Three Essays on Retirement and Savings Behaviour

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Abstract

This dissertation presents three essays on retirement and savings behaviour. It relies on secondary data from British national surveys to empirically address how workers prepare and adapt to the economic circumstances of later life.

Chapter 1 analyses the effectiveness of providing workers with the opportunity to join workplace pension schemes to stimulate pension savings. It estimates the potential opt-in rate among employees who haven't been offered a pension plan by an employer, had they been offered the opportunity to join a scheme. Governmental policies enforcing pension plan provision at every workplace could generate a major impact on aggregate participation rates. This potential success does not seem to be conditional on the existence of mechanisms imposed by law concerning the way workers are enrolled.

Chapter 2 examines the effect of workplace pension schemes provision and participation on other individual financial savings, such as personal pension plans and financial assets. It exploits the variability in workplace pension scheme provision and membership induced by the employer's payroll size as an identification strategy. No evidence is found that providing employees with access to workplace pension schemes would make them less likely to save through non-pension financial instruments. These results support the enforcement of the universal provision of workplace pension schemes as a national policy to improve financial preparation for retirement.

Chapter 3 builds on the literature of the economic role of home production of goods and services at retirement. The literature usually restricts the explanation of retirees' heterogeneous attitudes towards home production to gender differences or social norms related to couples' division of labour. The present study provides novel evidence that non-cognitive skills in the form of personality traits explain the heterogeneous reallocation of time and consumption that occurs during a transition from the labour market to retirement.

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Contents

List of Tables

List of Figures

Introduction

Developed countries were the first to face the consequences of the ageing population on governmental expenditures on social security. Lower labour market participation and deteriorated health conditions might turn the elderly into vulnerable group in the absence of appropriate income security. For this reason, multi-pillared pension systems modalities have been proposed (World Bank, 1994; OECD, 2006; Holzmann, 2000, 2012; Holzmann et al, 2008; Willmore, 2000; Davies, 2013) to support societies in two primary goals:

i. Mitigate the risk of elderly poverty; and
ii. Smooth consumption from work life into retirement.

State-provided cash benefits form the first pillar of old-age income security. They are often funded in a "pay-as-you-go" basis by national insurance contributions and general tax revenues. Hence, the sustainability of a national public pension system is conditional on the existence of a not very high number of retired people as a share of those of working age who are actually contributing - the old age dependency ratio. This adequacy is unlikely in more developed countries, especially due to their higher life expectancies.

Currently, public pensions form the major part of old-age income security in most European Union member states. However, a second pillar composed by "fully funded" pension plans is also relevant. For example, Sweden, the Netherlands, New Zealand and the United Kingdom have reformed their pension systems to stimulate retirement savings through voluntary/mandatory occupational pension plans to supplement the public statutory benefit. Due to the increasing adoption of fully funded pension systems, much of the responsibility for old-age income provision has moved from governments' budgets to households' finances. This led to a sharp increase in workers' required level of awareness about how much to save for retirement and how to allocate pension wealth (Lusardi, 2008). Additionally, most employers offering occupational schemes have substituted the provision of defined benefit plans for defined contribution plans, mainly to mitigate balance sheet exposures to fund imbalances. As a consequence, financial literacy interventions have been used as tools for enhancing individuals' downstream financial behaviour (Fernandes

et al, 2014; Miller et al, 2015), to counteract the increasing complexity of sophisticated products and the facilitated access to credit (Lusardi and Mitchell, 2007).

Aiming to overcome behavioural barriers to retirement savings such as procrastination and inertia (Samuelson and Zeckhauser, 1998), some pensions systems have meanwhile tried to transform workplace pension schemes into simpler and more automatic instruments. For example, the United Kingdom established universal provision of workplace pension plans with matching contributions by all employers and the automatic enrolment of eligible employees into these schemes. This reform was supported by a body of evidence in behavioural sciences which suggests that when workers are defaulted to join occupational pension schemes, participation rates are higher than if they had made the standard decision whether to opt in (Madrian and Shea, 2001; Choi et al., 2006; Benartzi and Thaler, 2013).

While default choices are expected to effectively boost workplace pension plans' participation, their effect on overall savings and its consistency with the public's preferences is still ambiguous. For example, an increase in workplace pension savings could be funded by a reduction in the amount households would save in other forms (Crawford et al, 2012). Also, letting employees actively decide (Carrol et al., 2009; Cronqvist and Thaler, 2004; Keller et al, 2011) whether to opt-in to a company's scheme might be preferred to "one-size-fits-all" impersonal defaults when individual characteristics are very heterogeneous or when government interventions (Sunstein and Thaler, 2003) are infeasible, undesirable or unethical (Sunstein, 2013; Arad and Rubinstein, 2015). A recent literature highlights that public policy should account for different levels of individual choice autonomy to enhance the adequacy of economic decisions (see Felsen et al., 2013; Arad and Rubinstein, 2015; Hagman et al., 2015). In this sense, a prudent policymaker might consider a society's views and perceptions on the use of libertarian-paternalistic mechanisms, for example, default options, and how the government should intervene in individuals' decision-making (Sunstein, 2015; Reisch and Sunstein, 2016; Jung and Mellers, 2016).

The World Bank's framework to assess pension systems and reform options (Holzmann et al, 2008) also considers a "non-financial pillar". Among other non-financial endowments, it includes access to informal family and friends support, and other formal social programs, such as health care or housing (Holzmann et al, 2008). Studies on the

economic role of home-production at retirement (e.g. Hurst, 2008; Luengo-Prado and Sevilla, 2013) suggest that retirees devote more time than workers to economically rewarding "do-it-yourself" housework tasks, for example preparing meals at home and doing laundry, in order to substitute market goods and services that they would, otherwise, have to pay for. As a consequence, a prudent evaluation of retirement savings adequacies and the mechanisms through which the ageing population cope with finances should reflect that an individual's ability to produce goods and services at home is part of her life-time wealth.

Considering this multi-pillared pension system modalities, the intent of this dissertation is to addresses workers' preparation and adaptation to the economic circumstances of retirement. It is comprised of three empirical studies, presented in different chapters, which rely on secondary data from British national longitudinal surveys, such as the British Household Panel Survey (University of Essex, 2010) and the Wealth and Assets Survey (Office for National Statistics, 2016). Chapter 1 analyses the effectiveness of providing workers with the opportunity to join workplace pension schemes to stimulate pension savings. Chapter 2 examines the effect of workplace pension schemes provision and participation on other individual financial savings, such as personal pension plans and financial assets. Chapter 3 builds on the literature of the economic role of home production of goods and services at retirement to show that non-cognitive skills in the form of personality traits explain the heterogeneous reallocation of time devoted to domestic chores and consumption that occurs during a transition from the labour market to retirement. To conclude the dissertation, Chapter 4 provides a summary of the analysis, its overriding concluding remarks and implications for public policy and for future investigation.

Chapter 1
Participation in workplace pension schemes and the effect of provision

Default choices and price subsidies have been suggested as public policy mechanisms to promote individual financial preparation for retirement via workplace pension schemes (Choi et al, 2006; Beshears et al., 2009; Chetty et al, 2014; Benartzi and Thaler, 2013). The reform initiated in the United Kingdom from October 2012, established by the 2008 Pensions Act, is a real application of such mechanisms at a national level. For example, it has not only stipulated mandatory matching contributions by employers (Madrian, 2012) and automatic enrolment of all workers (Madrian and Shea, 2001), but also imposed a universal duty on companies to provide such plans within the workplace. Nevertheless, estimates of the effect of workplace pension schemes provision on aggregate membership rates are currently absent. The existing literature on the determinants of savings and on who saves for retirement conventionally analyses saving behaviour of workers who have been offered a pension scheme within the workplace – the so called eligible workers (Bryan et al, 2011; Bryan and Lloyd, 2014). This study aims to fill this gap by estimating how the opportunity to join a workplace pension scheme is to impact overall pension plan participation.

The British reform is expected to be fully implemented by 2018, when workplace pension plans provision will be universally mandatory for employers. As a result, the isolated policy effect of provision of workplace pension schemes will no more be possibly disentangled from the reform's entire effect, which contains other mechanisms, for instance mandatory automatic enrolment and matching contributions. These facts make the British case an advantageous source of evidence to inform future policymaking internationally. In this sense, we use British longitudinal data from a period when the decision to provide a scheme was still a decision of the employer (1992-2009), i.e. not mandatory according to the 2008 Pensions Act. In sum, we estimate the potential opt-in rate among those workers who haven't been offered a plan, had they been offered a scheme by the employer.

Membership is conditional provision, so participation rates are only observed among those individuals who actually work for a company offering a plan, making membership decisions to be perfectly mediated by successful provision. Then, in order to develop an appropriate counterfactual for the observable membership rate among those actually working for an employer offering a pension scheme, we need to consider that workers who have the opportunity to save for retirement in a workplace scheme probably differ from those who are not offered this opportunity. Such differences are expected to occurs mainly in terms of job characteristics like sector (private or public), type (e.g. manual, skilled, and managerial), contract (permanent or temporary), and the employing company's number of workers.

We implement a matching on propensity scores method (Rosenbaum and Rubin, 1985; Austin, 2011) to estimate the potential opt-in rate among employees who haven't been offered a workplace pension plan, had they been offered the opportunity to join a scheme. Our results suggest that a policy enforcing pension plan provision at every workplace could, alone, generate a major impact on aggregate participation rates. We find no evidence that such success is conditional on the existence of mechanisms imposed by law concerning the way workers are enrolled or incentivized to join a scheme. For instance, policymakers could stimulate financial preparation for retirement through the promotion of earning-related workplace pension plans by simply prescribing mandatory provision in every workplace, while letting other components of a scheme to be determined by labour market circumstances between firms and workers, for example, the enrolment process, the level of matching contributions, and the portfolio risk profile and asset allocation.

We build on the literature that evaluates the use of public policy mechanisms with different levels of individual choice autonomy to enhance economic decisions (see Felsen et al., 2013; Arad and Rubinstein, 2015; Hagman et al., 2015). Allowing employees to actively decide (Carrol et al., 2009; Cronqvist and Thaler, 2004; Keller et al, 2011) whether to opt-in a scheme offered by the company might be preferred to "one-nudge-fits-all" impersonal defaults when individual characteristics are very heterogeneous, or when libertarian-paternalistic government interventions (Sunstein and Thaler, 2003) are infeasible, undesirable or unethical (Sunstein, 2013; Arad and Rubinstein, 2015). Additionally, a policymaker might want to consider public views and perceptions on the use of "nudges", for example, default options, and how the government should intervene in

individuals' decision-making (Sunstein, 2015; Reisch and Sunstein, 2016; Jung and Mellers, 2016).

Overall, this study highlights that disentangling the effect of provision is necessary for the accurate assessment of policy reforms combining universal provision with financial incentives and behavioral interventions such as default choices and price subsidies. The corresponding analysis is laid out in the rest of the chapter as follows. Section 1 illustrates the sampling procedure and presents some descriptive statistics. In Section 2, we describe our empirical strategy. In Section 3, we present the main results and some further analyses. Section 4 concludes.

1.1 Institutional background and data

Earnings-related occupational pension schemes always had a central role in the British pension system. Defined benefit pension schemes became dominant during the sixties and seventies as an effective way to manage more senior employees out of a business. In the eighties, the 1986 Social Security Act included personal pension schemes as an alternative tax-privileged investment vehicle for financial preparation for retirement, in which both the employer and the worker could make contributions, hence reducing membership in occupational pension schemes. During the nineties, the ageing population phenomenon started to affect the stability of the National Insurance system. Higher life expectancy imposed a larger burden on the pay-as-you-go State pension benefits due to a higher old age dependency ratio (ONS, 2012, p.3). In 2002, the Government established a Pensions Commission to review the UK private pension system and long-term savings, and to suggest empirically-informed policy reforms. The 2008 Pensions Act put into practice the Pensions Commission's recommendations by introducing a set of reforms within a five-year implementation period from October 2012. It imposed a duty on companies to provide workplace pension schemes with matching contributions, and automatic enrolment of employees into the scheme to overcome behavioural barriers to saving for retirement (Bryan et al, 2011).

The data used in this study consist of waves 2 to 18 of the British Household Panel Survey (University of Essex, 2010), covering the years 1992 to 2009, when workers had usually to actively opt in a plan and provision of a scheme was still an employer's decision, i.e. not imposed by the 2008 Pensions Act. The wave 1 panel consists of some 5,500 households and 10,300 individuals drawn from 250 areas of Great Britain.

Additional samples of 1,500 households in each of Scotland and Wales were added to the main sample in 1999, and in 2001 a sample of 2,000 households was added in Northern Ireland, making the panel suitable for UK-wide research. Hence, a representative sample of British individuals has been interviewed again each year thereafter. The BHPS provides information on respondents' demographic, occupational, educational, income and saving characteristics. The section titled "Employment", part of the individual questionnaire, included the following two subsequent questions:

I. *Does your present employer run a pension scheme or superannuation scheme for which you are eligible? Yes; no; don't know.*
II. *Do you belong to your employer's pension scheme? Yes; no; don't know.*

We used observations of individuals who responded to both questions and indicated to have an employed status, not self-employed, when asked about their current economic activity. An initial unbalanced panel, made up of 15.481 workers corresponding to 89,760 person-year observations was obtained. Column 1 of Table 1.1 shows that, on average, a workplace pension scheme was offered in 71.14 per cent of the cases over the period. This proportion is lower among females and individuals with no degree or further education and higher for those respondents aged between 30 and 59 years old. It has a positive relation with monthly earnings: only 40.32 per cent of workers in the lowest quintile are provided with this opportunity, while among workers in the highest quintile this proportion is equal to 87.56 per cent. In terms of job characteristics, pension provision increases monotonically with the number of employees in the workplace, probably due to economies of scale, and is much higher for professional/managerial positions, for the non-private sector, and for workers with full time and permanent contracts.

These proportions have similar patterns when we look at average membership rates among those workers actually working for a company offering a pension scheme (see Column 2) and, as a consequence, over total participation rates (see Column 3).

TABLE 1.1

Provision and participation in workplace pension schemes patterns

	(1) % of employees working for a company providing a pension scheme	(2) % of employees who are members of a pension scheme, conditional on provision	(3) % of total employees who are members of a workplace pension scheme
All	71.14	73.81	52.51
Males	72.06	75.68	54.53
Females	70.27	71.99	50.58
Age			
less than 20	40.89	23.95	9.79
20-29	66.21	60.16	39.83
30-39	74.32	77.71	57.76
40-49	77.35	81.38	62.95
50-59	74.20	79.66	59.10
60 or over	54.02	63.09	34.08
Education			
Degree or higher	85.28	85.43	72.86
Further education	82.07	79.51	65.25
A levels or equiv.	72.71	73.55	53.48
O levels or equiv.	68.46	69.92	47.87
Other or no qualifications	58.06	63.68	36.97
Earnings			
Quintile group 1 (lowest)	40.32	44.68	18.02
Quintile group 2	61.47	59.98	36.87
Quintile group 3	72.52	71.18	51.61
Quintile group 4	80.63	78.71	63.47
Quintile group 5 (highest)	87.56	87.74	76.82
Number of employees at workplace			
1-2	32.27	71.12	22.95
3-9	42.19	65.41	27.60
10-24	58.82	66.63	39.19
25-49	71.10	70.58	50.19
50-99	77.90	72.86	56.76
100-199	82.19	74.44	61.19
200-499	87.80	75.50	66.29
500-999	90.89	80.46	73.12
1000 or more	94.32	83.88	79.12
Job sector			
Private firm	61.41	65.25	40.07
Non-private firm	90.99	85.59	77.88
Job type			
Professional	85.55	86.98	74.41
Managerial	82.39	82.17	67.70
Skilled non-manual	70.49	69.54	49.02
Skilled manual	59.74	66.85	39.93
Partly skilled	61.17	61.10	37.38
Unskilled	45.53	54.26	24.70
Contract type			
Full time	74.98	76.02	56.99
Part time	55.90	62.04	34.68
Permanent	72.49	74.62	54.09
Temporary	45.34	48.96	22.20

Notes on tables are presented from page 93.

The percentage of total employees who are members of a workplace pension scheme is present in the first line of Column 3, showing that 52.51 per cent of workers currently pay into a workplace pension scheme. This percentage drops to 40.07 per cent if we consider only employees working for private firms. Among males it equals to 46.62 per cent, while for females it is equivalent to 32.90 per cent. These numbers are comparable with official statistics (ONS, 2011, p. 27) indicating that pensioned workers became a minority for the first time in the United Kingdom around the year of 2011, just few years later than the last year in our sample.

1.2 Empirical strategy

The binary nature of both provision and membership hinder us from making use of some methods suggested in the literature of policy evaluation (Blundell and Costa-Dias, 2009). For example, the control function method would generate inconsistent estimations, while other methods require the identification of sufficiently exogenous instruments for provision or of a valid continuously distributed special regressor (Lewbel, Dong, and Yang, 2012). Despite the fact that workplace pensions are not provided by random assignment, they are expected to depend stochastically on a vector of observable variables which describe a worker's job and socio-demographic characteristics. Hence, we can rely on observable predictors of provision, such as job attributes and individual characteristics, to account for the selection problem.

The probability of workplace plan provision conditional on job and socio-demographic characteristics is called the propensity score, here denoted by s:

$$\Pr[p = 1 | J, X] = s(J, X) \qquad (1)$$

where p is an indicator variable denoting whether the employer runs a pension scheme in which the worker is eligible; and J and X denote job characteristics and individual socio-demographic characteristics, respectively. In practice, the propensity score can be modelled, given the availability of a rich set of regressors, by implementing a binary outcome model, for example, a probit regression of the form:

$$\Pr[p_{it} = 1 | J, X] = \Phi(\gamma_1 J_{it} + \beta_1 X_{it} + \omega_t) \qquad (2)$$

where $\Phi(\bullet)$ is the standard normal cumulative distribution function; and ω_t denotes wave-specific characteristics. Then, with the estimated parameters, we are able to generate

predictions for p_{it} conditional on covariates, being $\hat{s}_{it}(J,X)$ estimated propensity score for i*th* case at time *t*.

A proper estimation of (2) provides us with some important conditions that are required to overcome the selection problem that occurs due to the absence of random assignment of provision. First, because we are able to assume that membership decisions, indicated by Y, are independent of provision after controlling for the variation in Y that is induced by differences in J,X, i.e. $Y \perp p|\, J,X$ (Cameron and Trivedi, 2005, p. 863). This conditional independence assumption given J,X also implies conditional independence given $s(J,X)$:

$$Y \perp p|\, J,X \Rightarrow Y \perp p|\, s(J,X) \qquad (3)$$

Moreover, it is possible to validate the occurrence of the overlap or common support condition (Cameron and Trivedi, 2005, p. 871), which means that, for every J,X, there is a positive probability that pension provision failed to occur:

$$0 < \Pr[p = 1|\, J,X] < 1 \qquad (4)$$

Finally, we can verify the occurrence of the balancing condition (Cameron and Trivedi, 2005, p. 864), which in the present evaluation means that for employees with the same propensity score, provision of a workplace pension scheme is as random and they should look identical in terms of their vectors J and X:

$$p \perp J,X|\, s(J,X) \qquad (5)$$

Potential outcomes are inferred from a set of comparison units for whom the observable characteristics J,X match those from the units that have provision of a pension scheme in the workplace up to some defined degree of closeness. In our setting, we implement a nearest-neighbour one-to-one (NN 1:1) matching on propensity scores procedure according to the following rule:

$$A_{it}\big(s(J,X)\big) = \{s_{jt}|\min_{jt}\|s_{it} - s_{jt}\| < r\} \qquad (6)$$

This means that all observations with propensity scores situated within a radius *r* are considered as potential matches, but only the closest counterfactual case *j*th from the group of individuals who are provided a scheme is actually matched with the *i*th case from the units with unsuccessful provision. Additionally, we impose exact matching on two

regressors: (i) the time variable, to avoid matching two observations from interviews made in different waves of the survey, possibly form the same individual; (ii) and on the number of employees in the workplace, as this variable showed to be one of the main drivers of membership via its effect on provision. Then, the estimated participation rate for the group of matched units in which a pension plan is provided identifies the counterfactual outcome for the group in which provision is inexistent.

