)		(0.0091)		(0.0110)		(0.0093)	
North	0.2897***	0.0322	0.2897***	0.0322	0.2089**	0.0236	0.2089**	0.0236
	(0.0896)		(0.0909)		(0.0839)		(0.0886)	
Expected wage	-0.0014	-0.0002	-0.0014	-0.0002	-0.0334	-0.0037	-0.0334	-0.0037
	(0.0230)		(0.0188)		(0.0298)		(0.0222)	
Pensionable earnings	-0.0321	-0.0034	-0.0321	-0.0034	0.1121*	0.0122	0.1121*	0.0122
	(0.0381)		(0.0319)		(0.0636)		(0.0599)	
Self-employed	-0.5481***	-0.0513	-0.5482***	-0.0513	-0.4148***	-0.0408	-0.4148***	-0.0408
	(0.1238)		(0.1187)		(0.1115)		(0.1119)	
Public worker	0.2641*	0.0306	0.2641*	0.0306	0.2676**	0.0321	0.2676**	0.0321
	(0.1370)		(0.1387)		(0.1248)		(0.1338)	
Agriculture	-0.3273	-0.0297	-0.3274	-0.0297	-0.2435	-0.0233	-0.2435	-0.0233
	(0.2168)		(0.2044)		(0.2210)		(0.1982)	
Building	0.0034	0.0004	0.0034	0.0004	0.0405	0.0045	0.0405	0.0045
	(0.1266)		(0.1264)		(0.1174)		(0.1227)	
Retail	-0.1425	-0.0142	-0.1426	-0.0142	-0.0797	-0.0084	-0.0797	-0.0084
	(0.1669)		(0.1659)		(0.1554)		(0.1595)	
Transport	-0.2927	-0.0264	-0.2927	-0.0264	-0.1925	-0.0187	-0.1925	-0.0187
	(0.1994)		(0.1831)		(0.1731)		(0.1770)	
Credit services	0.2913	0.0368	0.2913	0.0368	0.2918*	0.0382	0.2918	0.0382
	(0.1870)		(0.2254)		(0.1766)		(0.2199)	
General government	-0.2413	-0.0226	-0.2413	-0.0226	-0.2444	-0.0233	-0.2444	-0.0233
	(0.1807)		(0.1902)		(0.1672)		(0.1859)	
White collar	-0.2186**	-0.0226	-0.2186**	-0.0226	-0.2346**	-0.0247	-0.2346**	-0.0247
	(0.0990)		(0.1047)		(0.0965)		(0.1030)	
Manager	-0.5285***	-0.0429	-0.5285***	-0.0429	-0.3401**	-0.0309	-0.3401**	-0.0309
	(0.1716)		(0.1836)		(0.1632)		(0.1704)	
Ill after 50	0.3966***	0.0525	0.3966**	0.0525	0.3710***	0.0504	0.3710**	0.0504
	(0.1450)		(0.1789)		(0.1379)		(0.1734)	
Control	0.1608*	0.0189	0.1608*	0.0189	0.1261	0.0150	0.1261	0.0150
	(0.0933)		(0.0942)		(0.0855)		(0.0914)	
Effort	0.2600***	0.0326	0.2600***	0.0326	0.2373***	0.0303	0.2373***	0.0303
	(0.0928)		(0.0890)		(0.0834)		(0.0864)	
Reward	0.1955**	0.0235	0.1955**	0.0235	0.2182***	0.0276	0.2182**	0.0276
	(0.0896)		(0.0918)		(0.0846)		(0.0896)	
N	2,780	2,780	2,780	2,780	2,780	2,780	2,780	2,780
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 15: Estimates for retirement, males

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0071**	0.0007	0.0071**	0.0007	0.0048	0.0005	0.0048	0.0005
	(0.0032)		(0.0032)		(0.0031)		(0.0031)	
PV	-0.0170**	-0.0018	-0.0170**	-0.0018	-0.0249***	-0.0027	-0.0249***	-0.0027
	(0.0083)		(0.0085)		(0.0091)		(0.0083)	
North	0.2836***	0.0310	0.2835***	0.0310	0.1991**	0.0223	0.1991**	0.0223
	(0.0900)		(0.0909)		(0.0841)		(0.0888)	
Expected wage	0.0066	0.0007	0.0066	0.0007	-0.0186	-0.0020	-0.0186	-0.0020
	(0.0262)		(0.0209)		(0.0323)		(0.0238)	
Pensionable earnings	-0.0335	-0.0035	-0.0335	-0.0035	0.0890	0.0097	0.0890	0.0097
	(0.0396)		(0.0323)		(0.0641)		(0.0594)	
Self-employed	-0.5450***	-0.0503	-0.5449***	-0.0503	-0.4188***	-0.0408	-0.4188***	-0.0408
	(0.1239)		(0.1184)		(0.1118)		(0.1119)	
Public worker	0.2702**	0.0310	0.2702*	0.0310	0.2788**	0.0334	0.2788**	0.0334
	(0.1370)		(0.1392)		(0.1248)		(0.1347)	
Agriculture	-0.2941	-0.0267	-0.2941	-0.0267	-0.2043	-0.0199	-0.2043	-0.0199
	(0.2194)		(0.2059)		(0.2224)		(0.1999)	
Building	0.0181	0.0019	0.0181	0.0019	0.0617	0.0068	0.0617	0.0068
	(0.1276)		(0.1269)		(0.1184)		(0.1234)	
Retail	-0.1338	-0.0132	-0.1338	-0.0132	-0.0594	-0.0063	-0.0594	-0.0063
	(0.1680)		(0.1662)		(0.1576)		(0.1602)	
Transport	-0.2859	-0.0255	-0.2859	-0.0255	-0.1842	-0.0179	-0.1842	-0.0179
	(0.1996)		(0.1829)		(0.1742)		(0.1768)	
Credit services	0.2913	0.0363	0.2912	0.0363	0.2934*	0.0382	0.2934	0.0382
	(0.1864)		(0.2252)		(0.1757)		(0.2199)	
General government	-0.2505	-0.0231	-0.2504	-0.0231	-0.2556	-0.0241	-0.2556	-0.0241
	(0.1805)		(0.1903)		(0.1666)		(0.1860)	
White collar	-0.2101**	-0.0214	-0.2101**	-0.0214	-0.2199**	-0.0231	-0.2199**	-0.0231
	(0.0992)		(0.1047)		(0.0966)		(0.1030)	
Manager	-0.5149***	-0.0415	-0.5149***	-0.0415	-0.3210*	-0.0293	-0.3210*	-0.0293
	(0.1740)		(0.1848)		(0.1682)		(0.1723)	
Ill after 50	0.3902***	0.0508	0.3902**	0.0508	0.3634***	0.0488	0.3634**	0.0488
	(0.1452)		(0.1789)		(0.1382)		(0.1736)	
Control	0.1657*	0.0193	0.1656*	0.0193	0.1334	0.0158	0.1334	0.0158
	(0.0933)		(0.0942)		(0.0857)		(0.0914)	
Effort	0.2577***	0.0318	0.2577***	0.0318	0.2352***	0.0298	0.2352***	0.0298
	(0.0927)		(0.0889)		(0.0836)		(0.0863)	
Reward	0.1947**	0.0231	0.1947**	0.0231	0.2204***	0.0277	0.2203**	0.0277
	(0.0900)		(0.0919)		(0.0852)		(0.0899)	
N	2,780	2,780	2,780	2,780	2,780	2,780	2,780	2,780
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 16: Estimates for retirement, males