There is a difference δ in outcomes that identifies the average causal effect of provision on participation among those who were not provided with a workplace pension scheme. The literature in treatment evaluation defines this difference as the average treatment effect on the untreated. Here, we express it as:

$$\delta = \mathrm{E}[\Delta Y | p = 0] = \mathrm{E}\left[\frac{(p - s(J,X)Y)}{\Pr[p=1](1 - s(J,X))}\right] \qquad (6)$$

A consistent estimator based on a sample of size *N* and an estimated propensity score $\hat{s}(J_i, X_i)$ can finally be obtained by:

$$\hat{\delta} = \left(\frac{1}{N}\sum_{i=1}^{N} p_i\right)^{-1} \sum_{i=1}^{N}\left[\frac{1}{N}\frac{(p_i - \hat{s}(J_i,X_i))Y_i}{(1 - \hat{s}(J_i,X_i))}\right] \qquad (7)$$

In some specifications we impose matching without replacement (Cameron and Trivedi, 2005, p. 873; Austin, 2011, p. 405). In these cases, observations from the units that are not provided a pension scheme is matched to no more than one closest neighbour in which provision is successful. Also, we check whether the overlap condition and the balancing conditions from (4) and (5) hold. Notwithstanding, these previous checks may still be insufficient to determine whether omitted variables can alter the inference of the provision selection process, the conditional independence assumption from eq. (3). Hence, we implement the sensitivity analysis proposed by Rosenbaum (2002) and developed by Becker and Caliendo (2007), in which we infer how strongly a hidden bias caused by omitted covariates must influence provision in order to erode the outcomes of the matching procedure.

TABLE 1.2

Probit estimates (odds ratios) for the probability of pension provision

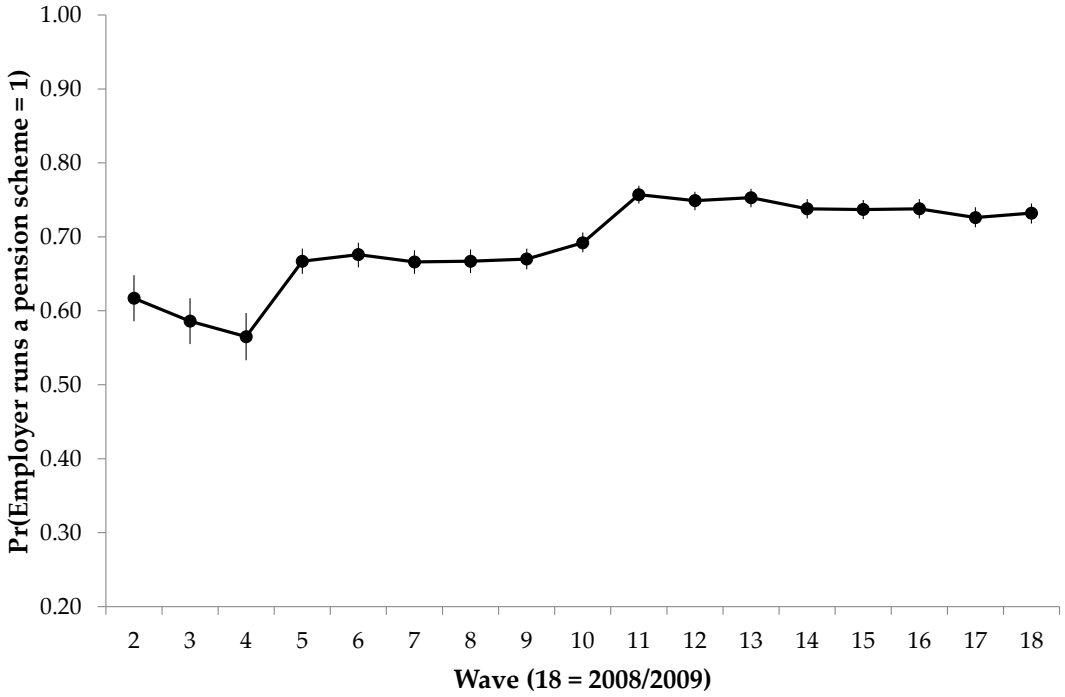
Dependent variable = 1 if employer offers a pension scheme; =0 otherwise

	Coefficient	Std. error	P-value
Demographics			
Male	-0.005	0.024	0.825
Age	0.052	0.012	0.000
Age^2	-0.001	0.000	0.000
Education			
Degree or higher	[*base*]		
Further education	0.004	0.049	0.942
A levels or equiv.	-0.005	0.036	0.897
O levels or equiv.	-0.016	0.036	0.652
Other or no qualifications	-0.122	0.039	0.002
Household income	-0.107	0.046	0.020
Household income^2	0.013	0.003	0.000
Job characteristics			
Earnings	1.049	0.154	0.000
Earnings^2	-0.046	0.012	0.000
Number of employees at workplace			
1-2	[*base*]		
3-9	0.159	0.044	0.000
10-24	0.472	0.045	0.000
25-49	0.739	0.046	0.000
50-99	0.960	0.047	0.000
100-199	1.147	0.049	0.000
200-499	1.457	0.050	0.000
500-999	1.601	0.055	0.000
1000 or more	1.625	0.053	0.000
Job sector			
Private firm	[*base*]		
Civil servant	1.424	0.058	0.000
Local govt.	1.624	0.038	0.000
NHS or higher education	1.267	0.046	0.000
Nationalised industry	0.803	0.163	0.000
Non-profit organisation	0.467	0.050	0.000
Armed forces	1.106	0.176	0.000
Other	0.310	0.075	0.000
Job type			
Professional	[*base*]		
Managerial	-0.04	0.051	0.432
Skilled non-manual	0.099	0.053	0.064
Skilled manual	-0.323	0.055	0.000
Partly skilled	-0.238	0.055	0.000
Unskilled	-0.451	0.068	0.000
Armed forces	-0.154	0.272	0.572
Contract type			
Full time	0.028	0.028	0.321
Permanent	0.978	0.034	0.000
Number of observations		89,760	
Number of individuals		15,481	
Log pseudolikelihood		-36,070.18	
Wald Chi-squared(68)		8,067.65	
Pseudo R^2		0.331	

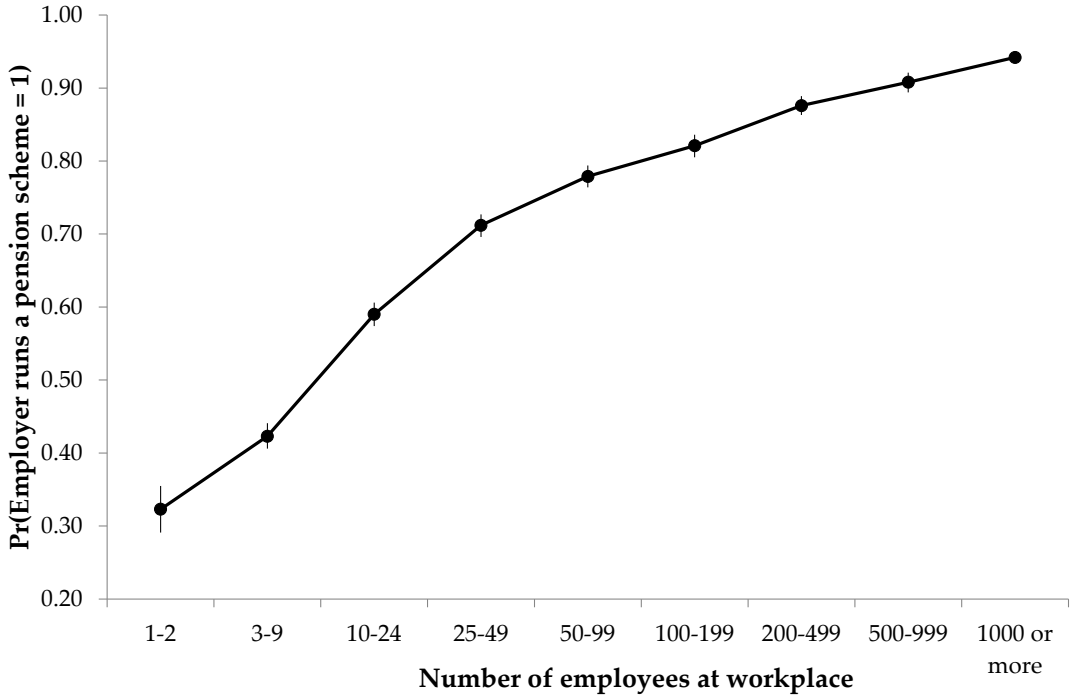
Notes on tables are presented from page 93.

FIGURE 1.1

a. Conditional probabilities of employer offering a pension scheme by wave



b. Conditional probabilities of employer offering a pension scheme by number of employees in the workplace



1.3 Main results and further analysis

The first step of our empirical strategy is to estimate the propensity score model of pension provision. Table 1.2 reports the estimates of the probit regression given by eq. (2). The covariates are the same presented in the descriptive statistics, but now we also include real household equivalent income as an additional demographic characteristic. Region and wave identifiers were also included but are omitted in Table 1.2. Among the demographic characteristics, we can observe that age predicts pension provision, but not gender, education and household income.

All job characteristics included as covariates are significant. A full-time contract is not a significant predictor, but a permanent contract is and has a positive relation with pension provision. As highlighted in the descriptive statistics, the number of employees at the workplace has a strong monotonic positive relation with pension provision. This relation can be observed in Figure 1.1a, plotting the predicted probabilities for employer offering a plan by the number of employees at the workplace. The dynamics of pension provision evolution across the waves of the survey can be observed in Figure 1.1b. An increase is observed during the beginning of the current century (between waves nine and eleven), but with provision remaining stable until the last period of the sample (wave eighteen).

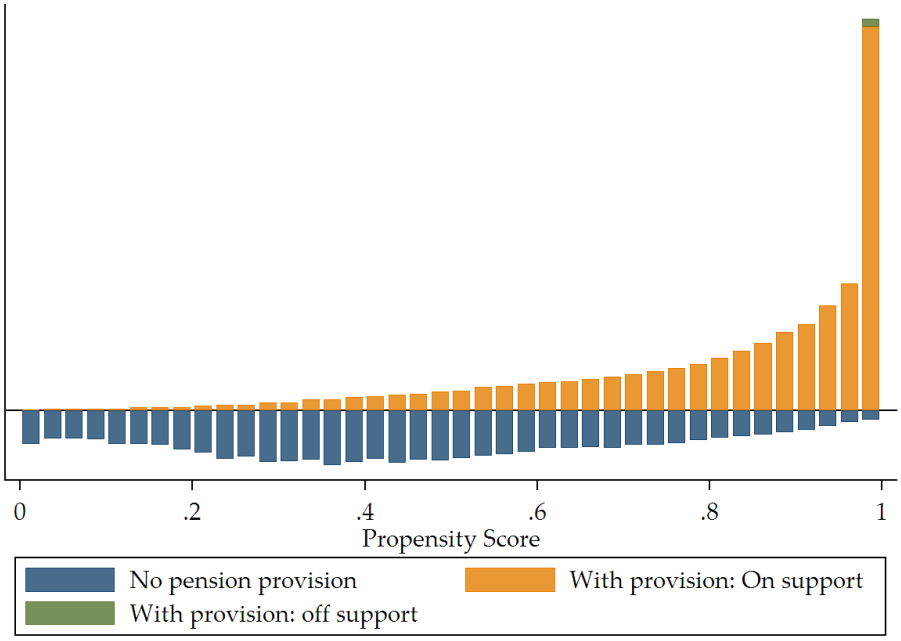
In order to verify the occurrence of the overlapping condition from (4), we first impose common support on the estimated propensity scores $\hat{s}_{it}(J, X)$. This procedure drops 52 observations in which a pension scheme is offered and whose score is higher than the maximum or less than the minimum score of the group without pension provision. Figure 1.2 shows the propensity score histogram by provision status. We can verify that the scores from both groups of observations clearly overlap across the entire probability range, and that the few dropped observations are situated in really extreme scores, close to unit. In sum, this means that even after imposing common support, there is always a positive probability that pension provision failed to occur for each unit in the group of individuals who are offered a pension scheme.

Having checked the overlap condition, we address the relationship of primary interest to this study, the effect of pension provision on membership outcomes represented in eq. (7). Column 1 in Table 1.3 shows the unmatched sample average membership, already presented in the descriptive statistics (Column 2 in Table 1.1), and repeated here

for comparison. Columns 2-7 in Table 1.3 report the average membership across different matching procedures in which was required common support and exact match on wave and in the scale variable identifying the number of employees in the workplace. The estimates suggest that pension provision has a major effect on membership rates. This can be also interpreted as the potential opt-in rate among those workers who haven't been offered a plan, had they been offered a scheme by the employer. As one can observe, by decreasing the radius used to match nearest-neighbours and imposing no replacement of previously matched counterfactual units, the number of observations on support decreases, but this does not vanish the major effect of provision on membership rates.

FIGURE 1.2

Histogram of estimated propensity scores by provision status



To verify the balancing condition described by eq. (5), we use our most restrictive specification, shown in Column 7 in Table 1.3, which imposes the smallest radius (r = 0.001) and no replacement. Figure 1.3 shows the effectiveness of the matching procedures to balance the two groups of observations in terms of: a) wave (2-18); b) number of workers in the job place (scale 1-9); and c) demographic and job characteristics. The standardized percentage bias for each covariate is obtained by dividing the mean of the group in which pension provision occurs by the mean of the control group, then subtracting one and multiplying by one hundred. We check its robustness by also including

characteristics that weren't used as covariates in the estimation of the propensity score, but are expected to affect a worker's decision to have retirement savings, such as household type (e.g. couple with dependent children) and home tenure (e.g. pays rent). In sum, we observe that for employees with very close propensity scores, provision of a workplace pension scheme is as good as random, since both groups are quite similar in terms of covariates.

Our last check involves the conditional independence assumption. Because we do not observe perfectly all variables simultaneously influencing provision of workplace schemes and membership decisions, matching estimators might be biased. We need to check whether unobserved covariates can sensibly change the inference about the effect of provision on membership rates, or alternatively, how strong an unmeasured variable must influence the selection process to erode the implications of the previously performed matching analysis. For this, we implemented the procedure operationalised by Becker and Caliendo (2007) which builds on the bounding approach of Rosenbaum (2002). Because we have a binary outcome, pension plan membership, the Mantel and Haenszel (1959) test statistic Q_{mh} is used. Rosembaum (2002) shows that this test statistics is bounded by a pair of known distributions, in which two scenarios are particularly useful: Q_{mh+} is the test statistic given that the effect of provision on membership was overestimated, and Q_{mh-} the case where we have underestimated it.

The adjusted Q_{mh} statistics and their corresponding bounds on the significance levels in P-values for each level of hidden bias are reported in Table 1.4. We present statistics for specifications in which the caliper distance r is equal to 0.001, with and without replacement. The bias due to unobserved covariates is Γ and represents odds of differential assignment to provision, so for instance $\Gamma = 1$ assumes no hidden bias, and $\Gamma = 2$ assumes a hidden bias that would double the odds. Given that we have a positive estimated effect of provision on membership rates, we can focus on the bounds under the assumption that we have overestimated such effect, i.e. Q_{mh+} . The effect is significant at $\Gamma = 1$ does not become insignificant for higher levels of hidden bias, stating that the confidence intervals for the effect of provision on membership would not include zero if an unobserved covariate caused the odds ratio of assignment to pension provisions to differ between the two groups. In summary, the results are not sensitive to deviations from the conditional independence assumption and that the estimation procedure has an identification strategy that is not invalidated.

TABLE 1.3

Matching on propensity scores estimates for the opt-in rate (average treatment effect on the untreated)

Outcome variable = 1 if worker is a member of a workplace pension scheme; = 0 otherwise

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Provision	0.738	0.500	0.518	0.564	0.558	0.562	0.582
[Std. errors]	[0.003]	[0.006]	[0.006]	[0.006]	[0.004]	[0.004]	[0.005]
Radius	No	0.010	0.005	0.001	0.010	0.005	0.001
Common support	No	Yes	Yes	Yes	Yes	Yes	Yes
No replacement	No	No	No	No	Yes	Yes	Yes
Exact match on:							
Wave (2-18)	No	Yes	Yes	Yes	Yes	Yes	Yes
Employees at workplace (scale 1-9)	No	Yes	Yes	Yes	Yes	Yes	Yes
Off support	0	3,045	5,120	12,743	10,278	11,221	15,589
On support	89,760	86,715	84,640	77,017	79,482	78,539	74,171
Employer does not provide a scheme	63,856	22,859	20,784	13,161	15,626	14,683	10,315

Notes on tables are presented from page 93.

FIGURE 1.3

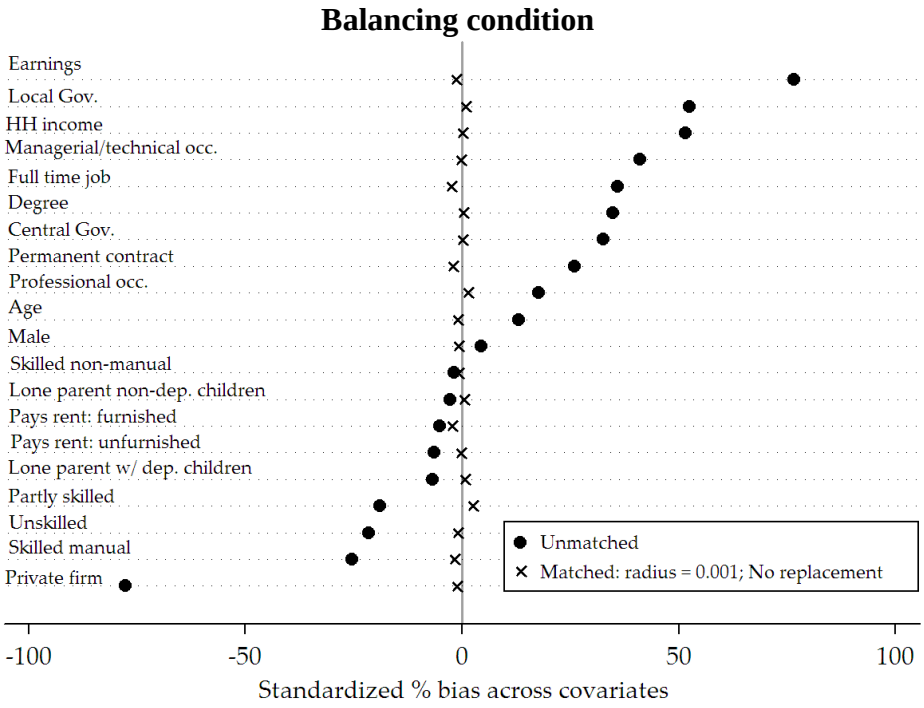


TABLE 1.4

Mantel-Haenszel adjusted statistics and significance levels

With replacement, $r = 0.001$

Γ	Q_{mh+}	P-value	Q_{mh-}	P-value
1	101.063	0.000	101.063	0.000
2	129.266	0.000	78.4906	0.000
3	149.476	0.000	67.2449	0.000
4	166.064	0.000	60.0186	0.000
5	180.512	0.000	54.8152	0.000
10	236.961	0.000	40.758	0.000
20	317.984	0.000	29.6833	0.000

No replacement, $r = 0.001$

Γ	Q_{mh+}	P-value	Q_{mh-}	P-value
1	92.0402	0.000	92.0402	0.000
2	116.971	0.000	71.3886	0.000
3	134.108	0.000	60.9675	0.000
4	147.733	0.000	54.2574	0.000
5	159.315	0.000	49.4298	0.000
10	202.726	0.000	36.4583	0.000
20	262.523	0.000	26.3729	0.000

1.3.1 Employees of private sector firms

In this subsection, we report the estimates of eq. (7) with data only from workers employed by private companies. This is relevant in the analysis due to its policy implication: workplace plans offered by private employers are usually different from the ones offered by public companies. For example, the proportion of 83 per cent of employees in the public sector who belonged to a workplace pension scheme can be decomposed in 79 per cent belonging to a defined benefit scheme, and the remainder 4 per cent belonging to defined contribution, group personal or group stakeholder plans. In the private sector, these proportions are expected to be much more balanced and affect membership rates differently. According to official statistics from the ONS (2011, p. 27), participation rates in the private sector are smaller than in the public sector, 32 percent and 83 per cent, respectively, in the year of 2011.