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0096***	0.0010	0.0096**	0.0010	0.0070*	0.0008	0.0070*	0.0008
	(0.0037)		(0.0039)		(0.0037)		(0.0038)	
ACC	-0.0138	-0.0015	-0.0138	-0.0015	-0.0218	-0.0024	-0.0218*	-0.0024
	(0.0137)		(0.0119)		(0.0154)		(0.0122)	
North	0.3753***	0.0410	0.3753***	0.0410	0.2830***	0.0315	0.2830**	0.0315
	(0.1122)		(0.1144)		(0.1041)		(0.1106)	
Expected wage	-0.0150	-0.0016	-0.0150	-0.0016	-0.0485	-0.0052	-0.0485*	-0.0052
	(0.0262)		(0.0238)		(0.0337)		(0.0283)	
Pensionable earnings	-0.0158	-0.0017	-0.0158	-0.0017	0.1365*	0.0147	0.1365	0.0147
	(0.0360)		(0.0389)		(0.0799)		(0.0847)	
Self-employed	-0.4576***	-0.0432	-0.4576***	-0.0432	-0.3206**	-0.0319	-0.3206**	-0.0319
	(0.1475)		(0.1617)		(0.1320)		(0.1529)	
Public worker	0.4307***	0.0521	0.4307**	0.0521	0.4010***	0.0496	0.4010**	0.0496
	(0.1559)		(0.1681)		(0.1444)		(0.1623)	
Agriculture	-0.4907*	-0.0405	-0.4907*	-0.0405	-0.5803*	-0.0459	-0.5802**	-0.0459
	(0.2944)		(0.2893)		(0.3153)		(0.2908)	
Building	-0.1436	-0.0146	-0.1436	-0.0146	-0.1555	-0.0161	-0.1554	-0.0161
	(0.1584)		(0.1584)		(0.1429)		(0.1544)	
Retail	-0.2277	-0.0219	-0.2277	-0.0219	-0.1550	-0.0157	-0.1550	-0.0157
	(0.1992)		(0.2017)		(0.1831)		(0.1923)	
Transport	-0.5183**	-0.0419	-0.5184**	-0.0419	-0.4036**	-0.0349	-0.4036*	-0.0349
	(0.2262)		(0.2208)		(0.1945)		(0.2112)	
Credit services	0.3602*	0.0461	0.3602	0.0461	0.3553**	0.0471	0.3553	0.0471
	(0.1950)		(0.2743)		(0.1813)		(0.2703)	
General government	-0.4682**	-0.0393	-0.4682*	-0.0393	-0.4218*	-0.0366	-0.4218*	-0.0366
	(0.2310)		(0.2522)		(0.2177)		(0.2447)	
White collar	-0.2063*	-0.0213	-0.2063	-0.0213	-0.2295*	-0.0242	-0.2294*	-0.0242
	(0.1219)		(0.1270)		(0.1188)		(0.1248)	
Manager	-0.9754***	-0.0640	-0.9755***	-0.0640	-0.7677***	-0.0554	-0.7676***	-0.0554
	(0.2496)		(0.2847)		(0.2382)		(0.2602)	
Home owner	0.1145	0.0129	0.1145	0.0129	0.1491	0.0177	0.1491	0.0177
	(0.1105)		(0.1173)		(0.1037)		(0.1148)	
Housing wealth	-0.0011***	-0.0000	-0.0011	-0.0000	-0.0010	-0.0000	-0.0010	-0.0000
	(0.0003)		(0.0036)		(0.0006)		(0.0054)	
Stock	-0.0309	-0.0032	-0.0309	-0.0032	-0.0980	-0.0101	-0.0980	-0.0101
	(0.1634)		(0.1639)		(0.1560)		(0.1620)	
Fund	0.2994*	0.0359	0.2995*	0.0359	0.3379**	0.0427	0.3378**	0.0427
	(0.1697)		(0.1613)		(0.1583)		(0.1587)	
Retirement fund	-0.3648**	-0.0320	-0.3649*	-0.0320	-0.4612**	-0.0390	-0.4611**	-0.0390
	(0.1856)		(0.2144)		(0.1794)		(0.2138)	
Working spouse	-0.1766	-0.0167	-0.1766	-0.0167	-0.2452**	-0.0226	-0.2451**	-0.0226
	(0.1191)		(0.1188)		(0.1152)		(0.1145)	
Ill after 50	0.4397***	0.0578	0.4397**	0.0578	0.4052***	0.0544	0.4051**	0.0544
	(0.1635)		(0.2051)		(0.1564)		(0.1991)	
Control	0.1846	0.0217	0.1846	0.0217	0.1384	0.0163	0.1384	0.0163
	(0.1205)		(0.1249)		(0.1104)		(0.1213)	
Effort	0.3132***	0.0396	0.3132***	0.0396	0.2689***	0.0343	0.2689**	0.0343
	(0.1144)		(0.1176)		(0.1040)		(0.1139)	
Reward	0.1393	0.0160	0.1393	0.0160	0.1433	0.0169	0.1432	0.0169
	(0.1135)		(0.1150)		(0.1073)		(0.1119)	
N	1,880	1,880	1,880	1,880	1,880	1,880	1,880	1,880
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 17: Estimates for retirement, males