The estimates across different matching procedures shown in Columns 2-7 in Table 1.5 suggest that pension provision has a major effect on membership rates also when we constrain the analysis to the private sector. Again, by decreasing the radius and imposing no replacement of previously matched counterfactual units, the number of observations on support decreases, but this does not dissipate the major effect of provision on membership rates.

1.3.2 The decision to opt-in among employees who have been just offered a plan

Our main analysis does not make reference to situations in which an employee was just offered a workplace pension plan. This may be of particular interest of policymakers aiming to infer how fast an average employee reacts to this new opportunity and how this affects membership rates in the short-term. Automatic enrolment has been indicated as one key mechanism to overcome behavioural barriers to saving for retirement because it helps to mitigate the effects of procrastination, status quo bias and inertia (Samuelson and Zeckhauser, 1988; Thaler and Benartzi, 2004; Madrian and Shea, 2001). Hence, we can make use of the present dataset to identify the determinants of opt-in decisions in the short-term, i.e. the choice of a worker to adhere to the workplace pension plan immediately after it starts to be offered by his employer.

We identify 3,757 transitions which denote situations in which an employee was not working for a company providing a workplace pension plan in a baseline wave of the survey ($p_{it-1} = 0$), and started to work for a company running a pension scheme in a follow up period ($p_{it} = 1$). Hence, these transition might have occurred due to job changes or even companies which started to offer a workplace plan to their employees. This set of information is not observable in the data. Then, we estimate the following model for their decision to opt-in the scheme:

$$\Pr[y_{it} = 1 | p_{it} = 1, p_{it-1} = 0] = \Phi(\gamma_2 J_{it} + \beta_2 X_{it} + \alpha_2 F_{it} + \omega_t) \quad (8)$$

where the decision to opt-in the scheme is indicated by $y_{it} = 1$, and zero otherwise; J_{it} is a vector of job characteristics that also includes now job satisfaction and whether the worker has promotion opportunities; X_{it} is a vector of demographic and household characteristics including, for instance, housing tenure and household type; and F_{it} is a vector of other financial conditions, for example, whether the worker has a personal pension plan, whether the workers saves from current income and whether he or she has problems to pay for housing. The estimates of the model represented by eq. (8) are shown in Table 1.6.

Among the demographic characteristics, education level is one of the main determinants of short-term opt-in decisions. Compared with the base level "Degree", all the coefficients associated with this categorical variable are negative and significant. Figure 1.4 shows the predicted membership rate for each education level. The conditional opt-in rate for workers with a degree is much higher than the one for those with lower qualifications. In terms of household characteristics, couples irrespectively if they have dependent children or not are more likely to opt-in than single adults. None of the financial conditions include as covariates turned to be significant. In terms of job characteristics, employees of the central or local government, for example, civil servants, and those working for the NHS or higher education institutions, are more likely to opt-in than those employed by a private firm. Being a full-time worker does not significantly predict the decision to opt-in decision, but having a permanent position is an important driver.

TABLE 1.5

Matching on propensity scores estimates for the opt-in rate (average treatment effect on the untreated) – Private sector only

Outcome variable = 1 if worker is a member of a workplace pension scheme; = 0 otherwise

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Provision	0.652	0.489	0.507	0.551	0.544	0.546	0.554
[Std. errors]	[0.003]	[0.006]	[0.006]	[0.006]	[0.004]	[0.004]	[0.005]
Radius	No	0.010	0.005	0.001	0.010	0.005	0.001
Common support	No	Yes	Yes	Yes	Yes	Yes	Yes
No replacement	No	No	No	No	Yes	Yes	Yes
Exact match on:							
Wave (2-18)	No	Yes	Yes	Yes	Yes	Yes	Yes
Employees at workplace (scale 1-9)	No	Yes	Yes	Yes	Yes	Yes	Yes
Off support	0	3,074	4,992	12,163	9,768	10,666	14,664
On support	60,227	57,153	55,235	48,064	50,459	49,561	45,563
Employer does not provide a scheme	23,244	20,170	18,252	11,081	13,476	12,578	8,580

Notes on tables are presented from page 93.

TABLE 1.6

Probit estimates (odd ratios) for the probability of the decision to opt-in among employees who have been just offered a workplace pension plan

Dependent variable = 1 if member of pension scheme; =0 otherwise

	Coefficient	Std. error	P-value
Demographics / HH characteristics			
Male	0.032	0.058	0.577
Age	0.055	0.012	0.000
Age^2	-0.001	0.000	0.000
Education			
Degree or higher	[*base*]		
Further education	0.004	0.111	0.000
A levels or equiv.	-0.439	0.080	0.000
O levels or equiv.	-0.316	0.082	0.000
Other or no qualifications	-0.458	0.094	0.000
Household income	-0.398	0.151	0.008
$Household\ income^2$	0.020	0.009	0.031
Household type			
Single: non-elderly	[*base*]		
Single: elderly	0.039	0.668	0.953
Couple: no children	0.160	0.102	0.117
Couple: dep. children	0.209	0.103	0.042
Couple: non-dep. children	0.192	0.114	0.092
Lone parent: dep. children	0.227	0.141	0.106
Lone parent: non-dep. children	0.091	0.164	0.582
Unrelated adults	0.058	0.174	0.739
Other	0.191	0.189	0.312
Housing tenure			
Owned with mortgage	[*base*]		
Local authority rented	-0.024	0.077	0.754
Housing assoc. rented	-0.111	0.114	0.333
Rented from employer	0.238	0.360	0.509
Rented private: unfurnished	0.032	0.098	0.742
Rented private: furnished	-0.096	0.123	0.438
Financial conditions			
Has personal pension plan	-0.017	0.063	0.788
Saves from current income	0.064	0.047	0.178
Has problems paying for housing	-0.055	0.082	0.505

Cont.

TABLE 1.6. *Cont.*

Dependent variable = 1 if member of pension scheme; =0 otherwise

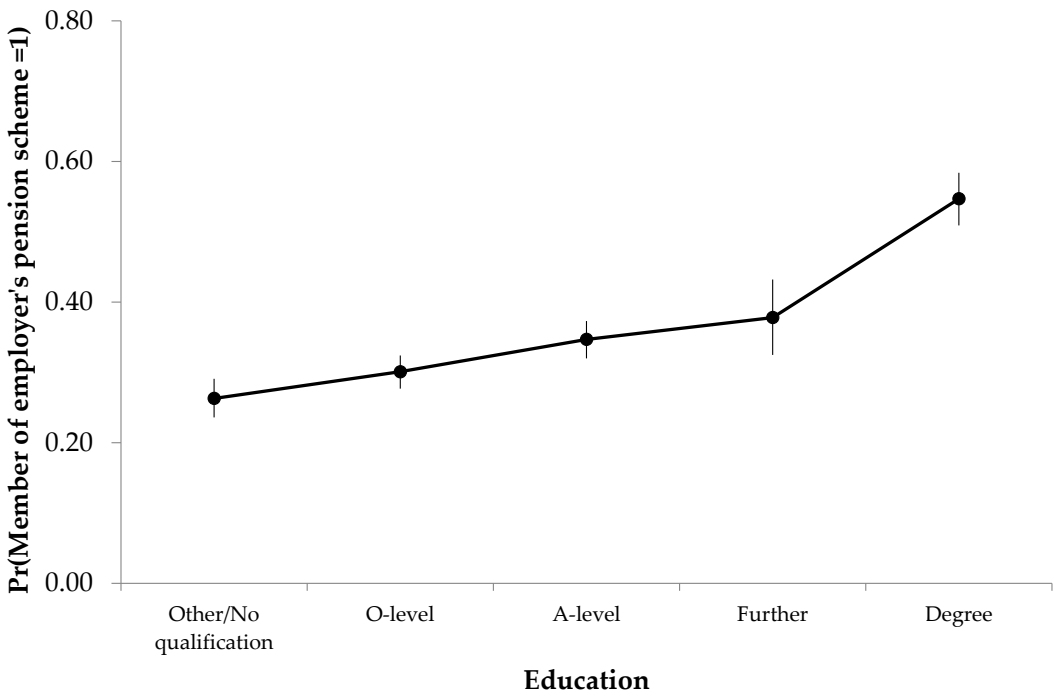
	Coefficient	Std. error	P-value
Job characteristics			
Earnings	-0.051	0.458	0.911
Earnings^2	0.034	0.034	0.317
Number of employees at workplace			
1-2	[*base*]		
3-9	-0.120	0.165	0.466
10-24	-0.284	0.162	0.079
25-49	-0.181	0.164	0.269
50-99	-0.211	0.166	0.202
100-199	-0.193	0.169	0.254
200-499	-0.105	0.168	0.531
500-999	-0.120	0.186	0.518
1000 or more	0.071	0.178	0.691
Job sector			
Private firm	[*base*]		
Civil servant	1.219	0.169	0.000
Local govt.	0.931	0.088	0.000
NHS or higher education	1.225	0.111	0.000
Nationalised industry	0.148	0.316	0.640
Non-profit organisation	0.121	0.127	0.342
Armed forces	0.537	0.496	0.248
Other	-0.032	0.325	0.922
Job type			
Professional	[*base*]		
Managerial	0.067	0.121	0.580
Skilled non-manual	0.071	0.127	0.577
Skilled manual	-0.119	0.132	0.367
Partly skilled	-0.190	0.137	0.164
Unskilled	-0.233	0.183	0.222
Armed forces	0.509	0.771	0.510
Contract type			
Full time	0.071	0.086	0.412
Permanent	0.728	0.113	0.000
Job satisfaction (scale 1-7)			
Not satisfied at all = 1	[*base*]		
2	-0.094	0.258	0.717
3	-0.005	0.224	0.983
Not satisfied/dissatisfied = 4	0.087	0.221	0.694
5	0.098	0.210	0.641
6	0.208	0.208	0.317
Completely satisfied = 7	0.346	0.213	0.105
Promotion opportunities	-0.060	0.050	0.231
Number of observations		3,757	
Number of individuals		3,145	
Conditional short-term opt-in rate [std. error]		0.356 [0.007]	
Log pseudolikelihood		-2,087.30	
Wald Chi-squared(68)		616.71	
Pseudo R^2		0.147	

Notes on tables are presented from page 94.

The conditional opt-in rate predicted by the model is 35.6 per cent (see bottom of Table 1.6). This rate reflects short-term decisions join the scheme just after provision starts, being much smaller than the average aggregate membership rates estimated in the previous main analysis. This suggests that provision of workplace pension plans have an effect on membership rates, but this phenomenon does not occur immediately after a worker is offered a plan, mainly in the private sector.

FIGURE 1.4

Conditional probability of workplace pension plan membership by education level



1.3.3 The evolution of opt-in rates

One of the limitations of the dataset used in this study is that we do not observe the characteristics of the pension plan offered to the employee. For example, we do not observe whether there are matching contributions by the employer, how simplified the enrolment process is or which kind of occupational pension scheme.is offered, e.g. defined benefit or defined contribution. Madrian (2012) reviews previous studies and denote that even with a matching employer contribution participation rates are often surprisingly low. Also, the study indicates that increasing the matching rate leads to small increases in savings. Beshears et al. (2010) find that when the employer match is eliminated or reduced, participation rates under automatic enrolment do not decline significantly. These previous

findings suggest that when automatic enrolment is implemented, it becomes a key driver of participation in a workplace pension scheme.

The emergence of automatic enrolment policies was promoted by American companies in the end of 1990s seeking for a preventive strategy for dealing with the IRS non-discrimination rules that conditioned the tax deductible status of a pension plan on the absence of a participation pattern that is skewed toward highly paid employees. Despite being a cheaper, simple and ingenious method, automatic enrolment was shown effective. It was recommended by consultants to companies exposed to potential discrimination features in their workplace-provided pension schemes. Simultaneously, academic research on saving behaviour opened an avenue for new research directions. The seminal works done by Madrian and Shea (2001), Thaler and Benartzi (2004), Choi et al. (2004) and Choi et al. (2006) analysed data from American companies in the end of the 1990s. A national public policy implementing automatic enrolment and other default options regarding contribution rates and asset allocation stated to be practiced in in New Zealand in 2007. Benartzi and Thaler (2013) indicate that the percentage of American employers offering 401(k) plan with automatic enrolment grew from 14 per cent in 2003 to 34 per cent in 2007 and to 58 per cent in 2009.

It becomes important to analyse the possibility that automatic enrolment started to be widely used in the United Kingdom at some point from wave 2 to wave 18. First, we estimate the following model for their decision to opt-in the scheme:

$$\Pr[y_{it} = 1 | p_{it} = 1] = \Phi(\gamma_3 J_{it} + \beta_3 X_{it} + \alpha_3 F_{it} + \omega_t) \qquad (9)$$

The estimates of the model represented by eq. (9) are shown in Table 1.7. Opt-in rates predicted by the model remained stable or even decreased since the second half of the nineties. Figures 1.5a shows that there was no upward trend on opt-in rates that would suggest a wide use of automatic enrolment in workplace pension schemes in the United Kingdom. In fact, these rates slightly decline between waves 9 and 11. The same conclusion is obtained when we observe the evolution of opt-in rates only among private sector workers shown in Figure 1.5b.

Although this analysis does not include automatic enrolment as a predictor, the stable membership ratse observed in Figure 1.5a and 1.5b do not suggest the occurrence of a sensible increase in the use of automatic enrolment during the sample period. Additionally, official statistics from the United Kingdom's Department for Work and

Pensions (2012) suggests that employers' likelihood to apply automatic enrolment in workplace pension schemes is positively associated with company size. For example, employer awareness of the specific duties to automatically enrol employees was lowest for micro employers at 46 per cent; 67 per cent for small employers; 84 per cent for medium employers; and 93 per cent for large employers. Similarly, support for automatic enrolment also varied with employer size, ranging from less than half of micro employers to nearly three quarters of large employers agreeing it is a good idea. Automatic enrolment practice is also sector specific. For example, since January 2007, all teachers aged between 18 and 70 have been automatically enrolled into the *Teachers' Pension Scheme*. In this sense, observing employer size and sector helps to overcome limitations generated by the unobserved characteristic of workplace pension plan enrolment process in our data.

Employer size and sector can also be verified as major determinants of the practice to automatically enrol employees into a company's pension scheme from British data provided in the Wealth and Assets Survey in its waves 2 and 3 (2008-2012). The frequencies presented in Appendix 1.A shows that within those who were automatically enrolled, this procedure was more frequently declared by those workers from larger non-private companies. Within private sector workers, completing a detailed form is the most common declared procedure in both waves – around 40 per cent, followed by automatic enrolment – around 22 per cent. On the contrary, for non-private and other types of organizations, automatic enrolment is the most frequent declared procedure among those individuals that are members of an occupational scheme. In wave 2, for example, 1,049 workers out of 2,819 (or 42.6 per cent) who were member of a workplace pension scheme declared to have been automatically enrolled, with wave 3 showing similar results.

Despite the existence of automatic enrolment in a reasonable scale even before the Reform started in 2012, there was no upward trend on opt-in rates that would suggest an increasing use of automatic enrolment in workplace pension schemes in the United Kingdom that would not be due to observable sector characteristics and employer size.

TABLE 1.7

Probit estimates (odds ratios) for probability of the decision to opt-in conditional on provision

Dependent variable = 1 if member of pension scheme; =0 otherwise

	Coefficient	Std. error	P-value
Demographics / HH characteristics			
Male	0.018	0.031	0.577
Age	0.118	0.008	0.000
Age^2	-0.001	0.000	0.000
Education			
Degree or higher	[*base*]		
Further education	-0.210	0.051	0.000
A levels or equiv.	-0.124	0.043	0.004
O levels or equiv.	-0.170	0.043	0.000
Other or no qualifications	-0.237	0.050	0.000
Household income	-0.104	0.060	0.080
Household income^2	0.011	0.004	0.006
Household type			
Single: non-elderly	[*base*]		
Single: elderly	-0.098	0.216	0.650
Couple: no children	-0.057	0.047	0.224
Couple: dep. children	0.003	0.048	0.946
Couple: non-dep. children	-0.068	0.053	0.202
Lone parent: dep. children	-0.128	0.070	0.067
Lone parent: non-dep. children	-0.176	0.075	0.020
Unrelated adults	-0.157	0.071	0.027
Other	-0.118	0.083	0.027
Housing tenure			
Owned with mortgage	[*base*]		
Local authority rented	-0.208	0.047	0.000
Housing assoc. rented	-0.097	0.070	0.166
Rented from employer	-0.031	0.150	0.836
Rented private: unfurnished	-0.302	0.050	0.000
Rented private: furnished	-0.228	0.053	0.000
Financial conditions			
Has personal pension plan	-0.508	0.034	0.000
Saves from current income	0.216	0.020	0.000
Has problems paying for housing	-0.158	0.034	0.000

Cont.