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0088**	0.0009	0.0088**	0.0009	0.0059	0.0006	0.0059	0.0006
	(0.0038)		(0.0039)		(0.0036)		(0.0038)	
PV	-0.0135	-0.0014	-0.0135	-0.0014	-0.0234*	-0.0025	-0.0234**	-0.0025
	(0.0108)		(0.0105)		(0.0122)		(0.0103)	
North	0.3694***	0.0399	0.3694***	0.0399	0.2718***	0.0296	0.2717**	0.0296
	(0.1129)		(0.1147)		(0.1048)		(0.1111)	
Expected wage	-0.0047	-0.0005	-0.0047	-0.0005	-0.0281	-0.0030	-0.0281	-0.0030
	(0.0315)		(0.0273)		(0.0370)		(0.0302)	
Pensionable earnings	-0.0192	-0.0020	-0.0192	-0.0020	0.1119	0.0119	0.1118	0.0119
	(0.0385)		(0.0396)		(0.0809)		(0.0830)	
Self-employed	-0.4522***	-0.0423	-0.4523***	-0.0423	-0.3253**	-0.0317	-0.3253**	-0.0317
	(0.1483)		(0.1611)		(0.1337)		(0.1529)	
Public worker	0.4376***	0.0524	0.4376***	0.0524	0.4196***	0.0513	0.4195**	0.0513
	(0.1565)		(0.1686)		(0.1445)		(0.1634)	
Agriculture	-0.4499	-0.0374	-0.4499	-0.0374	-0.5182	-0.0414	-0.5182*	-0.0414
	(0.2978)		(0.2912)		(0.3164)		(0.2936)	
Building	-0.1344	-0.0136	-0.1344	-0.0136	-0.1410	-0.0144	-0.1409	-0.0144
	(0.1598)		(0.1585)		(0.1439)		(0.1550)	
Retail	-0.2205	-0.0210	-0.2205	-0.0210	-0.1335	-0.0134	-0.1336	-0.0134
	(0.2002)		(0.2019)		(0.1857)		(0.1931)	
Transport	-0.5145**	-0.0412	-0.5145**	-0.0412	-0.3964**	-0.0338	-0.3964*	-0.0338
	(0.2262)		(0.2205)		(0.1954)		(0.2109)	
Credit services	0.3573*	0.0452	0.3574	0.0452	0.3555*	0.0462	0.3555	0.0462
	(0.1956)		(0.2742)		(0.1825)		(0.2704)	
General government	-0.4808**	-0.0397	-0.4808*	-0.0397	-0.4414**	-0.0372	-0.4413*	-0.0372
	(0.2323)		(0.2527)		(0.2182)		(0.2449)	
White collar	-0.2023*	-0.0206	-0.2023	-0.0206	-0.2221*	-0.0230	-0.2221*	-0.0230
	(0.1218)		(0.1269)		(0.1185)		(0.1247)	
Manager	-0.9673***	-0.0630	-0.9674***	-0.0630	-0.7473***	-0.0534	-0.7471***	-0.0534
	(0.2539)		(0.2859)		(0.2508)		(0.2632)	
Home owner	0.1214	0.0136	0.1214	0.0136	0.1563	0.0183	0.1563	0.0183
	(0.1108)		(0.1174)		(0.1040)		(0.1150)	
Housing wealth	-0.0011***	-0.0002	-0.0011	-0.0002	-0.0010	-0.0000	-0.0010	-0.0000
	(0.0004)		(0.0038)		(0.0009)		(0.0067)	
Stock	-0.0356	-0.0037	-0.0357	-0.0037	-0.1099	-0.0111	-0.1099	-0.0111
	(0.1644)		(0.1639)		(0.1575)		(0.1625)	
Fund	0.3003*	0.0357	0.3004*	0.0357	0.3386**	0.0420	0.3385**	0.0420
	(0.1690)		(0.1607)		(0.1577)		(0.1580)	
Retirement fund	-0.3700**	-0.0321	-0.3700*	-0.0321	-0.4660***	-0.0386	-0.4658**	-0.0386
	(0.1861)		(0.2139)		(0.1802)		(0.2134)	
Ill after 50	0.4300***	0.0556	0.4301**	0.0556	0.3918**	0.0513	0.3918**	0.0513
	(0.1641)		(0.2051)		(0.1571)		(0.1996)	
Control	0.1909	0.0223	0.1909	0.0223	0.1529	0.0178	0.1529	0.0178
	(0.1210)		(0.1249)		(0.1112)		(0.1216)	
Effort	0.3081***	0.0384	0.3081***	0.0384	0.2627**	0.0328	0.2627**	0.0328
	(0.1143)		(0.1175)		(0.1038)		(0.1141)	
Reward	0.1368	0.0155	0.1368	0.0155	0.1424	0.0165	0.1424	0.0165
	(0.1140)		(0.1151)		(0.1083)		(0.1122)	
Working spouse		-0.0166	-0.1771	-0.0166	-0.2406**	-0.0218	-0.2406**	-0.0218
			(0.1190)		(0.1159)		(0.1149)	
N	1,880	1,880	1,880	1,880	1,880	1,880	1,880	1,880
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 18: Estimates for retirement, females