TABLE 1.7. *Cont.*

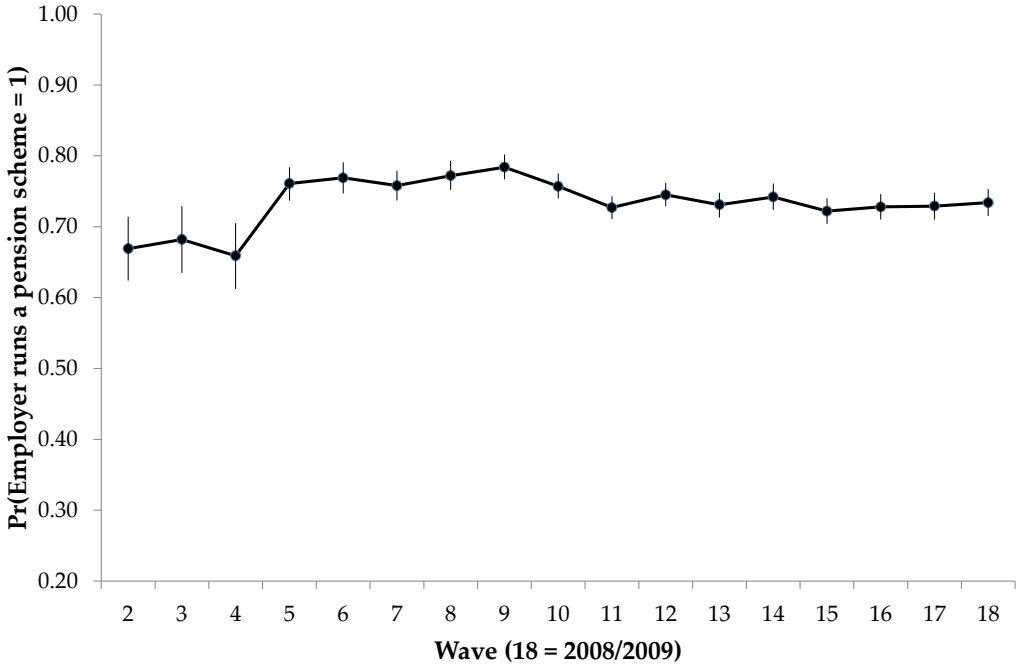
Dependent variable = 1 if member of pension scheme; =0 otherwise

	Coefficient	Std. error	P-value
Job characteristics			
Earnings	0.649	0.246	0.008
Earnings^2	0.000	0.018	0.995
Number of employees at workplace			
1-2	[*base*]		
3-9	-0.025	0.086	0.711
10-24	-0.410	0.085	0.628
25-49	0.011	0.086	0.899
50-99	0.055	0.086	0.522
100-199	0.105	0.086	0.220
200-499	0.201	0.086	0.019
500-999	0.377	0.088	0.000
1000 or more	0.307	0.089	0.001
Job sector			
Private firm	[*base*]		
Civil servant	1.197	0.063	0.000
Local govt.	0.844	0.041	0.000
NHS or higher education	0.730	0.051	0.000
Nationalised industry	0.602	0.110	0.000
Non-profit organisation	0.061	0.065	0.347
Armed forces	1.298	0.165	0.000
Other	0.389	0.098	0.000
Job type			
Professional	[*base*]		
Managerial	-0.096	0.053	0.071
Skilled non-manual	0.017	0.058	0.762
Skilled manual	-0.180	0.062	0.004
Partly skilled	-0.239	0.063	0.000
Unskilled	-0.332	0.091	0.000
Armed forces	0.552	0.330	0.094
Contract type			
Full time	-0.072	0.041	0.081
Permanent	0.834	0.048	0.000
Job satisfaction (scale 1-7)			
Not satisfied at all = 1	[*base*]		
2	-0.008	0.073	0.911
3	0.114	0.069	0.096
Not satisfied/dissatisfied = 4	0.044	0.071	0.535
5	0.092	0.068	0.177
6	0.067	0.067	0.317
Completely satisfied = 7	0.035	0.071	0.624
Promotion opportunities	-0.008	0.022	0.708
Number of observations		52,027	
Number of individuals		10,688	
Conditional short-term opt-in rate [std. error]		0.742 [0.003]	
Log pseudolikelihood		-22,516.15	
Wald Chi-squared(68)		4,076.71	
Pseudo R^2		0.244	

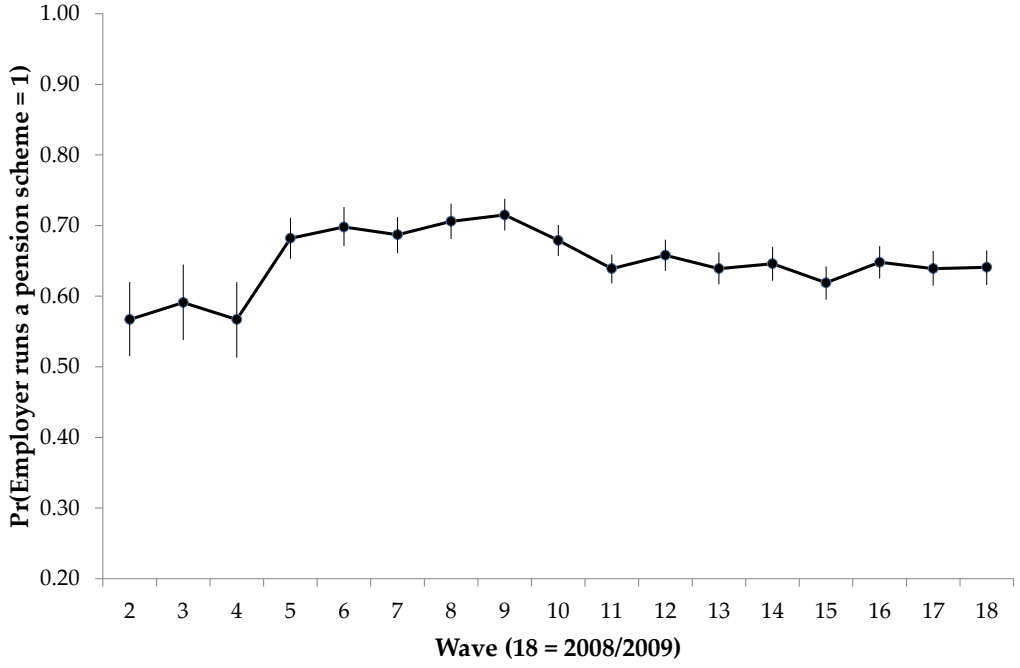
Notes on tables are presented from page 94.

FIGURE 1.5

a. Conditional probability of workplace pension plan membership by wave



b. Conditional probability of workplace pension plan membership by wave Private sector only



1.4 Conclusions

This chapter analysed how effective the opportunity given to a worker to join a workplace pension scheme is in order to generate an impact on pension plan participation. The results from a propensity score matching indicate that provision at every workplace can generate a major impact on aggregate participation rates, usually superior to 50 per cent. We also find no evidence that such success is conditional on the existence of policy rules concerning the way workers are enrolled or incentivized to join a scheme. By performing a set of robustness checks, we claim that these findings are not significantly sensitive to a hidden bias in the estimated propensity scores. When we repeated the analysis including only observations from employees of private companies, we observe that workplace pension provision still has a major impact on aggregate participation.

In order to consider how immediate an average employee reacts to the new opportunity to save for his retirement via a workplace pension scheme, and how this affects membership rates in the short-term, we analysed situations in which an employee just started to be offered an occupational pension scheme. We show that education level is one of the main predictors of short-term opt-in decisions along with having a permanent position. The average short-term opt-in rate predicted by the model is 35.6 per cent. Specifically among workers in the private sector, the predicted rate is of 30.2 per cent, and for those not employed by private firms, this percentage is equal to 54.6 per cent, highlighting the potential different characteristics between the pension schemes offered by private and non-private employers.

One of the limitations of this study is that we do not observe the characteristics of the pension plan offered by the company to the employees. Because automatic enrolment emerged as a practice among American companies in the end of 1990s, and consequently increased opt-in rates among those companies offering 401(k) plans, it becomes important to check whether there is evidence that automatic enrolment started to be widely used also in the United Kingdom during the period analysed in the present study. We show that predicted opt-in rates remained stable in the United Kingdom since the second half of the nineties. The inexistence of a positive trend in opt-in rates suggests the absence of an increasing use of automatic enrolment in workplace pension schemes. The same conclusion is obtained when we observe the evolution of opt-in rates among private sector workers.

The main policy contribution of this study is to suggest that pension reforms can still obtain major impacts on participation rates by prescribing mandatory provision of pension schemes in every workplace while letting other components of a scheme to be determined by active decisions of firms and workers. Automatic enrolment might be helpful to reduce the time an employee takes to opt-in a plan, i.e. to affect what we called here as the short-term opt-in rate. This comes with the cost of a "one-size-fits-all" impersonal default option that might not be appropriate due to heterogeneous characteristics of the population, especially in terms of the contribution rate. According to our results, the reform initiated in the United Kingdom from October 2012, established by the 2008 Pensions Act, could also be called "Universal Provision" alongside with "Automatic Enrolment".

1.5 Appendix

Appendix 1.A

Enrolment procedure declared by members of employer pension scheme
Wealth and Assets Survey - Waves 2 and 3

Number of employees at the workplace	*How did you join the pension scheme you are a member of?*					
	Completed detailed form	Automatically enrolled	Signed pre-completed form	Yes-or-No declaration	Other/Don't know	Total
	[1]	[2]	[3]	[4]	[5]	[6]
Panel A. Private firms						
Wave 2 (2008-2010)						
1 - 10	133	75	32	42	36	318
11 - 24	103	62	37	29	29	260
25 - 49	118	68	38	45	42	311
50 - 249	324	160	95	109	77	765
250 - 499	146	95	57	48	40	386
500 or more	225	170	76	79	54	604
Number of observations	1,049	630	335	352	278	2,644
Wave 3 (2010-2012)						
1 - 10	124	53	27	46	47	297
11 - 24	126	52	38	33	29	278
25 - 49	118	47	40	34	36	275
50 - 249	304	161	111	92	66	734
250 - 499	139	81	54	38	35	347
500 or more	235	162	88	90	55	630
Number of observations	1,046	556	358	333	268	2,561
Panel B. Non-private firms and other org.						
Wave 2 (2008-2010)						
1 - 10	52	85	26	28	15	206
11 - 24	81	100	37	38	25	281
25 - 49	93	172	34	70	38	407
50 - 249	91	340	73	121	68	693
250 - 499	97	130	28	54	22	331
500 or more	230	374	89	141	67	901
Number of observations	644	1,201	287	452	235	2,819
Wave 3 (2010-2012)						
1 - 10	58	68	30	23	16	195
11 - 24	85	79	24	48	18	254
25 - 49	112	151	25	70	27	385
50 - 249	199	309	72	128	77	785
250 - 499	73	88	37	41	26	265
500 or more	194	391	71	140	99	895
Number of observations	721	1,086	259	450	263	2,779

Chapter 2
Does the provision of workplace pension plans affect other savings?

Pension wealth accumulation has become a major attention of policymakers who deal with the consequences of the ageing population phenomenon. For instance, old-age benefits provided by State pensions are expected to rise, and so is the insolvency risk of national pension systems. With the increased adoption of fully funded private pension plans, much of the responsibility for old-age benefits provision has moved from governments' budgets to households' finances. Additionally, most employers have substituted occupational defined benefit plans for defined contribution schemes to mitigate balance sheet exposures to pension fund imbalances. This led to a sharp increase in workers' required level of awareness about the adequacy of their financial preparation for retirement. Financial literacy interventions have been suggested to help citizens to make informed decisions and improve their downstream financial behaviour (Lusardi, 2008; Fernandes et al, 2014; Miller et al, 2015). Financial awareness would then counteract the increasing complexity of sophisticated products and the facilitated access to credit (Lusardi and Mitchell, 2007).

Some national pension systems have concomitantly consolidated the accumulation of wealth through workplace pension schemes. Through the implementation of wide policy reforms, countries such as the Netherlands, Sweden, New Zealand and the United Kingdom, have establish workplace provided pension schemes as a major pillar to sustain their citizens' appropriate financial preparation for retirement. For instance, the United Kingdom's Pensions Act 2008 established the universal provision of workplace pension plans by all employers and the automatic enrolment of eligible employees into these schemes. A body of evidence in behavioural sciences supports that when workers are defaulted into pension schemes, participation rates are higher than if they had made the standard decision to opt in or not (Madrian and Shea, 2001; Choi et al., 2006; Benartzi and Thaler, 2013).

While default choices are expected to effectively boost workplace pension plans' participation, the effect on overall savings is still ambiguous. For example, an increase in

workplace pension contributions could be financed by a reduction in the amount households would save in other forms (Crawford et al, 2012). Using administrative data, Chetty et al (2014) addressed the crowd-out on savings accounts and showed that the effect of retirement savings policies on wealth accumulation depend on whether they change savings rates by active or passive choice. In summary, price subsidies induce wealthier and more sophisticated individuals to shift assets from taxable accounts to retirement accounts.

Usual limitations in available data and research designs are appointed as reasons for the still not clear identification of the relationship between pension and non-pension financial saving. Administrative data is usually not easily available, making the use of national surveys containing self-reported measures of wealth accumulation and saving attitudes the most frequent data source. Guariglia and Markrose (2000) showed that contributions to personal pension plans are made essentially for retirement purposes, whereas conventional savings are done for precautionary motives. The study of Banks et al (2002) indicates that those who have accumulated pension wealth tend to have larger balances in financial wealth than those without, while a certain degree of substitutability between earning-related pension schemes and financial wealth was suggested by Attanasio and Rohwedder (2003). Using data from the mid-2000s, Crossley and O'Dea (2010) showed that those who paid into a pension tended to have higher non-pension wealth than those who didn't pay into a pension. More recently, Crawford et al (2015) pointed that active saving in financial assets is greater among those reporting saving for retirement or for an investment. Despite these efforts, the endogenous relation of saving decisions imposes empirical challenges to a correct identification of causality.

Workplace pensions are not provided by random assignment. Their provision by employers is expected to on a vector of characteristics which describe the job position and the worker socio-demographics. This study originally exploits the variability in workplace pension scheme provision and membership induced by the employer's payroll size in number of employees as an identification strategy. First of all, we show that the chance of an employee to work for a firm which offers a pension scheme increases monotonically with the corresponding number of co-workers. Also, conditional on provision, opt in decisions in workplace plans increase with the number of workers, potentially due to the fact that, on average, larger employers offer more attractive pension plans. We claim that the number of workers at the workplace is a sufficiently exogenous instrumental variable (Angrist et al., 1996; Angrist and Krueger, 2001), which allows us to identify the causal

effect of workplace pensions on other forms of savings such as personal pension plans and financial vehicles. In short, except through the engagement in a workplace pension scheme, the number of co-workers is not expected to affect saving decisions.

The corresponding analysis is performed using British data from two national surveys. We use data containing information about workers' saving attitudes from the British Household Panel Survey (University of Essex, 2010) for the years 1992 to 2008; and from the Wealth and Assets Survey (WAS) for the years 2008 to 2012. During this sample period, the decision to provide a workplace pension scheme was still an employer's decision, i.e. not mandatory as it came later by the reform legislated by the Pensions Act 2008. In our results, we find no evidence that providing employees with access to workplace pension schemes would make them less likely to save through non-pension financial instruments. Precisely, when we find a significant effect, it is positive, which is in accordance with previous relationships observed in the literature. Also, given the natural substitutability between pension vehicles, workplace pensions have shown a negative impact on personal pension plan participation,.

Overall, this study builds on the literature which suggests the relevance of workplace pension schemes in the apparatus of national pension systems. To lay out the present analysis, the rest of the chapter is structured as follows. Section 1 illustrates the sampling procedure and provides descriptive statistics for the variables of interest. Section 2 describes our empirical strategy, while in Section 3 we present the main results and further analyses. Section 4 concludes and discusses policy implications.

2.1 Data and descriptive statistics

The data used in this study consists of waves 2 to 18 of the British Household Panel Survey (BHPS) for the years 1992 to 2008; and of waves 2 and 3 from the Wealth and Assets Survey (WAS) for the years 2008 to 2012. During this period, automatic enrolment of employees into a workplace pension's scheme was not a practice enforced by law, as it came later by the legislation of the Pensions Act 2008. Until 2012, most British workers still had to actively choose to opt in workplace pension plans and the provision of such schemes was still a decision of employers. Additionally to questions related with pensions (Appendix A), both datasets contain information about job characteristics expected to be related to workplace pensions provision and membership, for example, the number of employees in the job place, type of contract (e.g. full-time, permanent), firm sector (e.g.

private) and job classification. Other household and individual characteristics expected to be related to the variables of interest are also available, such as household income, tenure, and type; education, and earnings.

We used observations of employed individuals (not self-employed) who responded to all the questions related to: i) workplace pension plan provision and membership; ii) the number of employees in the workplace; iii) whether the worker has recently paid into a personal pension plan; iii) and whether he has recently saved any income. Given this, our initial samples are composed by 99,351 observations from 16,816 individuals who were respondents to the BHPS; and 26,870 observations from 20,385 individuals who responded to the WAS. The proportions of observations in which an employee reports that his employer offers a pension scheme in workplace are presented in Column 1 of Table 2.1. In both datasets, this proportion is monotonically and strictly increasing with the number of employees in the employing firm (Panel A and Panel B). In Column 2, we observe that, conditional on workplace pension provision, the proportion of workers that opt to join the scheme is also increasing. Membership rates are around 0.70 among workers employed by firms in the lowest range of number of employees, while in the highest range proportions are above 0.83. In sum, the information contained in both columns suggests a consistent association between an employer's payroll, workplace pension provision and membership rates.

Personal plan membership decreases as participation in workplace plans increases, as expected, due to the natural substitution between these two pension products. Column 3 of Table 2.1 shows that, conditional on workplace pension provision, the proportion of workers that contribute to a personal pension plan changes ranges from around 0.17 in firms with a small number of workers to around 0.10 in the largest employers. Differently, the proportions in Column 4 show a positive association between the number of employees in the workplace and the practice of non-pension savings in the form of financial wealth accumulation among those who are offered a workplace pension scheme. Figures 2.1 and 2.2 compare the average personal pension plan membership and practice of financial savings between the groups of members and non-members of workplace schemes. Workplace plan membership is negatively related to the demand for personal pensions, and positively related with practice of financial savings. Such associations suggest that the effect of workplace pensions on other savings could possibly be identified through the

variability induced by the observed employer's payroll size, which is addressed in the next section.

TABLE 2.1

Proportions of key variables by number of employees in the workplace

Panel A: British Household Panel Survey (Waves 2-18)

	Employer offers a pension scheme	Conditional on [1] = Yes		
		Member of workplace pension scheme	Has personal pension	Saves from current income
	[1]	[2]	[3]	[4]
Number of employees in the workplace				
1 - 2	0.300	0.707	0.184	0.577
3 - 9	0.396	0.644	0.163	0.529
10 - 24	0.558	0.659	0.157	0.531
25 - 49	0.685	0.697	0.158	0.534
50 - 99	0.760	0.718	0.147	0.549
100 - 199	0.808	0.735	0.151	0.560
200 - 499	0.866	0.745	0.122	0.553
500 - 999	0.901	0.796	0.121	0.578
1000 or more	0.936	0.833	0.106	0.578
Number of individuals	16,816		12,676	
Number of observations	99,351		68,284	

Panel B: Wealth and Assets Survey (Waves 2-3)

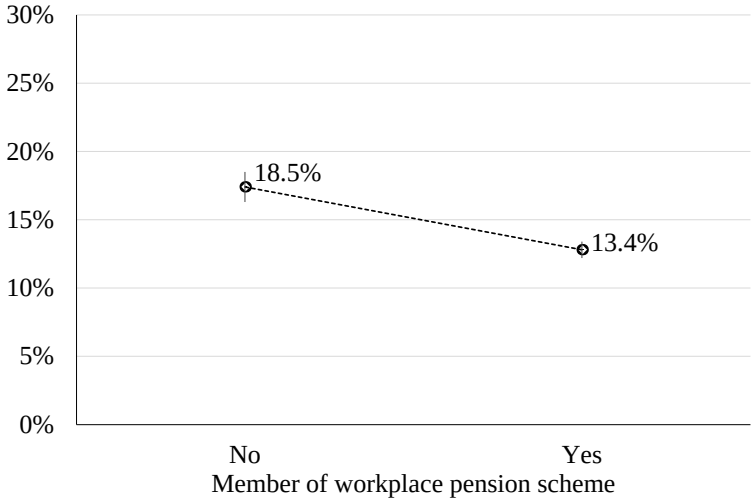
	Employer offers a pension scheme	Conditional on [1] = Yes		
		Member of workplace pension scheme	Has personal pension	Saved in the last 2 years[a]
	[1]	[2]	[3]	[4]
Number of employees in the workplace				
1 - 10	0.333	0.718	0.171	0.632
11 - 24	0.512	0.747	0.143	0.621
25 - 49	0.623	0.798	0.137	0.610
50 - 249	0.752	0.819	0.124	0.653
250 - 499	0.809	0.826	0.133	0.647
500 or more	0.885	0.903	0.107	0.683
Number of individuals	20,385	13,292		8,412
Number of observations	26,870	17,417		12,270

Notes on tables are presented from page 95.

FIGURE 2.1

Rates of personal pension plan membership among those who are offered a workplace pension

BHPS – Has a personal pension plan: Yes = 1, 0 otherwise



WAS - Has a personal pension plan: Yes = 1, 0 otherwise

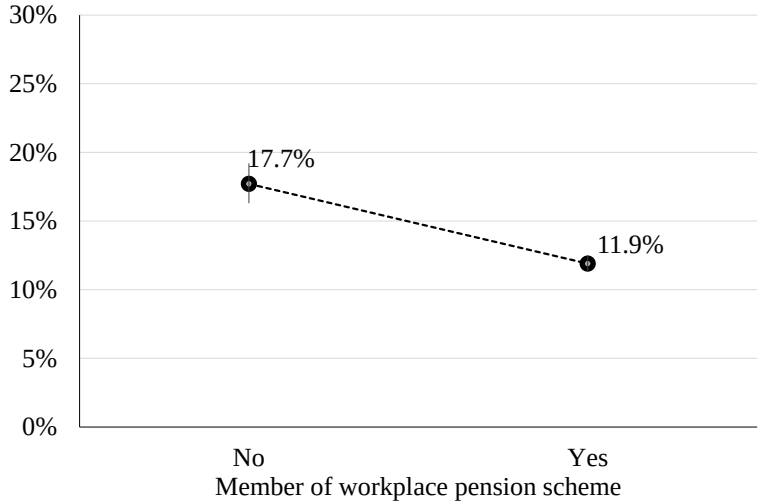
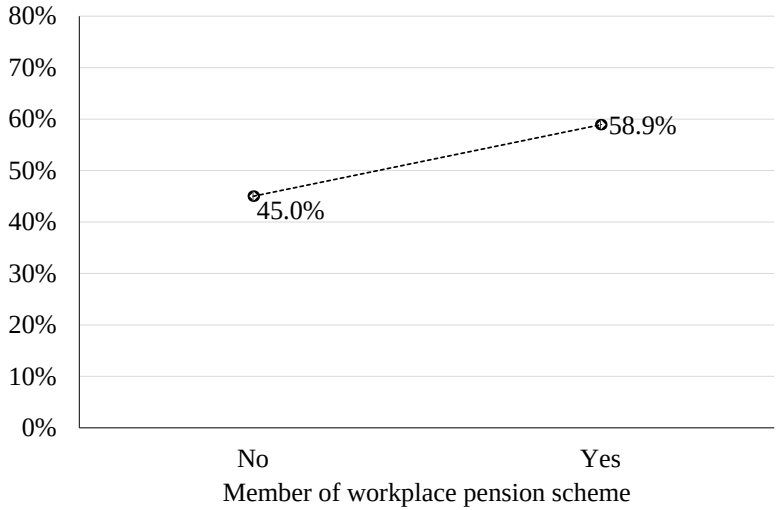


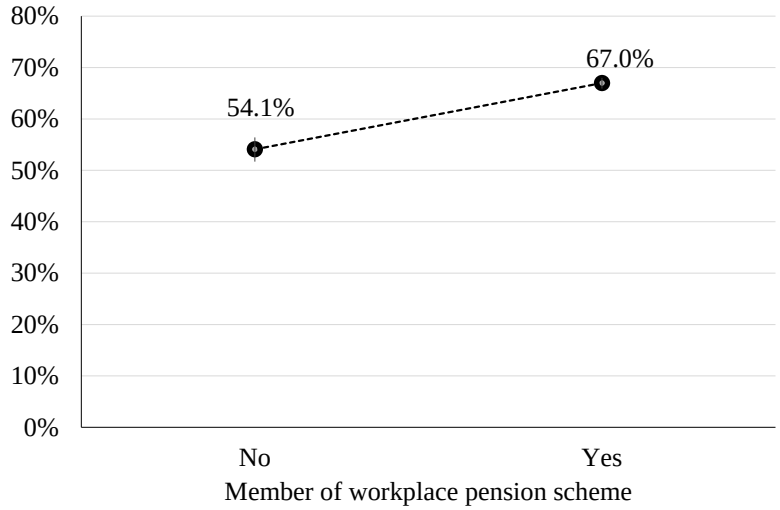
FIGURE 2.2

Rates of saving practice among those who are offered a workplace pension

BHPS - Saves from current income: Yes = 1, 0 otherwise



WAS – Saved in the last 2 years: Yes = 1, 0 otherwise



2.2 Empirical strategy

In order to identify the effect of workplace pension provision on other saving attitudes we would like to estimate the following panel equation:

$$\Pr[y_{ikt} = 1] = \phi(\alpha + \delta p_{it} + \beta \mathrm{X}_{it}) \qquad (1)$$

where y_{ikt} is worker's *i* outcome *k* indicating whether he practices other forms of savings at time *t*; p_{it} is an indicator variable denoting whether the worker's employer provides a pension scheme in the workplace; X_{it} is a vector of socio-demographic and job characteristics; and $\phi(\bullet)$ is a cumulative distribution function. In reality, employees do not become members of workplace pensions by random assignment, so the parameter of interest, δ, cannot be consistently estimated, i.e., we cannot deduce it directly from the joint distribution of y and X using observational data.

In our descriptive statistics, we saw that employers' payroll size in number of employees is correlated with workplace pension provision, the endogenous regressor. Hence, in our identification strategy we exploit this variability induced by the employer's payroll size to claim that the number of workers at the workplace is a sufficiently exogenous instrumental variable that allows us to identify the causal effect of workplace pensions on other forms of savings. This is in line with the idea that a reasonable instrument is uncorrelated with the outcome variable for reasons beyond its effect on the endogenous covariate (Angrist and Krueger, 2001, p. 72), and sufficiently correlated with the endogenous covariate for reasons the researcher can verify and explain.

In terms of functional form, a robust estimation of the parameter of interest, δ, can be obtained with a linear instrumental variable estimate, such as a two-stage least squares - 2SLS, for the binomial endogenous regressor, p. A 2SLS estimation of Equation 1 can be represented by the following pair of equations:

$$\Pr[p_{it} = 1] = \alpha_1 + \gamma_1 \mathrm{N}_{it} + \beta_1 \mathrm{X}_{it} + \varepsilon_{1it} \qquad (2)$$

$$\Pr[y_{ikt} = 1] = \alpha_2 + \delta \hat{p}_{it} + \beta_2 \mathrm{X}_{it} + \varepsilon_{2it} \qquad (3)$$

where N_{it} is a vector of dummies identifying the number of employees at workplace in ranges (as described in Table 2.1); and $\hat{p}_{it}$ is the linear prediction for the likelihood of pension provision conditional on N and X.

The first stage regression is defined by Equation 2, which generates $\hat{p}_{it}$. Equation 3 represents the second stage, in which we regress the outcome of interest on the estimated predictions for provision $\hat{p}_{it}$ obtained in the previous step. As indicated by Angrist and Krueger (2001, p. 80), even if the underlying second-stage relationship is nonlinear, a linear instrumental variables estimate captures the average effect of interest for a binomial endogenous regressors (Chesher, 2010; Chesher and Rosen, 2013). For cases where the particular outcome of interest is not binomial, but continuous, we can modify the linear probability model represented in Equation 1, substituting $\Pr[y_{ikt} = 1]$ for simply y_{ikt}. The 2SLS estimation represented by Equations 2 and 3 generates a consistent estimate for the parameter of interest, δ, which is initially called as the local average effect of provision (Imbens and Angrist, 1994), when the second stage regression error ε_{2it} is uncorrelated with the instrumental variable, N_{it}, used in the first stage.

Because provision is supposed to affect the outcomes of interest only for those ones that actually become members of a workplace pension scheme, we also test the relevance of our instrument to identify the effect of membership on the outcomes of interest. For this, we substitute p_{it} by m_{it}, where the latter is a binomial variable indicating whether the worker has saved in a workplace scheme, to get the corresponding second stage regression as:

$$\Pr[y_{ikt} = 1|p = 1] = \alpha_2 + \delta\widehat{m}_{it} + \beta_2 \mathrm{X}_{it} + \varepsilon_{2it} \qquad (4)$$

Within subjects fixed effects are used to estimate Eq. 2-4 only in the BHPS sample. This is followed to avoid generating bias estimates, as exposed by Nickell (1981), due to the "large N, small T" characteristic of our WAS sample.

To claim that these estimates are also an informative description of the whole population response to a given treatment, for instance, the impact of a large policy change in workplace pension schemes provision and/or membership, we need to discuss the support of the vector of categorical instruments $\mathrm{N_{it}}$. Heckman and Vytlacil (2005) show that both the average causal treatment effect of the treatment and LATE are averages of the marginal treatment effect - MTE over different subsets of the instrumental variable support, or subpopulations (Cameron and Trivedi, 2005). In our case, for the identification of provision effect, the MTE can be described as:

$$\mathrm{MTE} = \frac{\partial \mathrm{E}[y|\mathrm{X},\mathrm{N}]}{\partial \Pr[p=1|\mathrm{X},\mathrm{N}]} \qquad (5)$$

In this sense, LATE is the average of MTE over only an interval of N where provision rates differ. The estimate of the population average treatment effect – ATE is the expected value of MTE over the full support of N, including where the probability of provision/membership is (close to) zero or one. This is equivalent to the overlap or matching assumption, which is necessary for identifying some population measures of impact (Cameron and Trivedi, 2005):

$$0 < \Pr[p = 1|\mathrm{X}, \mathrm{N}] < 1 \qquad (6)$$

The matching assumption requires that, conditional on X and N, there are both provided and no provided cases, and the same would be required when we instrument membership instead of provision. This assumption ensures there is overlap between the treated and untreated subsamples: for each case with $p = 1$ there is another matched case with similar likelihood to be provided with (member of) a workplace pension scheme with $p = 0$. Because this assumption can be observed in the output of our first stage estimation in Eq. (2), we should address it in our further analysis too.

2.3 Main results and further analysis

Our empirical analysis starts by obtaining the 2SLS estimates for the effect of workplace pension provision on other savings. We also present the OLS estimate of the same effect as a means of comparison. Tables 2.2a and 2.2b show that when workers are provided a pension scheme within their workplaces they are significantly less likely to declare themselves as members of personal pensions. The expected substitution effect between these two types of pension savings is then verified in both BHPS and WAS data, for instance, it is estimated as a decrease of 6.4 and 21.6 percentage points, respectively. Notwithstanding, the attitude to put something away in a bank's saving account or investment seems to not be substituted by workplace pension provision. In fact, when there is a significant effect, it is actually a positive one, for example, equal to 12.8 percentage points in the 2SLS estimation. These results are in line with previous correlational studies showing that conventional financial savings are usually formed for precautionary motives, not usually to support retirement goals (e.g. Guariglia and Markrose, 2000).

The same patterns of results are obtained when we instrument workplace pension membership and restrict the sample to include only those observations of workers that are offered a pension scheme within the workplace. Tables 2.3a and 2.3b show that when workers are members of a workplace pension scheme they are significantly less likely to

declare to be members of personal pensions, but not less likely to save in other non-pension financial vehicles. For example, the marginal effect of membership on personal plan participation estimated by 2SLS in the BHPS and WAS samples are, respectively, negative in 22.9 and 29.6 per cent. When the outcome variable is the probability of saving from income in other non-pension financial vehicles, the marginal effect is positive in both samples, but statistically significant only in the WAS sample, and equal to 21.7 per cent.

TABLE 2.2

Marginal effect of workplace pension provision on other savings

a. BHPS (Waves 2-18)

	Has personal pension		Saves from current	
	OLS	2SLS	OLS	2SLS
	[1]	[2]	[3]	[4]
Employer offers a pension scheme	-0.018	-0.064	0.018	0.038
	[0.004]***	[0.018]***	[0.001]***	[0.026]
Number of individuals	16,421	13,756	16,421	13,756
Number of observations	95,191	92,526	95,191	92,526

b. WAS (Waves 2-3)

	Has personal pension		Saved in the last 2 years[a]	
	OLS	2SLS	OLS	2SLS
	[1]	[2]	[3]	[4]
Employer offers a pension scheme	-0.105	-0.216	0.087	0.128
	[0.006]***	[0.017]***	[0.010]***	[0.025]***
Number of individuals	15,849	15,849	12,348	12,348
Number of observations	16,521	16,521	12,681	12,681

Notes on tables are presented from page 95.

TABLE 2.3

Marginal effect of workplace pension participation on other savings conditional on provision

a. BHPS (Waves 2-18)

	Has personal pension		Saves from current	
	OLS	2SLS	OLS	2SLS
	[1]	[2]	[3]	[4]
Member of workplace pension scheme	-0.048	-0.229	0.027	0.179
	[0.007]***	[0.099]**	[0.008]***	[0.140]
Number of individuals	12,378	9,959	12,378	9,959
Number of observations	65,500	63,081	65,500	63,081

b. WAS (Waves 2-3)

	Has personal pension		Saved in the last 2 years[a]	
	OLS	2SLS	OLS	2SLS
	[1]	[2]	[3]	[4]
Member of workplace pension scheme	-0.073	-0.296	0.060	0.217
	[0.009]***	[0.071]***	[0.014]***	[0.091]**
Number of individuals	10,037	10,037	7,964	7,964
Number of observations	10,393	10,393	8,128	8,128

Notes on tables are presented from page 95.

In sum, the main results for the regression analysis are broadly similar to the insights we found from the unconditional approach in descriptive statistics presented in Section 2. One example of this is the comparison between the estimated marginal effect of workplace pension membership among those who are offered a scheme by the employer presented in Table 2.3 and the information illustrated in Figures 2.1 and 2.2. In both, workplace plan membership is observed as negatively related to the demand for personal pensions, and positively related with the practice of financial savings.

The tests of over-identifying restrictions, here denoted by the Hansen's *J* statistic (Baum, Schaffer and Stillman, 2007), show that *J* is far from rejection of its null in all cases, giving us greater confidence that our instrument set, bands of number of employees in the workplace, is exogenous. Also, tests of under-identification and weak-identification

of instruments are presented within the 'first stage' results in Appendix B and C. These tests ensure what was suggested previously in the descriptive statistics: that the instrument is also sufficiently correlated with the variables of interest, provision and membership.

In order to further analyse the effect of workplace pension schemes, we extend the analysis to other proxies for non-pension financial savings available in BHPS and WAS. For example, in the BHPS:

> *"About how much on average do you personally manage to save a month?"*

And, from WAS:

> "*What is the approximate net amount that you have added to your savings accounts and investments in the last two years? (By net amount I mean the amount that you have added minus any amounts that you have withdrawn over this period.)".*

Hence, we use the question from BHPS to estimate the impact on self-reported monthly savings in real amounts of British Pounds, while the question from WAS, due to its categorical nature, was recoded as a binomial outcome, to indicate the occurrence (or not) of net additions to savings accounts and investments.

The effect of workplace pension plan provision on individual monthly savings, according to the 2SLS estimate, is slightly negative but not statistically different than zero. Table 2.4a summarizes the results, providing also the OLS estimate and the test for the over-identification of instruments. Similarly, Table 2.4b shows that we observe no effect on real monthly savings also when we instrument membership instead of provision, and restricting the sample only to observations of workers who are offered a workplace pension scheme.

TABLE 2.4

a. Marginal effect of workplace pension plan provision on individual monthly savings

	Real monthly savings (in £)	
	OLS	2SLS
	[1]	[2]
Employer offers a pension scheme	-2.860	-1.305
	[1.617]*	[8.160]
Number of individuals	16,249	13,508
Number of observations	91,662	88,921

b. Marginal effect of workplace pension plan participation on individual monthly savings conditional on provision

	Real monthly savings (in £)	
	OLS	2SLS
	[1]	[2]
Member of workplace pension scheme	2.068	35.763
	[2.592]	[51.980]
Number of individuals	12,214	9,738
Number of observations	62,948	60,472

Notes on tables are presented from page 96.

Differently, Table 2.5a and 2.5b show that both provision and membership have significant effects on the probability of individuals adding net amounts to savings accounts and investments. For example, provision increases the likelihood of such savings, on average, in 7.2 percentage points; while membership among those who are offered a workplace pension scheme is expected to increase the same probability in 25.7 percentage points.

TABLE 2.5

a. Marginal effect of workplace pension plan provision on net investment practice

	Has added a net amount to investments in the last 2 years	
	OLS	2SLS
	[1]	[2]
Employer offers a pension scheme	0.036	0.072
	[0.012]***	[0.029]**
Number of individuals	10,079	10,079
Number of observations	10,101	10,101

b. Marginal effect of workplace pension plan participation on net investments practice

	Has added a net amount to investments in the last 2 years	
	OLS	2SLS
	[1]	[2]
Member of workplace pension scheme	0.036	0.257
	[0.017]**	[0.105]**
Number of individuals	6,866	6,866
Number of observations	6,875	6,875

Notes on tables are presented from page 97.

The robustness of our instrument N_{it} passes the identification test not only when we use two different datasets, but also different outcomes. As highlighted in our empirical strategy, the instrumental variable model with binomial outcome represented by Equations (2) and (3) generates a consistent estimate for the parameter of interest δ, which is the estimate for the "local" average treatment effect - LATE (Angrist et al., 1996; Chesher and Rosen, 2013). We initially qualify it as "local" because, in general, it captures the causal effect on the compliers, i.e., those individuals that are induced to participate in the treatment as a result of a variation in the instrument (Angrist and Imbens, 1995; Angrist and Krueger, 2001).

2.4 Conclusions

In this chapter, we have analysed the effect of workplace pension schemes provision and participation on other individual financial savings, such as personal pension plans and financial assets. Using data from two national surveys from the United Kingdom, we focused on the time period that the decision to provide a scheme in the workplace was still an employer's decision and not mandatory for all firms in the United Kingdom, as it became after the reform legislated by the Pensions Act 2008. We originally exploited the fact that the chance of an employee to work for a firm which offers a pension scheme increases monotonically with the corresponding number of co-workers. This variability in workplace pension scheme provision generated by payroll size was shown to be a sufficiently exogenous instrumental variable, allowing us to point identify the causal effect of workplace pensions on other forms of saving attitudes. Hence, in addition to the causal inference aimed by this study, it also has the methodological contribution of presenting a valid instrumental variable that can be used in future research designs. Extensions of the present empirical strategy could be potentially applied to the analysis of more specific continuous measures of savings, and to individual finances administrative data.

Overall, we found no evidence that providing employees with access to workplace pension schemes would make them less likely to save through non-pension financial instruments. While workplace schemes and personal plans are reasonably interchangeable pension products, other non-pension financial savings seem not to be affected. This result is in line with previous studies using British data which showed that contributions to pension plans and conventional savings do not offset each other completely (Guariglia and Markrose, 2000); and that they even might occur simultaneously (Crossley and O'Dea, 2010). Given a sufficient covariate similarity between the British samples used in the present study and samples from other target populations (Bisbee et al, 2015), our findings support the idea that the estimated local average effects could be extrapolated to describe the potential impact of national reforms based on universal provision and/or membership of workplace pension schemes. As a consequence, this study builds on the literature which supports the pertinence of workplace pension schemes in the apparatus of national pension systems.