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0072***	0.0155***	0.0018	0.0155***	0.0018	0.0146**	0.0015	0.0150**	0.0015
	(0.0027)	(0.0054)		(0.0053)		(0.0059)		(0.0061)	
ACC	-0.0180**	-0.0293	-0.0034	-0.0293*	-0.0034	-0.0649**	-0.0068	-0.0672***	-0.0069
	(0.0072)	(0.0227)		(0.0167)		(0.0281)		(0.0251)	
Age	0.0310***	0.1510***	0.0174	0.1510***	0.0174	0.1449***	0.0152	0.1547***	0.0160
	(0.0040)	(0.0219)		(0.0191)		(0.0229)		(0.0546)	
Expected wage	0.0032	0.0545*	0.0063	0.0545	0.0063	-0.0179	-0.0019	-0.0171	-0.0018
	(0.0058)	(0.0280)		(0.0361)		(0.0352)		(0.0396)	
Pensionable earnings	0.1067***	-0.1652***	-0.0190	-0.1652**	-0.0190	0.1921**	0.0201	0.2000	0.0206
	(0.0359)	(0.0526)		(0.0663)		(0.0913)		(0.1368)	
North		-0.0458	-0.0052	-0.0459	-0.0052	-0.0348	-0.0036	-0.0461	-0.0047
		(0.1388)		(0.1404)		(0.1398)		(0.1609)	
Self-employed		-0.5186***	-0.0538	-0.5187***	-0.0538	-0.5085**	-0.0477	-0.5373**	-0.0494
		(0.1961)		(0.1972)		(0.2015)		(0.2672)	
Public worker		0.3426**	0.0433	0.3427*	0.0433	0.3970**	0.0463	0.4210*	0.0484
		(0.1626)		(0.1847)		(0.1718)		(0.2367)	
White collar		-0.3172**	-0.0348	-0.3173*	-0.0348	-0.4076**	-0.0401	-0.4334*	-0.0418
		(0.1517)		(0.1787)		(0.1613)		(0.2391)	
Manager		-0.5230*	-0.0472	-0.5232**	-0.0473	-0.4200	-0.0366	-0.4513	-0.0384
		(0.2744)		(0.2614)		(0.2633)		(0.3277)	
N	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185
Rho	0.80	.	.	0.00	0.00	.	.	0.04	0.04
Age dummies	No	No	No	No	No	No	No	No	No

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 19: Estimates for retirement, females

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0020	0.0164***	0.0016	0.0164***	0.0016	0.0153***	0.0014	0.0153**	0.0014
	(0.0026)	(0.0051)		(0.0058)		(0.0058)		(0.0061)	
ACC	-0.0122*	-0.0350	-0.0034	-0.0350*	-0.0034	-0.0702**	-0.0065	-0.0702***	-0.0065
	(0.0070)	(0.0225)		(0.0179)		(0.0288)		(0.0231)	
Expected wage	0.0016	0.0570**	0.0055	0.0570	0.0055	-0.0137	-0.0013	-0.0137	-0.0013
	(0.0057)	(0.0265)		(0.0359)		(0.0293)		(0.0400)	
Pensionable earnings	0.0630**	-0.1855***	-0.0180	-0.1855***	-0.0180	0.1592**	0.0147	0.1592	0.0147
	(0.0293)	(0.0451)		(0.0680)		(0.0796)		(0.1305)	
North		0.0113	0.0011	0.0113	0.0011	0.0061	0.0006	0.0061	0.0006
		(0.1372)		(0.1481)		(0.1395)		(0.1503)	
Self-employed		-0.3937**	-0.0352	-0.3938*	-0.0352	-0.4043**	-0.0342	-0.4042*	-0.0342
		(0.1754)		(0.2030)		(0.1858)		(0.2118)	
Public worker		0.3732**	0.0405	0.3733*	0.0405	0.4190**	0.0435	0.4189**	0.0435
		(0.1681)		(0.1945)		(0.1810)		(0.2003)	
White collar		-0.4106***	-0.0373	-0.4107**	-0.0373	-0.4884***	-0.0416	-0.4883**	-0.0415
		(0.1481)		(0.1877)		(0.1608)		(0.1961)	
Manager		-0.4990*	-0.0385	-0.4990*	-0.0385	-0.3782	-0.0295	-0.3781	-0.0295
		(0.2840)		(0.2727)		(0.2842)		(0.2804)	
N	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185
Rho	0.75	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 20: Estimates for retirement, females

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0055**	0.0164***	0.0019	0.0164***	0.0019	0.0128*	0.0013	0.0136*	0.0014
	(0.0026)	(0.0058)		(0.0055)		(0.0068)		(0.0071)	
PV	-0.0114**	-0.0131	-0.0015	-0.0131	-0.0015	-0.0492*	-0.0052	-0.0566*	-0.0057
	(0.0045)	(0.0164)		(0.0157)		(0.0290)		(0.0318)	
Age	0.0292***	0.1482***	0.0169	0.1482***	0.0169	0.1369***	0.0144	0.1634**	0.0164
	(0.0041)	(0.0220)		(0.0192)		(0.0229)		(0.0778)	
Expected wage	0.0025	0.0400*	0.0045	0.0400	0.0045	-0.0224	-0.0023	-0.0206	-0.0021
	(0.0045)	(0.0231)		(0.0365)		(0.0294)		(0.0424)	
Pensionable earnings	0.0728**	-0.1525***	-0.0173	-0.1525**	-0.0173	0.2294**	0.0241	0.2614	0.0261
	(0.0320)	(0.0510)		(0.0660)		(0.0975)		(0.1723)	
North		-0.0393	-0.0044	-0.0393	-0.0044	-0.0269	-0.0028	-0.0596	-0.0059
		(0.1386)		(0.1398)		(0.1401)		(0.1867)	
Self-employed		-0.4779**	-0.0493	-0.4778**	-0.0493	-0.4170**	-0.0399	-0.4873	-0.0440
		(0.1932)		(0.1955)		(0.1989)		(0.3221)	
Public worker		0.3230**	0.0402	0.3230*	0.0402	0.3532**	0.0408	0.4171	0.0462
		(0.1616)		(0.1840)		(0.1688)		(0.2848)	
White collar		-0.3261**	-0.0353	-0.3261*	-0.0353	-0.4087**	-0.0401	-0.4839	-0.0449
		(0.1522)		(0.1785)		(0.1621)		(0.3070)	
Manager		-0.5234*	-0.0467	-0.5234**	-0.0467	-0.4062	-0.0356	-0.4849	-0.0397
		(0.2698)		(0.2595)		(0.2605)		(0.3848)	
N	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185
Rho	0.65	.	.	0.00	0.00	.	.	0.12	0.12
Age dummies	No	No	No	No	No	No	No	No	No

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 21: Estimates for retirement, females

	(1)	(2)		(3)		(4)		(5)	
Model	Linear	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Fixed Effect	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	-0.0008	0.0176***	0.0017	0.0176***	0.0017	0.0149**	0.0014	0.0149**	0.0014
	(0.0027)	(0.0053)		(0.0060)		(0.0062)		(0.0064)	
PV	-0.0071	-0.0135	-0.0013	-0.0135	-0.0013	-0.0410	-0.0038	-0.0410*	-0.0038
	(0.0046)	(0.0166)		(0.0169)		(0.0291)		(0.0247)	
Expected wage	0.0005	0.0367*	0.0035	0.0367	0.0035	-0.0259	-0.0024	-0.0259	-0.0024
	(0.0047)	(0.0216)		(0.0365)		(0.0295)		(0.0440)	
Pensionable earnings	0.0404	-0.1685***	-0.0162	-0.1685**	-0.0162	0.1811*	0.0168	0.1810	0.0168
	(0.0256)	(0.0469)		(0.0681)		(0.0950)		(0.1386)	
North		0.0176	0.0017	0.0176	0.0017	0.0158	0.0015	0.0159	0.0015
		(0.1367)		(0.1472)		(0.1393)		(0.1494)	
Self-employed		-0.3531**	-0.0316	-0.3531*	-0.0316	-0.3279*	-0.0284	-0.3278	-0.0284
		(0.1740)		(0.2011)		(0.1822)		(0.2104)	
Public worker		0.3502**	0.0374	0.3502*	0.0374	0.3680**	0.0381	0.3679*	0.0381
		(0.1668)		(0.1934)		(0.1753)		(0.1979)	
White collar		-0.4192***	-0.0378	-0.4193**	-0.0378	-0.4884***	-0.0419	-0.4883**	-0.0419
		(0.1474)		(0.1874)		(0.1600)		(0.1954)	
Manager		-0.5092*	-0.0388	-0.5093*	-0.0388	-0.3966	-0.0309	-0.3966	-0.0309
		(0.2780)		(0.2706)		(0.2822)		(0.2789)	
N	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185	1,185
Rho	0.62	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 22: Estimates for retirement, females

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0214**	0.0021	0.0214**	0.0021	0.0158*	0.0014	0.0158*	0.0014
	(0.0097)		(0.0089)		(0.0089)		(0.0088)	
ACC	-0.0290	-0.0028	-0.0290	-0.0028	-0.1533***	-0.0138	-0.1532***	-0.0138
	(0.0250)		(0.0221)		(0.0450)		(0.0446)	
North	-0.0385	-0.0038	-0.0385	-0.0038	-0.0082	-0.0007	-0.0082	-0.0007
	(0.1817)		(0.2032)		(0.1912)		(0.2186)	
Expected wage	0.0441	0.0043	0.0441	0.0043	-0.3154***	-0.0285	-0.3154***	-0.0285
	(0.0388)		(0.0517)		(0.1169)		(0.0999)	
Pensionable earnings	-0.2102***	-0.0206	-0.2102**	-0.0206	0.5102**	0.0461	0.5102*	0.0461
	(0.0683)		(0.0870)		(0.2158)		(0.2675)	
Self-employed	-0.6069**	-0.0522	-0.6070**	-0.0522	-0.4976	-0.0409	-0.4975*	-0.0409
	(0.2705)		(0.2751)		(0.3083)		(0.2996)	
Public worker	0.3741	0.0409	0.3742	0.0409	0.6083**	0.0643	0.6082**	0.0643
	(0.2294)		(0.2625)		(0.2560)		(0.2966)	
White collar	-0.4668**	-0.0432	-0.4669*	-0.0432	-0.5302**	-0.0449	-0.5301*	-0.0449
	(0.2240)		(0.2617)		(0.2399)		(0.2800)	
Manager	-0.5610	-0.0427	-0.5610	-0.0427	-0.3205	-0.0254	-0.3205	-0.0254
	(0.3799)		(0.3556)		(0.3947)		(0.3823)	
Home owner	-0.1475	-0.0133	-0.1475	-0.0133	-0.0728	-0.0063	-0.0728	-0.0063
	(0.2379)		(0.2174)		(0.2576)		(0.2341)	
Housing wealth	-0.0002	-0.0000	-0.0002	-0.0000	-0.0002	-0.0000	-0.0002	-0.0000
	(0.0002)		(0.0035)		(0.0002)		(0.0031)	
Stock	0.5856*	0.0718	0.5856*	0.0718	0.6566*	0.0742	0.6565*	0.0742
	(0.3459)		(0.3459)		(0.3738)		(0.3640)	
Fund	-0.3331	-0.0285	-0.3331	-0.0285	-0.4325	-0.0332	-0.4325	-0.0332
	(0.3625)		(0.4191)		(0.3774)		(0.4540)	
Working spouse	0.0133	0.0013	0.0132	0.0013	-0.0528	-0.0046	-0.0528	-0.0046
	(0.1938)		(0.2030)		(0.2083)		(0.2171)	
N	731	731	731	731	731	731	731	731
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 23: Estimates for retirement, females