The present analysis puts the wide reforms in pension's legislation implemented by countries such as the Netherlands, Sweden, New Zealand and the United Kingdom in a

favourable position to sustain financial preparation for retirement. This is of particular interest of other international policymakers who are currently dealing with the consequences of ageing population on governmental expenditures and the insolvency risk of pay-as-you-go national pension systems. Policy alternatives could enforce universal provision of workplace pension plans in every workplace. In this case, the access to a pension plan is facilitated and contributions are directly deducted from employment earnings, but the employee still have to actively decide whether to opt-in a scheme offered by the company (Carrol et al., 2009; Cronqvist and Thaler, 2004; Keller et al, 2011). We have shown here that when a worker opts-in, this does not significantly affect other non-pension saving practices. This might be preferred to "one-nudge-fits-all" impersonal defaults options when individual characteristics are very heterogeneous, or when libertarian-paternalistic government interventions are infeasible, undesirable or unethical (Sunstein, 2013; Arad and Rubinstein, 2015; Sunstein, 2015; Reisch and Sunstein, 2016; Jung and Mellers, 2016).

2.5 Appendix

Appendix 2.A

Questions related to workplace pension plan provision and membership, personal pension plan membership, and other savings in the BHPS:

a) *Does your present employer run a pension scheme or superannuation scheme for which you are eligible?* [Yes, No, Don't know]
b) *Do you belong to your employer's pension scheme?* [Yes, No, Don't know]
c) *I'd like to ask you now about private personal pensions, that is a pension that you yourself have taken out on your own behalf. In the past year, that is since [Date] have you paid any contributions or premiums for a private personal pension, or had such contributions paid on your behalf by the Department for Work and Pensions?* [Yes, No, Don't know]
d) *Do you save any amount of your income for example by putting something away now and then in a bank, building society, or Post Office account other than to meet regular bills? Please include share purchase schemes, ISA's and Tessa accounts.* [Yes, No, Don't know]

Questions related to workplace pension plan provision and membership in the WAS:

a) *Can I just check, does your employer offer access to an occupational pension scheme or superannuation scheme?* [Yes, No, Don't know].
b) *Are you eligible to belong to your employer's occupational pension scheme?* [Yes, No, Don't know].
c) *Are you a member of the pension scheme?* [Yes, No, Don't know].
d) Personal pension membership is identified by a derived variable *Whether has a personal pension* [Yes, No, Don't know].
e) *Now thinking about all of your savings and investments, in the last two years, have you added any money to your savings and investments?* [Yes, No, Don't know].

Appendix 2.B

Predictors of workplace pension plan provision and membership - BHPS sample

	Employer offers a pension scheme		Member of workplace pension scheme	
	[1]		[2]	
Number of employees in the workplace				
1 - 2	[*Base*]		[*Base*]	
3 - 9	0.060	0.011	-0.009	0.018
10 - 24	0.127	0.012	-0.023	0.018
25 - 49	0.190	0.012	-0.02	0.019
50 - 99	0.240	0.012	-0.004	0.019
100 - 199	0.270	0.012	0.003	0.019
200 - 499	0.307	0.013	0.018	0.019
500 - 999	0.322	0.013	0.035	0.019
1000 or more	0.318	0.013	0.044	0.019
Private firm	-0.199	0.008	-0.145	0.011
Job type				
Professional	[*Base*]		[*Base*]	
Managerial and Technical	-0.006	0.009	-0.019	0.009
Skilled non-manual	0.003	0.010	-0.028	0.011
Skilled manual	-0.050	0.011	-0.024	0.012
Partly skilled	-0.048	0.011	-0.032	0.013
Unskilled	-0.072	0.015	-0.041	0.023
Armed forces	-0.053	0.040	0.113	0.043
Full time job	0.020	0.006	0.015	0.008
Permanent contract	0.167	0.008	0.167	0.012
Underindentification of instruments				
Kleibergen-Paap rk LM statistic	958.265		61.349	
Chi-squared(8) p-value	[0.000]		[0.000]	
Weak identification of instruments				
Cragg-Donald Wald F statistic	448.834		19.371	
Number of individuals	13,756		9,959	
Number of observations	92,526		63,081	

Notes: Estimates obtained from the first stage regression represented by Equation (2). Standard errors clustered at the individual level shown in the ride side of the coefficients. All estimates include within subjects fixed-effects and dummy variables indicating time (survey wave) effects. Other covariates included in the estimation were: (i) measures of (log transformed) real monthly earning and (log transformed) annual equivalized household net real income; and (iii) individual and household characteristics such as age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Appendix 2.C

Predictors of workplace pension plan provision and membership - WAS sample

	Employer offers a pension scheme		Member of workplace pension scheme	
	[1]		[2]	
Number of employees in the workplace				
1 - 10	[*Base*]		[*Base*]	
11 - 24	0.151	0.011	0.033	0.016
25 - 49	0.264	0.011	0.063	0.015
50 - 249	0.364	0.010	0.077	0.013
250 - 499	0.412	0.013	0.092	0.016
500 or more	0.467	0.011	0.150	0.014
Responsible for supervising	0.032	0.007	-0.011	0.008
Full time job	0.070	0.008	0.046	0.010
Kleibergen-Paap rk LM statistic	2,141.708		160.568	
Chi-squared(8) p-value	[0.000]		[0.000]	
Cragg-Donald Wald F statistic	491.128		32.514	
Number of individuals	15,849		10,037	
Number of observations	16,521		10,393	

Notes: Estimates obtained from the first stage regression represented by Equation (2). Standard errors clustered at the individual level shown in the ride side of the coefficients. Estimates include dummy variables indicating time (survey wave) effects. Other covariates included in the estimation were: (i) measures of individual and household income; and (ii) individual and household characteristics such as gender, age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Chapter 3
Non-cognitive skills and the economic role of home production at retirement

There is an empirically well-documented reduction in household consumption expenditure at retirement (Hamermesh, 1984, Mariger, 1987; Robb and Burbidge, 1989; Banks et al., 1998; Bernheim et al., 2001; Schwerdt, 2005; Haider and Steohens, 2007; Battistin et al., 2009; Miniaci et al., 2010). This sharp drop in expenditures was referred as a puzzle (Banks et al., 1998) given the implications of the life-cycle hypothesis (Blundell at el. 1994) which states that individuals would save for retirement aiming to smooth consumption across the life span. However, a body of literature suggests this can be explained by the fact that a decline in spending at retirement is usually related to food and work-related shopping (Hurst, 2008). Also, these monetary expenditure measures do not necessarily correspond to an actual food intake reduction, because retirees substitute market goods and services for "do-it-yourself" and economically rewarding domestic chores, for example preparing meals at home (Luengo-Prado and Sevilla, 2013). This literature also documents the existence of a substantial heterogeneity in spending changes at retirement, across consumption categories and in the time new retirees devote to housework tasks.

Recent empirical analyses try to explain this heterogeneity with gender differences and social norms associated to couples' division of labour (Stancanelli and Soest, 2012; Luengo-Prado and Sevilla, 2013; Ciani, 2016; Bonsang and Soest, 2015). Alternatively, Auspurg et al (2015) using an experimental evidence on gender identity found little evidence of any systematic gender differences in the preference for housework, suggesting that the reasons for the observed division of domestic chores might lie elsewhere. Consequently, a major question remains not fully understood: what are the determinants of the heterogeneous changes in home production at retirement in terms of individual differences? Since its economic role is not only related to the rewarding aspects, but also with the costly nature of performing effortful and time demanding tasks, preferences for

doing housework might be driven by individual characteristics that go beyond gender, marital status, and health conditions.

Individual psychological differences in the form of non-cognitive skills like conscientiousness, self-control, interpersonal abilities, motivation, and creativity, generally not captured by conventional cognitive ability tests of intelligence and memory, have been shown as important determinants of individuals' economic behaviour (Heckman et al, 2006; Borghans et al, 2008; Almlund et al, 2011; Heckman, 2011). When classified according to the Five-Factor model of personality (Costa and McCrae, 1992) - openness to experience (appreciation for ideas), conscientiousness (the need for achievement, self-discipline, and planned behavior), extraversion (seek out for social stimulation), agreeableness (interpersonal sensitivity) and neuroticism (emotional stability), these traits consist of high-order dimensions that determine individuals' comparative advantages in terms of non-cognitive abilities, and shape their preferences, habits and situational actions. Consequently, in this study we build on the literature of retirement behaviour and the economic role of home-production by examining whether these non-cognitive skills determine the observed heterogeneous changes on the time individuals devote to housework due to a transition from the labour market to a retired status.

Studies integrating non-cognitive skills and economic analysis have helped to explain individuals' heterogeneous performances on economically rewarding activities and their reactions to changes in job market status. For example, in terms of remuneration, Nandi and Nicoletti (2014) found that openness to experience and extraversion are rewarded, while agreeableness and neuroticism are penalized. A negative relation between individual levels of agreeableness and wages was also identified by Heineck (2011). Conscientious individuals report more life satisfaction from increases in income (Boyce and Wood, 2011) but experience greater drops in life satisfaction due to unemployment (Boyce et al, 2010). Conscientiousness also predicts job performance (Hurtz and Donovan, 2000), but conscientious workers who lack agreeableness may be ineffective, particularly in jobs requiring cooperative interchange with others (Witt et al., 2002). Recent evidence from Oerlemans and Bakker (2014) suggests that extraverts do not experience boosts in momentary happiness when spending time in merely pleasurable activities such as relaxing, watching TV, and reading. In fact, they report higher levels of satisfaction with life because they engage on motivationally salient and rewarding activities, e.g. physical exercises and economically rewarding work, especially when executed with others. These

facts might play a role at retirement not only because non-cognitive skills determine comparative advantages in task performances, but also because in the absence of paid work as at retirement, doing housework becomes a salient economically rewarding activity that allows individuals to save monetary income through home production.

As predictors of personal achievement, success and satisfaction during working life, non-cognitive abilities were also identified as relevant determinants of retirement circumstances. Higher scores of agreeableness and conscientiousness, and lower scores of neuroticism have been shown as predictors of life satisfaction and positive experiences among retirees (Robinson et al., 2010). Higher levels of conscientiousness are more likely to be economically prepared for retirement, being potentially better at determining the optimal level of spending in a way that they have lower risk of outspending their resources before death (Hurd et al., 2012), with extraverted retirees presenting higher social activity due to their more outgoing nature (Lockenhoff et al., 2009). Recently, Kesavayuth et al. (2016) investigated how personality and gender impact well-being among retirees, and showed that retirement has a positive effect on leisure satisfaction for both males and females, but not necessarily life satisfaction and income satisfaction. While females' have their well-being at retirement shaped by personality traits, the same does not seems to occur for males. In summary, previous empirical evidence allows us to hypothesise that new retirees' attitudes towards housework might be shaped by non-cognitive skills, and thus might explain much of the observed heterogeneity.

In order to perform the present analysis, we use British longitudinal data which includes individual measures of non-cognitive skills and responses about the amount of hours spent on an average week on housework tasks. Our empirical strategy identifies individuals who were in the labour market in a baseline period and made a transition to retirement in the follow-up period. Then, we estimate the average change in hours of housework (outcome variable) between both periods. To account for the endogeneity of retirement, we build a counterfactual scenario composed by observations of individuals with similar characteristics who stayed in the labour market during both periods. We describe the explanatory power of non-cognitive skills on new retirees' actions towards housework and link them with observed consumption patterns. Our results report an increase in the number of hours devoted to housework tasks at the moment of retirement for both genders, mainly for cohabiting couples and individuals previously working full time. We show that the integration of non-cognitive skills into the empirical analysis helps

to explain heterogeneous changes in the number of hours devoted to housework at the moment of retirement in a degree similar to other factors previously documented in the literature.

This chapter has four additional sections. In Section 1, we provide a conceptual framework and outline a simple two-period model of transition to retirement from the labour market which includes housework as a decision variable. We first study the inter-temporal constraints of this model to later incorporate non-cognitive skills into retirees' consumption decision problem. Then, Section 2 details the data and the empirical method. Section 3 presents the results and details how they contrast with previous empirical studies. Finally, Section 4 proposes some implications of this study and its conclusions.

3.1 Conceptual framework

Retirement is an important life transition in which a set of economic decisions are typically taken to reallocate income, consumption and time. For instance, labour income ceases to be a relevant part of individuals' endowments and money inflows become exogenous, given the amount of savings previously accumulated. Consumption expenditures related to job activity, such as meals near the work place, transportation, clothing and training, lose relevance. After considering these exogenous factors, new retirees' economic choices are still conditional on circumstances such as marital status, household type, and more specifically, individual differences like personal skills, preferences and habits. They are also expected to allocate at least part of their new endowment of time to housework, leisure and physical activities. Essentially, these decisions involve the transition process in which retirees reorient their lives from job-related activities to more domestic ones.

The analytical foundations for the study of household production and the allocation of time within the household were developed by Becker's (1965) classic study (see Heckman, 2015). Therefore, the literature household production became solid (Muth, 1966; Becker, 1981; Pollak and Wachter, 1975; Kerkhofs and Kooreman, 2003) and some attention have been given to the large potential impact of the inclusion of home-production on national accounts (see Stiglitz et al, 2009; and Bridgman et al, 2012). Although, the economic role of housework at retirement is still neglected in inter-temporal descriptive models of retirement behaviour (see Aguiar et al, 2012), being frequently omitted as a decision variable or as part of individuals' life-time wealth (for example, Gustman and

Steinmeier, 2009; Laun and Wallenius, 2013). Aiming to fill this gap, we present a stylized two-period model of a transition to retirement from the labour market in which housework is part of the agent's decision problem. To motivate the later empirical analysis, we study this model's comparative statics and how non-cognitive skills might shape a retiree decision to do housework.

3.1.1 Theoretical set-up

In our setup, housework appears as a component of the agent's inter-temporal constraints being part of life-time wealth. Assuming that non-cognitive skills determine individuals' actions towards tasks that demand effort and ability, we incorporate personality traits to account for their effects not only on productivity but also on actions not related with the task's output, such as when individuals denote utility directly from performing the task.

First of all, time is discrete and individuals live for two periods. In the first period, they participate in the labour market and earn a fixed amount w_t, which they can either consume c_t or save in a private savings account s_t aiming to afford consumption c_{t+1} later in life. Considering that the postponed consumption in the form of private savings is capitalized by a risk-free rate, r_{t+1} and goods and services bought in the first period cannot be stored, real consumption in each period can be described by:

$$c_t = w_t - s_t \tag{1}$$

$$c_{t+1} = (1 + r_{t+1})s_t \tag{2}$$

Individuals have utility given by:

$$\mathcal{U}(c_t, c_{t+1}) = u(c_t) + \beta E_t[u(c_{t+1})] \tag{3}$$

where the period utility function $u(\cdot)$ is increasing in consumption, reflecting the fundamental desire for more consumption; and β denotes the individual subjective discount factor. Agents choose according to their period utility $u(\cdot)$, satisfying the inter-temporal budget constrain given by the combination of (1) and (2):

$$c_t + \frac{c_{t+1}}{1+r_{t+1}} = w_t \tag{4}$$

The equality described above can be interpreted as the life-time wealth of the individual. Individuals also might engage in home production of goods and services which they would have to buy in the market otherwise, e.g. cooking, cleaning, and doing laundry.

Housework levels are set given the comparative advantages individuals face in each period between paying for housework related items and producing them by themselves.

In order to accommodate these additional features in the model, we propose that consumption in each period to be described:

$$c_t = w_t - s_t + z_t \qquad (1')$$

$$c_{t+1} = (1 + r_{t+1})s_t + z_{t+1} \qquad (2')$$

where z_t and z_{t+1} are potential new features induced by public policy or individual active choice. In the case when housework is a determinant of consumption in each period that cannot be stocked from period 1 to period 2, but might affect the decision of the working-age individuals, we have that $z_t = h_t$ and $z_{t+1} = h_{t+1}$.

The inter-temporal budget constraint or life-time wealth can now be described by:

$$c_t + \frac{c_{t+1}}{1+r_{t+1}} = w_t + z_t + \frac{z_{t+1}}{1+r_{t+1}} \qquad (4')$$

Note that the last term in the right hand side can be interpreted as the present value of a pension or the present value of home production of goods and services during retirement. We assume there are no governmental pension policies, but private savings. Individuals are able to postpone consumption by saving in the first period and to produce goods and services at home in both periods.

In this sense, consumption in each period is described by:

$$c_t = w_t - s_t + h_t \qquad (1'')$$

$$c_{t+1} = (1 + r_{t+1})s_t + h_{t+1} \qquad (2'')$$

And life-time wealth given by:

$$c_t + \frac{c_{t+1}}{1 + r_{t+1}} = w_t + h_t + \frac{h_{t+1}}{1 + r_{t+1}}$$

Now consider that $c_{t+1} - c_t = \Delta c_{t+1}$ and $h_{t+1} - h_t = \Delta h_{t+1}$, so we can also combine (1'') and (2'') to get:

$$\Delta c_{t+1} = (1 + r_{t+1})s_t - (w_t - s_t) + \Delta h_{t+1} \qquad (5)$$

where $(1 + r_{t+1})s_t$ is a proxy for the available income in t+1; $-(w_t - s_t) = c_t - h_t$ is the part of real consumption in t from the purchase of market goods and services with money income. If an individual desires to smooth consumption during his transition to retirement,

not only savings, but also home production of part of his consumption in *t+1* is a possibility, and this desire would be reflected in the utility function in (2.3). In the same way, when the replacement rate of income during retirement is close to the unity, i.e., almost no drop in income, the individual is able to make use of his, now available, time endowment and substitute the purchase of market goods and services by home production.

By isolating Δh_{t+1} we can observe that housework is expected to co-vary with real consumption changes, with available money income and with expenditures over market goods and services with money income in the first period.

$$\Delta h_{t+1} = \Delta c_{t+1} - (1 + r_{t+1})s_t + (w_t - s_t) \qquad (6)$$

There are also theoretical motivations for including personality traits as covariates in our empirical tests of the relationship between a transition to retirement and housework production. According to the comparative advantage based approaches suggested by the literature on the integration of personality measures in economic models (Heckman et al.,2006; Almlund et al., 2011; Heckman, 2011), non-cognitive skills in the form of personality traits determine individuals' actions towards tasks that demand effort and ability.

3.1.2 Incorporating non-cognitive skills into new retirees' decision problem

We incorporate personality traits to account for their effects not only on productivity but also on actions non-related with the task's output, for instance when individuals denote utility directly from performing the task.

First, we take equation (2''), which represents consumption at retirement (second period) describing its now static constraints and drop time subscripts. Real monetary income is assumed as exogenous now and given by retirement savings, $w = (1 + r_{t+1})s_t$

$$C = w + h \qquad (7)$$

where *C* is real consumption of final goods and services; w is the exogenous flow of monetary income; and h is home production of good and services to own consumption, or simply housework. In this sense, housework *h* can be described as a task j which outcome depends on productivity φ, which itself is a function of individual actions taken a_i , traits θ and effort e_j.

$$h = \varphi(a_i, \theta\,, e_j), \qquad a \in \mathcal{A},\ i \in \{1, \dots, K\},\ \theta \in \Theta,\ e \in \mathcal{E} \qquad (8)$$

We assume personality traits are individual endowments, and that choices are determined by traits and effort, as they affect productivity in tasks (Heckman, 2011). Effort is also an endowment and when it increases in one task it might diminish in another, leading to the restriction $\sum_{j=1}^{J} e_j = \bar{e}$. Productivity is assumed to be increasing in effort. Effort can complement traits, $\frac{\partial^2 \varphi}{\partial e \partial \theta'} > 0$, or be a substitute to them, $\frac{\partial^2 \varphi}{\partial e \partial \theta'} < 0$. In order to generalize the notion of effort to a broader class of behaviours, let's assume that actions themselves also depend on traits θ, effort e_i, and situation $k \in K$, and let $\mathcal{M}$ be the set of actions, including those ones not directly contributing to productivity.

$$a_i = \tau_i(\theta, e_i, k), \qquad a \in \mathcal{A} \in \mathcal{M} \tag{9}$$

Agents may not only have preferences over consumption of final goods and services, but also may value the output of the task, the effort and actions devoted to it in their own right. In this sense, the agent solves

$$\max \ \mathcal{U}(a, C, \varphi, e) \qquad s.t \quad (7) \tag{10}$$

According to this setup, a transition to retirement is a situation *s*, which might affect housework given (6) and (7).