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0209**	0.0020	0.0209**	0.0020	0.0159*	0.0014	0.0159*	0.0014
	(0.0099)		(0.0090)		(0.0092)		(0.0088)	
PV	-0.0291	-0.0028	-0.0291	-0.0028	-0.1260***	-0.0114	-0.1260***	-0.0114
	(0.0242)		(0.0211)		(0.0457)		(0.0400)	
North	-0.0371	-0.0036	-0.0371	-0.0036	-0.0227	-0.0020	-0.0226	-0.0020
	(0.1829)		(0.2034)		(0.1955)		(0.2166)	
Expected wage	0.0481	0.0046	0.0481	0.0046	-0.2538**	-0.0230	-0.2538***	-0.0230
	(0.0413)		(0.0529)		(0.1061)		(0.0980)	
Pensionable earnings	-0.2085***	-0.0201	-0.2084**	-0.0201	0.3053	0.0276	0.3053	0.0276
	(0.0686)		(0.0879)		(0.2180)		(0.2657)	
Self-employed	-0.5704**	-0.0487	-0.5702**	-0.0487	-0.3737	-0.0314	-0.3736	-0.0314
	(0.2758)		(0.2736)		(0.3046)		(0.2923)	
Public worker	0.3685	0.0396	0.3684	0.0395	0.5523**	0.0576	0.5523*	0.0576
	(0.2289)		(0.2630)		(0.2516)		(0.2917)	
White collar	-0.4593**	-0.0418	-0.4592*	-0.0418	-0.4977**	-0.0424	-0.4976*	-0.0424
	(0.2272)		(0.2635)		(0.2421)		(0.2803)	
Manager	-0.5628	-0.0422	-0.5627	-0.0422	-0.3171	-0.0252	-0.3171	-0.0252
	(0.3808)		(0.3548)		(0.3890)		(0.3774)	
Home owner	-0.1499	-0.0133	-0.1499	-0.0133	-0.0588	-0.0052	-0.0587	-0.0052
	(0.2374)		(0.2179)		(0.2546)		(0.2337)	
Housing wealth	-0.0001	-0.0000	-0.0001	-0.0000	0.0001	0.0000	0.0001	0.0000
	(0.0002)		(0.0034)		(0.0002)		(0.0032)	
Stock	0.5901*	0.0716	0.5900*	0.0716	0.6554*	0.0741	0.6553*	0.0741
	(0.3432)		(0.3456)		(0.3627)		(0.3601)	
Fund	-0.3421	-0.0287	-0.3420	-0.0287	-0.4478	-0.0343	-0.4477	-0.0343
	(0.3637)		(0.4179)		(0.3759)		(0.4442)	
Working spouse	0.0212	0.0021	0.0212	0.0021	-0.0027	-0.0002	-0.0027	-0.0002
	(0.1949)		(0.2023)		(0.2111)		(0.2131)	
N	731	731	731	731	731	731	731	731
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 24: Estimates for retirement, females

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0157***	0.0015	0.0157***	0.0015	0.0142**	0.0013	0.0142**	0.0013
	(0.0049)		(0.0058)		(0.0057)		(0.0062)	
ACC	-0.0340	-0.0032	-0.0340*	-0.0032	-0.0663**	-0.0060	-0.0663***	-0.0060
	(0.0219)		(0.0183)		(0.0292)		(0.0236)	
North	0.0746	0.0072	0.0746	0.0072	0.0640	0.0059	0.0640	0.0059
	(0.1359)		(0.1526)		(0.1379)		(0.1542)	
Expected wage	0.0599**	0.0057	0.0599	0.0057	-0.0133	-0.0012	-0.0133	-0.0012
	(0.0265)		(0.0383)		(0.0307)		(0.0416)	
Pensionable earnings	-0.1844***	-0.0175	-0.1844***	-0.0175	0.1343	0.0122	0.1342	0.0122
	(0.0449)		(0.0704)		(0.0834)		(0.1370)	
Self-employed	-0.4608**	-0.0401	-0.4607**	-0.0401	-0.4326**	-0.0360	-0.4325*	-0.0360
	(0.2108)		(0.2246)		(0.2196)		(0.2354)	
Public worker	0.3077*	0.0320	0.3076	0.0320	0.3570*	0.0359	0.3569*	0.0359
	(0.1772)		(0.1979)		(0.1906)		(0.2048)	
White collar	-0.4622***	-0.0410	-0.4621**	-0.0410	-0.4991***	-0.0420	-0.4990**	-0.0420
	(0.1592)		(0.2089)		(0.1705)		(0.2194)	
Manager	-0.4857	-0.0372	-0.4856	-0.0372	-0.3196	-0.0253	-0.3196	-0.0253
	(0.3066)		(0.3109)		(0.3155)		(0.3304)	
Ill after 50	0.2287	0.0243	0.2286	0.0243	0.1275	0.0123	0.1275	0.0123
	(0.2088)		(0.2561)		(0.1961)		(0.2658)	
Control	0.0309	0.0030	0.0309	0.0030	-0.0360	-0.0032	-0.0359	-0.0032
	(0.1767)		(0.1888)		(0.1888)		(0.2008)	
Effort	0.0959	0.0096	0.0958	0.0096	0.1028	0.0099	0.1028	0.0099
	(0.1603)		(0.1574)		(0.1654)		(0.1604)	
Reward	0.3800**	0.0444	0.3800**	0.0444	0.3695**	0.0409	0.3695**	0.0409
	(0.1718)		(0.1706)		(0.1787)		(0.1733)	
N	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 25: Estimates for retirement, females

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0169***	0.0016	0.0169***	0.0016	0.0143**	0.0013	0.0143**	0.0013
	(0.0050)		(0.0060)		(0.0060)		(0.0065)	
PV	-0.0123	-0.0012	-0.0123	-0.0012	-0.0350	-0.0032	-0.0350	-0.0032
	(0.0164)		(0.0174)		(0.0277)		(0.0246)	
North	0.0806	0.0077	0.0806	0.0077	0.0750	0.0069	0.0750	0.0069
	(0.1358)		(0.1517)		(0.1384)		(0.1532)	
Expected wage	0.0382*	0.0036	0.0382	0.0036	-0.0260	-0.0024	-0.0260	-0.0024
	(0.0216)		(0.0388)		(0.0306)		(0.0455)	
Pensionable earnings	-0.1652***	-0.0156	-0.1652**	-0.0156	0.1447	0.0133	0.1447	0.0133
	(0.0469)		(0.0699)		(0.0939)		(0.1421)	
Self-employed	-0.4107**	-0.0357	-0.4106*	-0.0357	-0.3516*	-0.0299	-0.3515	-0.0299
	(0.2073)		(0.2206)		(0.2127)		(0.2320)	
Public worker	0.2849	0.0292	0.2848	0.0292	0.3040*	0.0304	0.3040	0.0304
	(0.1769)		(0.1970)		(0.1840)		(0.2022)	
White collar	-0.4636***	-0.0407	-0.4635**	-0.0407	-0.4883***	-0.0414	-0.4883**	-0.0414
	(0.1590)		(0.2079)		(0.1681)		(0.2183)	
Manager	-0.4816	-0.0367	-0.4815	-0.0367	-0.3208	-0.0255	-0.3208	-0.0255
	(0.2995)		(0.3072)		(0.3093)		(0.3278)	
Ill after 50	0.2558	0.0274	0.2558	0.0274	0.2005	0.0202	0.2005	0.0202
	(0.2209)		(0.2528)		(0.2106)		(0.2572)	
Control	0.0104	0.0010	0.0104	0.0010	-0.0544	-0.0048	-0.0543	-0.0048
	(0.1774)		(0.1870)		(0.1886)		(0.1986)	
Effort	0.0899	0.0089	0.0898	0.0089	0.0930	0.0090	0.0930	0.0090
	(0.1593)		(0.1565)		(0.1648)		(0.1593)	
Reward	0.3843**	0.0448	0.3843**	0.0448	0.3640**	0.0406	0.3639**	0.0406
	(0.1717)		(0.1700)		(0.1771)		(0.1726)	
N	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 26: Estimates for retirement, females

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0223**	0.0022	0.0223**	0.0022	0.0181*	0.0016	0.0181*	0.0016
	(0.0104)		(0.0095)		(0.0093)		(0.0093)	
ACC	-0.0269	-0.0026	-0.0269	-0.0026	-0.1506***	-0.0136	-0.1506***	-0.0136
	(0.0237)		(0.0225)		(0.0473)		(0.0458)	
North	0.0219	0.0021	0.0219	0.0021	0.0757	0.0069	0.0757	0.0069
	(0.1717)		(0.2220)		(0.1860)		(0.2350)	
Expected wage	0.0437	0.0042	0.0437	0.0042	-0.3316***	-0.0299	-0.3316***	-0.0299
	(0.0383)		(0.0556)		(0.1241)		(0.1054)	
Pensionable earnings	-0.2327***	-0.0226	-0.2327**	-0.0226	0.4803**	0.0433	0.4803*	0.0433
	(0.0784)		(0.0981)		(0.2226)		(0.2633)	
Self-employed	-0.6257**	-0.0533	-0.6257**	-0.0533	-0.4283	-0.0355	-0.4284	-0.0355
	(0.2801)		(0.2950)		(0.3103)		(0.3268)	
Public worker	0.3732	0.0401	0.3731	0.0401	0.6372**	0.0672	0.6372**	0.0672
	(0.2505)		(0.2702)		(0.3006)		(0.3091)	
White collar	-0.4957**	-0.0451	-0.4957*	-0.0451	-0.5046*	-0.0426	-0.5046*	-0.0426
	(0.2449)		(0.2827)		(0.2677)		(0.2989)	
Manager	-0.5364	-0.0414	-0.5364	-0.0414	-0.1119	-0.0097	-0.1119	-0.0097
	(0.4313)		(0.4225)		(0.4586)		(0.4776)	
Home owner	-0.1730	-0.0153	-0.1731	-0.0153	-0.0888	-0.0077	-0.0888	-0.0077
	(0.2787)		(0.2528)		(0.2815)		(0.2473)	
Housing wealth	-0.0061	-0.0006	-0.0061	-0.0006	-0.0002	-0.0000	-0.0002	-0.0000
	(0.0766)		(0.1004)		(0.0003)		(0.0055)	
Stock	0.4612	0.0530	0.4612	0.0530	0.5887	0.0641	0.5887	0.0641
	(0.3579)		(0.3743)		(0.3924)		(0.3984)	
Fund	-0.2071	-0.0185	-0.2071	-0.0185	-0.3988	-0.0311	-0.3988	-0.0311
	(0.4470)		(0.4718)		(0.4627)		(0.4889)	
Working spouse	0.0057	0.0006	0.0057	0.0006	-0.0363	-0.0032	-0.0363	-0.0032
	(0.1973)		(0.2147)		(0.2184)		(0.2280)	
Ill after 50	-0.0219	-0.0021	-0.0219	-0.0021	-0.1713	-0.0144	-0.1713	-0.0144
	(0.2260)		(0.3423)		(0.2418)		(0.3701)	
Control	-0.0265	-0.0025	-0.0265	-0.0025	-0.2431	-0.0195	-0.2431	-0.0195
	(0.2538)		(0.2580)		(0.2652)		(0.2941)	
Effort	0.0059	0.0006	0.0059	0.0006	0.0017	0.0002	0.0017	0.0002
	(0.2190)		(0.2180)		(0.2559)		(0.2355)	
Reward	0.5420**	0.0692	0.5420**	0.0692	0.6105**	0.0725	0.6106**	0.0725
	(0.2577)		(0.2375)		(0.2800)		(0.2543)	
N	698	698	698	698	698	698	698	698
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