Home production might co-vary with changes in the consumption basket, because it acts as a substitute for market goods and services like meals, cleaning and laundry. When there is no possible substitution, like in the case of some paid leisure activities (entertainment and travelling, for example), adjustments in housework levels allow them to economize the exogenous flow of income to pay for these expenditures. The inclusion of non-cognitive skills is due to their association with the actions taken in response to new constraints, endowments and incentives facing agents given their preferences (Heckman, 2011, p. 20). Additionally to the effect of traits through consumption reallocation given a transition to retirement, there might be direct effects due to individuals having preferences over the actions taken during the task itself, including those ones not directly contributing to productivity, cooking or grocery shopping being typical examples.

3.2 Data and empirical strategy

We use longitudinal data from a nationally representative sample, the British Household Panel Survey – BHPS. Since its second wave, the BHPS has information on the amount of hours individuals spend on housework on average per week, e.g. time spent

cooking, cleaning and doing the laundry. In Wave 15, respondents were asked a set of fifteen questions, being three questions for each of the non-cognitive skill according to the Five-Factor model of personality (Costa and McCrae, 1992): openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Scores in each trait were measured by the participant's average response to sets of three questions per trait, with answers ranging in a scale from 1 – "does not apply" to 7 – applies perfectly" (see Appendix). This fifteen-item questionnaire of the Five-Factor model of personality is a shorter inventory well suited for applications in large-scale multidisciplinary surveys which was shown to be robust across different survey methods (Lang et al, 2011) and strongly correlated with full versions for all Five-Factor scales (Donnellan and Lucas, 2008).

In order to assess the internal consistency of the answers given, we estimated the standardized alpha indexes under the assumptions of the measurement error model of Cronbach (1951). The reliability of the data is measured by the inter correlation among the test items, indicating the degree to which a set of questions measure the same trait as a one-dimensional construct. The corresponding alpha indexes are situated at levels ranging from 0.5112 for conscientiousness to 0.6750 to neuroticism respectively. These reliability levels are similar to ones obtained by Heineck (2007) and Nandi and Nicoletti (2009), who use the BHPS's questionnaire, and to the ones obtained by Heineck and Anger (2010) and Boyce et al (2015), who use the German Socio-Economic Panel survey – SOEP, with a similar inventory of questions. Having checked the utility and reliability of the questionnaire, we also have to consider the constraints that personality data might impose to the sampling procedure.

The literature in psychology indicates that personality traits might change given life circumstances over the life-cycle (Costa and McCrae, 2006; Luhmann et al, 2014), imposing some restriction on its use in longitudinal studies. First of all, we cannot make use of information on housework that was observed before wave 15, because life events that occurred earlier, e.g. marriage, unemployment, and disability, might have affected the development of a particular personality trait. For the same reasons, we shouldn't rely on a larger number of periods after personality traits have been measured. Thus, we've selected an initial panel sample of individuals aged fifty-five or above: (i) who were in the labour market in a baseline period and transit to a retired status in a follow-up period, or (ii) who

stayed in the labour market in both periods, during waves 16 to 18, i.e., the last three BHPS's waves.

Our outcome variable, housework change, was built by taking the first difference of housework in hours per week for waves 16 to 18. Next, we identified extreme housework changes beyond the upper and lower outer fences of the distribution. We defined a fence as the range outside of which an outlier exists, and calculated them according to the following expressions: $f_l = \text{Q1} - 1.5(\text{IQR})$ and $f_u = \text{Q3} + 1.5(\text{IQR})$, where f_l and f_u represent the lower and upper quartile ranges, respectively; Q1 and Q2 represent the first and third quartiles, respectively; and IQR is the inter-quartile range (Q1 - Q3). After this adjustment, we obtained a sample of 3,674 individual-year observations.

At the retired status, both men and women aged fifty-five or above have higher levels of housework compared with peers in the labour market. Table 3.1 has descriptive statistics for housework levels in the baseline and follow-up periods and the corresponding changes for both groups as well. Columns 1-3 show that while positive housework changes are frequent given a transition to retirement, in general there are no changes in the counterfactual group, as shown by Columns 4-6. By comparing the rows presenting housework statistics form men and woman, we can observe an average gender gap in levels of housework for those who stay in the labour force (8.49 hours) which persists given a transition to retirement (8.86 hours). These numbers highlight the relevant share of housework that is still done by women, a phenomenon consistent with the findings of Kan (2008, 2012), Gupta (1999) and Hersch and Stratton (2002) in samples of working-age individuals.

In terms of household type, we see that increases in housework at retirement only occur significantly for individuals cohabiting with a spouse or partner. A similar situation occurs for those who were full time workers in the baseline period. Because they potentially devoted more time to job activities than part time workers, they show a larger increase in housework at the moment they leave the labour market. In sum, these statistics by household type and full time versus part time workers are in line with the ones presented by Bryan and Sevilla-Sanz (2010, p. 6) in a sample of British workers.

TABLE 3.1

Summary of statistics for housework

Variable	Entered retirement			Stayed in the labour market		
	Baseline	Follow-up	Change	Baseline	Follow-up	Change
	[1]	[2]	[3]	[4]	[5]	[6]
All	9.964	11.462	1.799	8.898	8.891	-0.007
	[0.414]	[0.469]	[0.352]	[0.129]	[0.131]	[0.091]
Men	5.710	7.136	1.426	5.180	5.159	-0.021
	[0.418]	[0.493]	[0.421]	[0.110]	[0.112]	[0.092]
Women	13.769	15.995	2.186	13.640	13.650	0.010
	[0.559]	[0.634]	[0.569]	[0.200]	[0.202]	[0.170]
Cohabiting couples	9.368	11.522	2.154	8.757	8.742	-0.015
	[0.482]	[0.551]	[0.392]	[0.149]	[0.151]	[0.099]
Other household types	10.815	11.231	0.415	9.499	9.526	0.027
	[0.748]	[0.829]	[0.786]	[0.251]	[0.244]	[0.225]
Full time job (baseline)	7.882	10.621	2.739	7.219	7.247	0.028
	[0.577]	[0.692]	[0.535]	[0.133]	[0.135]	[0.097]
Part time job (baseline)	11.315	12.242	0.927	12.804	12.716	-0.088
	[0.564]	[0.633]	[0.455]	[0.262]	[0.264]	[0.203]
Individuals	316	316	316	1,488	1,488	1,488
Observations	318	318	318	3,356	3,356	3,356

Notes on tables are presented from page 97.

TABLE 3.2

Domestic division of housework between cohabiting partners per type of activity

Partner does/paid %	Entered retirement [1]		Stayed in the labour market [2]		Difference (1-2) [3]	
Men (Obs. = 1,986)						
Grocery shopping	0.332	[0.035]	0.525	[0.012]	-0.193	[0.037]***
Cooking	0.625	[0.036]	0.675	[0.011]	-0.050	[0.037]
Cleaning/hoovering	0.592	[0.036]	0.704	[0.011]	-0.112	[0.038]***
Washing and ironing	0.772	[0.031]	0.815	[0.009]	-0.043	[0.032]
Women (Obs. = 1,394)						
Grocery shopping	0.050	[0.018]	0.096	[0.008]	-0.046	[0.020]**
Cooking	0.050	[0.018]	0.092	[0.008]	-0.042	[0.020]**
Cleaning/hoovering	0.071	[0.022]	0.104	[0.009]	-0.033	[0.024]
Washing and ironing	0.007	[0.007]	0.044	[0.006]	-0.037	[0.009]***

Notes on tables are presented from page 97.

Four out of five observations in both groups are related to co-habiting couples/partners. Therefore, we present statistics concerning how these couples share their time devoted to housework tasks. Table 3.2 shows the share of men and women indicating whether housework is mostly done by his/her partner or paid. Affirmative answers indicate a lack of contribution from the respondent to the total level of housework within a household. The negative values associated with the retirement effect in the last column denote that fewer new retirees respond that only a partner/spouse or paid help does the corresponding housework activity. Although, here we observe a gender gap in terms of division of housework for individuals in the labour market, which persists after a transition to retirement.

Female participation increases in all activities except cleaning and hoovering, while men do not present average increases in cooking, washing and ironing. The largest gender gap occurs in washing and ironing activities, while the smallest is associated with grocery shopping. Indeed, these numbers suggest a slightly more equitable division of housework after one of the spouses retires and indicates that gender is a key determinant of individual reactions to a transition to retirement and housework. As pointed out by previous studies, in the modern society, retirement is not a passage associated only to male individuals anymore (Moen et al., 2001). Women experience housework differently as a consequence of their career and marital status (Bryan and Sevilla-Sanz, 2011) and of gendered expectations that pose a barrier to the equality of domestic division of labour (Kan, 2012).

Household and individual characteristics expected to have influence on the outcome variable were included as covariates. Table 3.3 reports descriptive statistics of these control variables for the group of interest and the counterfactual group. We observe that both groups have equivalent hours devoted to housework in the baseline period when aggregating all members that cohabit, these averages being higher than 19.5 hours per week. The major differences in the two groups are in demographic characteristics such as gender and age, and labour market baseline characteristics like being a self-employed worker and having a full-time job. In terms of financial conditions, household income in a single person and multiple person households is not comparable in terms of expenditure power because of sharing rules and economies of scale between adults and children. Thus, we adjusted household income dividing it by the normalising factor provided in the BHPS, also known as equivalence scale. Other categorical variables like education and health

status, and geographical region and wave (both omitted from Table 3.3) were also included in the study. These groups' covariates highlight the need to control for the biased composition of our counterfactual group in the empirical strategy later.

The main estimating equation in this analysis is based on the following expression for housework:

$$\Delta h_{it} = \alpha + \delta k_{it} + \rho\theta_i + \beta X_{it} + w_t + \varepsilon_{it} \qquad (11)$$

where Δh_{it} is the change in housework in hours per week of individual *i* at year *t*; k_{it} is an indicator variable that assumes the value of one for the occurrence of a transition to retirement (treatment group) and zero if the individual stayed in the labour market in that particular year (control group); θ_i is a vector of personality traits; X_{it} is a vector of individual and household characteristics; w_t is a wave (time) fixed effect and ε_{it} is the error term. The parameter of interest is δ, which captures the main effect of retirement on housework. In other words, the parameter of interest captures how much time a person who stayed in the labour market would devote to housework if this person were to enter retirement.

The explanatory power of the non-cognitive skills is obtained by estimating the marginal effects of the vector θ_i conditional on $k = \{0,1\}$. In this sense, we have:

$$\Delta h_{it,k=0} = \alpha_0 + \rho_0\theta_i + \beta_0 X_{it} + w_{0,t} + \varepsilon_{0,it} \qquad \text{(Stayed in the labour market)} \qquad (12)$$

$$\Delta h_{it,k=1} = \alpha_1 + \rho_1\theta_i + \beta_1 X_{it} + w_{1,t} + \varepsilon_{1,it} + \delta \quad \text{(Entered retirement)} \qquad (13)$$

$$\delta = E[\Delta h_{it}|k_{it=1}] - E[\Delta h_{it}|k_{it=0}] \qquad \text{(Average causal effect of retirement)} \qquad (14)$$

There are empirical advantages on the use this potential outcomes framework (Cameron and Trivedi, 2005) to infer the causal effect of retirement on housework using observational data. First, it mitigates biases from comparisons over time in observation of individuals who entered retirement that could be the result of trends. Additionally, it overcomes biases in follow-up period comparisons between those who entered retirement and those in the control group that could be the result from permanent group differences (Imbens and Wooldridge, 2007). Most importantly, it allows us to analyse the extent to which non-cognitive skills in the form of personality traits moderates the time reallocation at the moment of retirement.

The framework described by equation (11) seeks to compare the observed housework change of a given individual entering retirement with a counterfactual prediction of housework change if the same retired individual had not in fact entered retirement. Given the fact that no individual can be observed in both situations, the literature about estimation of treatment effects emphasizes ways to build counterfactuals in observational studies (Cameron and Trivedi, 2006, p. 866). The OLS estimation of equation (3.1) neither control for permanent unobserved heterogeneity, nor for a potential correlation between a transition to retirement and the transitory error, ε_{it}. Such a correlation arises if housework changes and the decision to retire are determined simultaneously.

Furthermore, we cannot rely on a larger number of periods after personality traits have been measured, so our panel does not allow the implementation of fixed effects estimation without the cost of creating a correlation between the regressors and the error term biased results (Nickell, 1981). Other dynamic panel data estimation procedures, for instance the ones proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) could not be applied in our case because of the absence of valid instruments or the violation of over-identifying restrictions.

It is possible to implement a matching on propensity scores estimation (Heckman, Ichimura and Todd, 1998), which entails obtaining matched sets of observations of individuals that performed a transition to retirement with observations of individuals who stayed in the labour market. Both sets of observations are then required to have similar probability of entering retirement ($k = 1$), in a given year and conditional on observed baseline characteristics $\mathbf{x}$: $p(\mathbf{x}) = \Pr[k = 1|\mathrm{X} = \mathbf{x}]$, the so-called balancing condition (Cameron and Trivedi, 2005, p.864). Matching on propensity scores method allows us to analyse the observational non-randomized data in question by mimicking the characteristics of a randomized control trial, and in this sense, reducing selection bias (Austin, 2011, p. 419).

TABLE 3.3

Descriptive statistics of the covariates

Variable	Entered retirement		Stayed in the labour market	
Lagged HH housework	19.519	[0.586]	19.736	[0.197]
Non-cognitive skills				
O - Openess to experience	-0.086	[0.058]	0.010	[0.017]
C - Conscientiousness	0.135	[0.054]	0.227	[0.016]
E - Extraversion	-0.023	[0.054]	-0.151	[0.017]
A - Agreeableness	0.091	[0.055]	0.003	[0.017]
N - Neuroticism	-0.220	[0.054]	-0.186	[0.016]
Demographics				
Men	0.509	[0.028]	0.560	[0.009]
Age	63.305	[0.278]	59.835	[0.075]
Cohabiting couples	0.796	[0.023]	0.810	[0.007]
Labour (baseline)				
Self-employed	0.154	[0.020]	0.193	[0.007]
Full-time job	0.481	[0.028]	0.699	[0.008]
Financial conditions				
Log equivalised HH income	10.134	[0.047]	10.321	[0.012]
Paying rent	0.091	[0.016]	0.096	[0.005]
Education and Health				
Degree or higher	0.151	[0.020]	0.140	[0.006]
Further education	0.088	[0.016]	0.081	[0.005]
A level	0.129	[0.019]	0.181	[0.007]
O level	0.226	[0.024]	0.245	[0.007]
Other or no qualification	0.406	[0.028]	0.354	[0.008]
Health status (last 12 months)	2.119	[0.045]	2.032	[0.013]
Individuals	316		1,488	
Observations	318		3,356	

Notes on tables are presented from page 98.

3.3 The effect of a transition to retirement on home production

We start by presenting the ordinary least squares - OLS estimates of the average effect of a transition to retirement on the time individuals devote to housework tasks, which is equivalent to taking the first derivative of Eq. (11) with respect to S_i. Table 3.4 shows that a transition to retirement from the labour market has a positive effect on

housework equal to 1.767 hours in a model with no covariates except lagged household housework hours and wave fixed-effects, and 1.768 hours in a model including all the other covariates.

As a robustness check, we estimated the effect of retirement on housework applying different matching on propensity scores procedures: nearest neighbour one-to-ne, nearest neighbour twenty-to-one, radius caliper, and kernel. Exact match was applied on wave and on those covariates with large biases evidenced before in the descriptive statistics: cohabiting couple, full-time job in the baseline period and gender. Figure 3.1 presents the standardizes percentage bias between the means of the groups of interest and the counterfactual across covariates. It shows that the required balanced condition between individuals that entered retirement and those who stayed in the labour force is satisfied, since the percentage biases across baseline covariates are not statistically different than zero in the matched sample. Table 3.5 shows that the corresponding estimates of the effect of retirement on housework are stable and, again, robustly similar to the OLS estimates. In general, these results are in line with the positive effect of retirement on time devoted to housework obtained by Luengo-Prado and Sevilla (2013) and Stancanelli and Soest (2012).

These estimates corroborate with the application of matching on propensity scores as a robustness check to overcome the limitations of our data and also cover methodological gaps in the literature concerning the endogeneity of retirement. Existing evaluations of the retirement effect on time devoted to housework tasks relied on cross-sectional estimates (for example Luengo-Prado and Sevilla, 2013), used discontinuity designs to explore the exogenous source of variation around retirement age with respect to eligibility for a pension (for example Stancanelli and Soest, 2012; Ciani, 2016), or even aimed to control for unobserved characteristics by implementing fixed effects estimations (Bonsang and Soest, 2015). Our innovative application of the potential outcomes approach allows us to estimate the average causal effect of a transition to retirement using an individual's change in housework hours as a sample unit and also link this with non-cognitive skills and other individual characteristics to explain the present heterogeneity.

TABLE 3.4

The effect of a transition to retirement on housework (OLS estimates)

Dep. Variable = housework change	[1]	[2]	[3]	[4]	[5]	[6]
Transition to retirement	1.767	1.757	1.777	1.791	1.748	1.768
	[0.350]***	[0.350]***	[0.352]***	[0.354]***	[0.356]***	[0.357]***
Non-cognitive skills	No	Yes	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes	Yes
Labour	No	No	No	Yes	Yes	Yes
HH Financial conditions	No	No	No	No	Yes	Yes
Health and education	No	No	No	No	No	Yes
Individuals	1,605	1,605	1,605	1,605	1,605	1,605
Observations	3,674	3,674	3,674	3,674	3,674	3,674

Notes on tables are presented from page 98.