Table 27: Estimates for retirement, females

	(2)		(3)		(4)		(5)	
Model	Probit		Probit		CRE Probit		CRE Probit	
Estimation Method	Pooled MLE		MLE		Pooled MLE		MLE	
	Coefficient	APE	Coefficient	APE	Coefficient	APE	Coefficient	APE
SSW	0.0218**	0.0021	0.0218**	0.0021	0.0178*	0.0016	0.0178*	0.0016
	(0.0105)		(0.0096)		(0.0095)		(0.0094)	
PV	-0.0277	-0.0027	-0.0278	-0.0027	-0.1268***	-0.0117	-0.1268***	-0.0117
	(0.0231)		(0.0212)		(0.0451)		(0.0410)	
North	0.0245	0.0024	0.0245	0.0024	0.0532	0.0049	0.0532	0.0049
	(0.1727)		(0.2224)		(0.1903)		(0.2336)	
Expected wage	0.0494	0.0048	0.0494	0.0048	-0.2681**	-0.0247	-0.2681***	-0.0247
	(0.0409)		(0.0577)		(0.1105)		(0.1031)	
Pensionable earnings	-0.2336***	-0.0226	-0.2336**	-0.0226	0.2642	0.0244	0.2642	0.0244
	(0.0793)		(0.1003)		(0.2184)		(0.2665)	
Self-employed	-0.5867**	-0.0502	-0.5867**	-0.0502	-0.2786	-0.0243	-0.2786	-0.0243
	(0.2908)		(0.2925)		(0.3210)		(0.3202)	
Public worker	0.3706	0.0396	0.3706	0.0396	0.5924**	0.0629	0.5925*	0.0629
	(0.2508)		(0.2711)		(0.2985)		(0.3060)	
White collar	-0.4917**	-0.0446	-0.4917*	-0.0446	-0.4659*	-0.0404	-0.4659	-0.0404
	(0.2472)		(0.2849)		(0.2735)		(0.3006)	
Manager	-0.5419	-0.0416	-0.5419	-0.0416	-0.0978	-0.0087	-0.0978	-0.0087
	(0.4301)		(0.4219)		(0.4480)		(0.4725)	
Home owner	-0.1797	-0.0158	-0.1797	-0.0158	-0.0765	-0.0068	-0.0765	-0.0068
	(0.2763)		(0.2528)		(0.2788)		(0.2470)	
Housing wealth	-0.0039	-0.0004	-0.0039	-0.0004	0.0001	0.0000	0.0001	0.0000
	(0.0769)		(0.1010)		(0.0004)		(0.0062)	
Stock	0.4618	0.0529	0.4618	0.0529	0.5725	0.0633	0.5725	0.0633
	(0.3578)		(0.3748)		(0.3894)		(0.3972)	
Fund	-0.2100	-0.0187	-0.2100	-0.0187	-0.3751	-0.0302	-0.3751	-0.0302
	(0.4484)		(0.4711)		(0.4664)		(0.4851)	
Working spouse	0.0126	0.0012	0.0126	0.0012	0.0101	0.0009	0.0101	0.0009
	(0.1994)		(0.2139)		(0.2223)		(0.2253)	
Ill after 50	-0.0255	-0.0024	-0.0255	-0.0024	-0.1699	-0.0146	-0.1699	-0.0146
	(0.2269)		(0.3417)		(0.2436)		(0.3667)	
Control	-0.0240	-0.0023	-0.0241	-0.0023	-0.2527	-0.0206	-0.2527	-0.0206
	(0.2546)		(0.2578)		(0.2680)		(0.2938)	
Effort	0.0119	0.0012	0.0119	0.0012	0.0367	0.0034	0.0367	0.0034
	(0.2188)		(0.2187)		(0.2522)		(0.2345)	
Reward	0.5451**	0.0693	0.5452**	0.0693	0.6407**	0.0783	0.6408**	0.0783
	(0.2571)		(0.2376)		(0.2778)		(0.2545)	
N	698	698	698	698	698	698	698	698
Rho	.	.	0.00	0.00	.	.	0.00	0.00
Age dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: monetary values in 2011 Euro. SSW and MI are divided by 10000, House Value is divided by 100000. s.e. in round brackets.

9 Conclusion

This paper estimates a structural reduced form of the Option Value model of retirement behaviour first developed by Stock and Wise (1990). This model has the advantage of taking into account both current and future retirement wealth accruals. By imposing parameter values and using social security wealth and financial marginal incentive measures as explanatory variables in a reduced form version model of retirement, the assess the participation response to the incentives embedded in the Social Security system may be assessed.

The model is estimated using the Italian data of the Survey of Health, Ageing and Retirement in Europe (SHARE), which offer offer great advantages over previous research in at least three aspects. After controlling for a number of significant individual and job characteristics, as well as for the potential correlation of incentives and unobserved individual effects (by using a Correlated Random Effect model), results suggest that workers are responsive to the financial incentives embedded in the Italian social security system. Results also suggest that unobserved heterogeneity is small and not significant, and it totally disappears when many individuals and job characteristics are controlled for, meaning that there is sufficient information to explain heterogeneity among individuals.

This is important for policy and efficiency reasons. If unobserved characteristics were important, it would be more difficult to define an optimal (from a social welfare point of view) age of retirement, and individuals - under the assumption that they know their own characteristics, like taste for work or productivity, better than the social planner - should be left freer to choose when to retire. This could reduce choice distortions and improve efficiency, avoiding for example the losses in productivity that could arise either by keeping unproductive workers at work or by inducing to retire workers who are still productive. However, the fact that observable characteristics of individuals seems important to explain retirement, given certain incentives, suggests that these characteristics could be used to adjust the incentives embedded in the social security system as a way to improve the efficiency of the social security system.

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