FIGURE 3.1

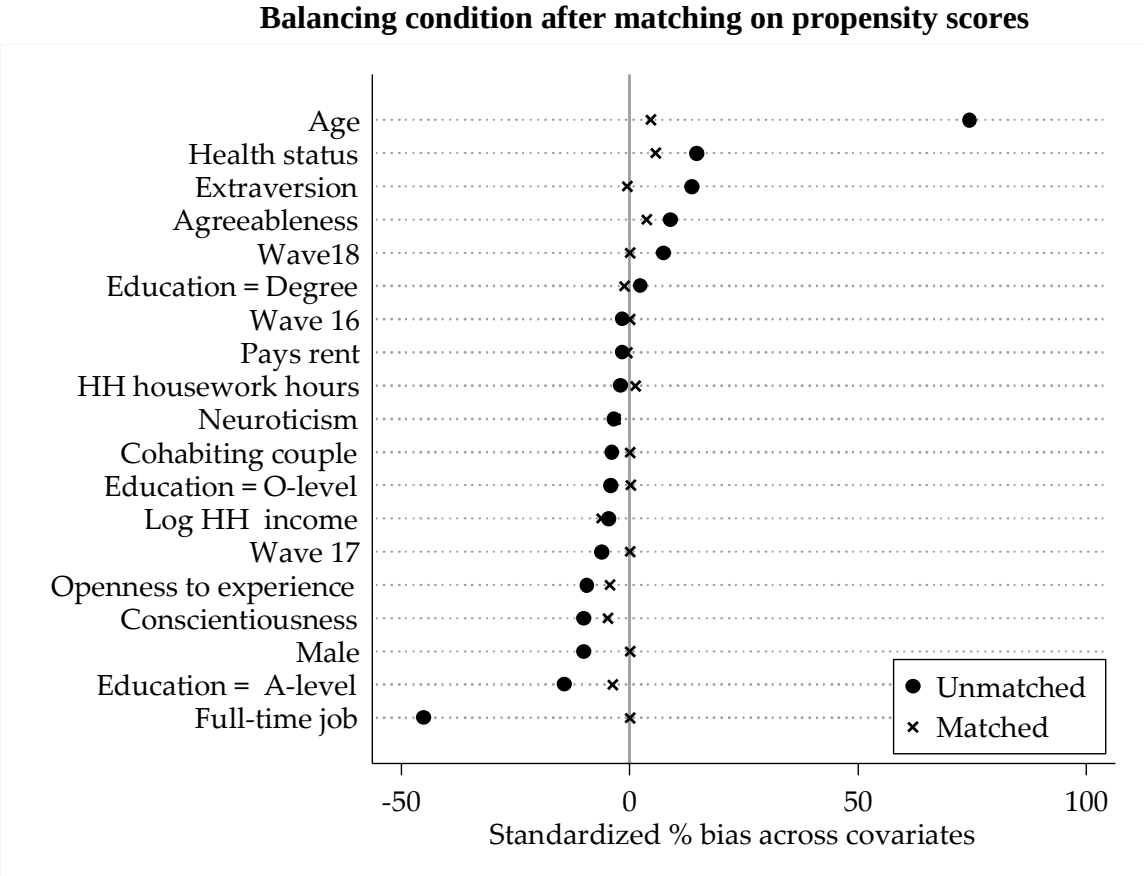

Balancing condition after matching on propensity scores
Age
Health status
Extraversion
Agreeableness
Wave18
Education = Degree
Wave 16
Pays rent
HH housework hours
Neuroticism
Cohabiting couple
Education = O-level
Log HH income
Wave 17
Openness to experience
Conscientiousness
Male
Education = A-level
Full-time job
Unmatched
Matched
-50
0
50
100
Standardized % bias across covariates

TABLE 3.5

The effect of a transition to retirement on housework (MPS estimates)

Dep. Variable = housework change	Regression [1]	NN 1:1 [2]	NN 20:1 [3]	Radius (0.05) [4]	Kernel [5]
Transition to retirement	1.768	1.990	1.776	1.871	1.870
	[0.357]***	[0.557]***	[0.388]***	[0.388]***	[0.390]***
Exact match on:					
Wave (16-18)	-	Yes	Yes	Yes	Yes
Couple	-	Yes	Yes	Yes	Yes
Full-time job (baseline)		Yes	Yes	Yes	Yes
Male	-	Yes	Yes	Yes	Yes
Matched transitions	-	317	317	312	312
Observations	3,674	3,650	3,650	3,645	3,645

Notes on tables are presented from page 98.

3.3.1 The influence of non-cognitive skills conditional on a transition to retirement

The analysis of the marginal effects of non-cognitive skills conditional on a transition to retirement or permanence in the labour market gives us elucidating results. As shown in Table 3.6, for those individuals who entered retirement, there is a significant positive effect associated with extraversion that is robust across estimations with increasing levels of controls. Of all the personality explanation, Columns 1-6 shows that extraversion is a key determinant of the changes on the time new retirees devote to housework tasks, the more extroverted being the ones that present higher increases on housework hours due to retirement. For an additional standard deviation on the extraversion score, when we include the whole set of control variables, housework increases 0.873 hours on the top of the average effect of a transition to retirement.

The positive and significant marginal effect of extraversion on housework for those entering retirement has two potential explanations. It could be explained by the fact that extroverts do less housework than the average while they are participating in the labour market, and then catch up with the average at retirement given their new time endowment; or extroverted new retirees simply start doing more hours of housework than the average individual at retirement. In order to test this, we estimated the marginal effect of each non-cognitive skill on housework levels. We also repeated this procedure using consumption measures present in the dataset, such as eating-out and individual monthly leisure expenditures, and grocery and food household weekly bill, as dependent variables in order to check for the occurrence of expenditure patterns related with non-cognitive skills. Despite being proxies for real consumption choices and imperfect non-continuous (scale) measures of expenditures, they provide indicatives of the direction of the association between consumption per category and each non-cognitive skill conditional on a transition to retirement.

Among those who stayed in the labour market, extraversion is negatively associated with housework hours and positively related with individual leisure and eating out expenditures, and household grocery and food bill. Table 3.7 in Columns 1-4 shows that the more extroverted devote less time to domestic chores than an average individual when still in the labour market, but catch up with the average when entering retirement. This finding is consistent with the observed positive relationship between extraversion and pre-

retirement expenditures on socializing with others, and with the adjectives of extraverted people of being outgoing and oriented towards people. Additionally, this finding builds on evidence collected by Kesavayuth et al. (2016) using British data which shows that leisure satisfaction increases at retirement for both men and women.

TABLE 3.6

Marginal effects of non-cognitive skills on housework

Dep. Variable = housework change	[1]	[2]	[3]	[4]	[5]	[6]
Stayed in the labour market						
O - Openess to experience	0.073	0.078	0.083	0.112	0.126	0.134
	[0.082]	[0.085]	[0.085]	[0.086]	[0.088]	[0.088]
C - Conscientiousness	-0.140	-0.159	-0.163	-0.149	-0.145	-0.169
	[0.091]	[0.095]	[0.095]	[0.096]	[0.096]	[0.096]
E - Extraversion	-0.089	-0.069	-0.063	-0.070	-0.074	-0.063
	[0.078]	[0.081]	[0.081]	[0.082]	[0.082]	[0.083]
A - Agreeableness	0.001	-0.009	-0.008	-0.019	-0.027	-0.029
	[0.079]	[0.082]	[0.083]	[0.083]	[0.082]	[0.082]
N - Neuroticism	-0.122	-0.117	-0.117	-0.110	-0.112	-0.117
	[0.078]	[0.085]	[0.085]	[0.086]	[0.088]	[0.087]
Entered retirement						
O - Openess to experience	-0.258	-0.211	-0.210	-0.199	-0.171	-0.124
	[0.315]	[0.314]	[0.314]	[0.313]	[0.314]	[0.310]
C - Conscientiousness	0.491	0.458	0.460	0.451	0.460	0.434
	[0.419]	[0.411]	[0.411]	[0.411]	[0.411]	[0.411]
E - Extraversion	0.985	0.874	0.877	0.878	0.887	0.873
	[0.371]**	[0.364]**	[0.364]**	[0.362]**	[0.360]**	[0.354]**
A - Agreeableness	-0.151	-0.155	-0.158	-0.171	-0.172	-0.170
	[0.397]	[0.390]	[0.390]	[0.388]	[0.390]	[0.384]
N - Neuroticism	0.124	0.149	0.147	0.170	0.167	-0.117
	[0.334]	[0.334]	[0.332]	[0.330]	[0.329]	[0.328]
Demographics	No	Yes	Yes	Yes	Yes	Yes
Labour	No	No	Yes	Yes	Yes	Yes
HH Financial conditions	No	No	No	Yes	Yes	Yes
Health and education	No	No	No	No	Yes	Yes
Wave 15 conditions	No	No	No	No	No	Yes
Individuals	1,605	1,605	1,605	1,605	1,605	1,605
Observations	3,674	3,674	3,674	3,674	3,674	3,674

Notes on tables are presented from page 99.

TABLE 3.7

Marginal effects of non-cognitive skills on housework hours and consumption measures

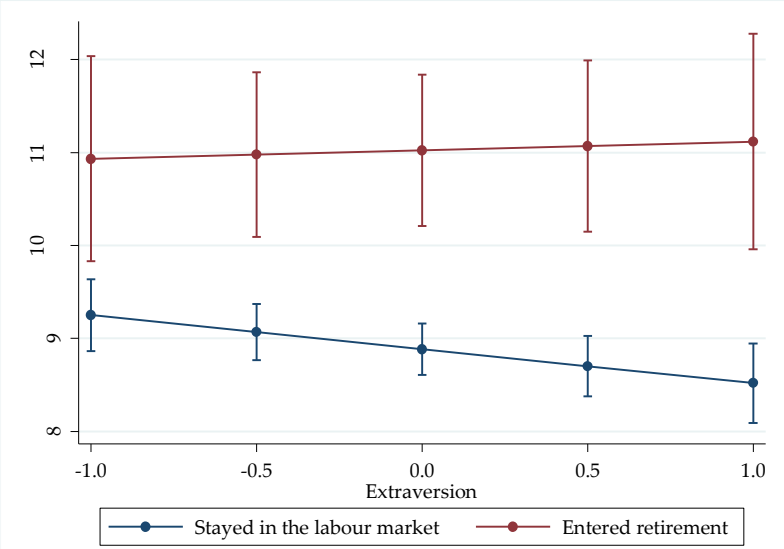
	Dependent Variable			
	Housework (hours per week) [1]	Leisure expenditures (scale 0-12) [2]	Eating out expenditures (scale 0-12) [3]	Grocery and food (scale 1-12) [4]
Stayed in the labour market				
O - Openess to experience	0.291	0.099	-0.061	0.004
	[0.160]	[0.083]	[0.084]	[0.043]
C - Conscientiousness	0.175	-0.007	-0.179	0.012
	[0.185]	[0.084]	[0.088]*	[0.045]
E - Extraversion	-0.366	0.292	0.421	0.141
	[0.153]**	[0.081]***	[0.076]***	[0.044]***
A - Agreeableness	0.045	-0.084	0.042	-0.010
	[0.158]	[0.096]	[0.090]	[0.044]
N - Neuroticism	0.153	-0.067	-0.035	-0.036
	[0.178]	[0.080]	[0.081]	[0.046]
Entered retirement				
O - Openess to experience	0.454	-0.063	-0.142	-0.100
	[0.401]	[0.144]	[0.161]	[0.079]
C - Conscientiousness	0.262	0.030	0.053	-0.086
	[0.487]	[0.172]	[0.193]	[0.102]
E - Extraversion	0.092	0.008	0.102	-0.028
	[0.402]	[0.166]	[0.180]	[0.097]
A - Agreeableness	-0.151	-0.351	-0.079	0.251
	[0.491]	[0.176]*	[0.193]	[0.107]**
N - Neuroticism	-0.149	-0.137	-0.078	0.033
	[0.417]	[0.145]	[0.185]	[0.096]
Demographics	Yes	Yes	Yes	Yes
Labour	Yes	Yes	Yes	Yes
HH Financial conditions	Yes	Yes	Yes	Yes
Health and education	Yes	Yes	Yes	Yes
Wave 15 conditions	Yes	Yes	Yes	Yes
Individuals	1,610	1,610	1,613	1,614
Observations	3,690	3,681	3,701	3,709

Notes on tables are presented from page 99.

FIGURE 3.2

Predicted levels of housework and consumption expenditures

a. Housework hours



b. Grocery and food bill

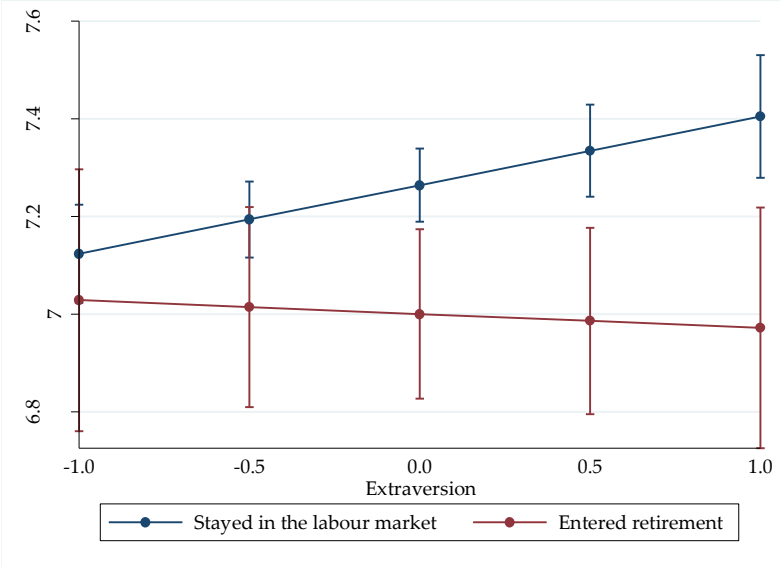
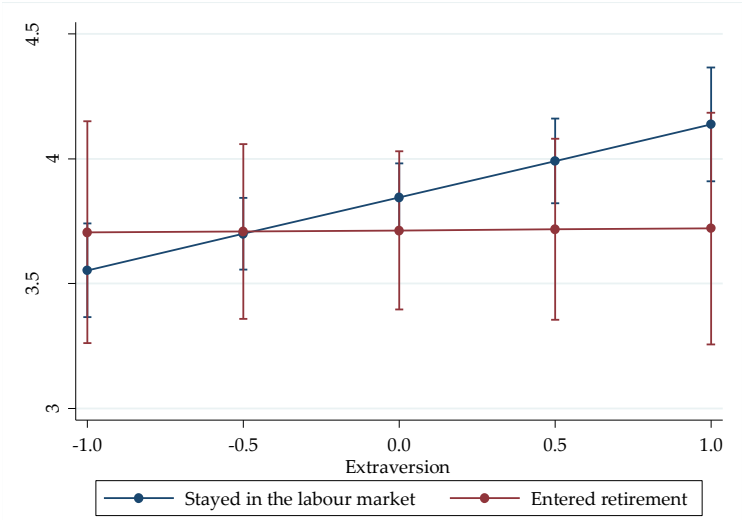
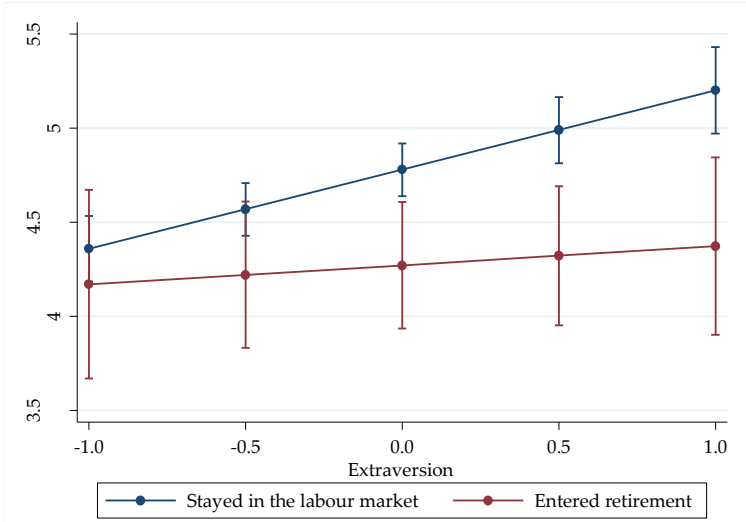


FIGURE 3.2 (Continued)

c. Leisure expenditures



d. Eating out expenditures



Notes: (i) the figure reports predicted levels of housework in hours, reported monthly leisure and eating out individual expenditures (scale 0-12) and reported weekly household grocery and food bill (scale 1-12), conditional on the occurrence of a transition to retirement or permanence in the labour market, across extraversion scores; (ii) for more information about the estimation porcedure, see notes from Table 3.7.

The graphical analysis of the predicted levels of housework and consumption measures across different levels of extraversion also helps to identify the pattern of time and consumption reallocation that happens at retirement. Figure 3.2 shows that household grocery and food bill and individual eating out expenditures decrease significantly due to a transition to retirement while housework hours increases, but leisure expenditures remain stable.

There is consistency between these results and the adjectives of extraverted people: being pro-active, energetic, and oriented towards people, given that while in the labour market, these individuals' expenditures on socializing with others, e.g. eating at restaurants and leisure activities, also show a positive association with extraversion. They are consistent also with the idea that pre-retirement entertainment habits, that cannot be produce at home, like travelling, going to a bar or to the movies, can be sustained by producing at home other goods and services that otherwise these new retirees would have to pay for, for example meals, laundry, cleaning, washing and gardening.

3.3.2 The explanatory power of non-cognitive skills compared to other covariates

In order to compare the explanatory power of the non-cognitive skill of extraversion with other covariates that showed to be relevant to explain the embedded heterogeneity, we present estimates of the effect of retirement conditional on: (i) gender, (ii) whether the household has cohabiting partners, (iii) whether the new retiree had a full time or part time job in the baseline period, and (iv) the individual having an extraversion level equal to one standard deviation above and below the average. Table 3.8 present these estimates showing that new retirees of both men and women are expected to increase their time devoted to housework activities respectively 1.298 hours and 2.249 hours per week. For an individual cohabiting with a spouse or partner, the average effect of a transition to retirement on housework is estimated as equal to 2.102 hours, while for individuals living in other types of households there is no significant effect. Individuals previously working full time are expected to make use of their extra endowment of time at retirement to increase housework on average 2.648 hours, while previously part-time workers are only expected to increase less than one hour per week.

Comparing these estimates with the ones predicted for individuals with extraversion scores equivalent to one standard deviation above and below the mean, gives

us clear notion of the important role of extraversion. The estimated housework change at retirement is equal to 2.642 hours for those individuals with extraversion scores equal to one standard deviation above the average score, and only equal to 0.952 for those with an extraversion score equivalent to one standard deviation below the average score. These estimates suggest that the power of extraversion to explain the heterogeneity of housework at retirement to be as relevant as gender, the type of household that the individual lives and whether he had a full time job.

TABLE 3.8

Heterogeneity by gender, household type, job type and extraversion

	Gender		Household type		Job type		Extraversion	
	Men	Women	Couples	Others	Part-time	Full-time	-1SD	+1SD
Transition to retirement	1.298	2.249	2.102	0.300	0.897	2.648	0.952	2.642
	[0.445]***	[0.553]***	[0.393]***	[0.778]	[0.461]*	[0.534]***	[0.532]*	[0.497]***
Non-cognitive skills	Yes		Yes		Yes		Yes	
Demographics	Yes		Yes		Yes		Yes	
Labour	Yes		Yes		Yes		Yes	
HH Financial conditions	Yes		Yes		Yes		Yes	
Health and education	Yes		Yes		Yes		Yes	
Individuals	1,605		1,605		1,605		1,605	
Observations	3,674		3,674		3,674		3,674	

Notes on tables are presented from page 99.

3.4 Conclusions

This study presented novel evidence that non-cognitive skills explain new retirees' reallocation of time in favour of housework - a potential substitute for market purchases at the moment of retirement (Luengo-Prado and Sevilla, 2013). We elaborate on literature that explains the sharp drop in consumption expenditures that occurs at retirement and was previously referred as a puzzle (Hurst, 2008; Banks et al., 1998) given the implications of conventional life-cycle models (Blundell at el. 1994). In particular, our study not only brings greater attention to the role of home-production as a decision variable in descriptive models of saving for retirement, but also highlights the relevance of individual differences to explain the heterogeneity present in new retirees' economic behaviour. Although some empirical analyses explain part of this heterogeneity according to gender differences and social norms associated to couples' division of labour (Stancanelli and Soest, 2012; Luengo-Prado and Sevilla, 2013; Ciani, 2016; Bonsang and Soest, 2015), recent experimental evidence on gender identity (Auspurg et al, 2015) has found little evidence of any systematic gender differences in the preference for housework, suggesting that the reasons for the observed preferences towards housework might lie beyond these factors.

We show that the integration of non-cognitive skills into the empirical analysis helps to explain heterogeneous changes in the number of hours devoted to housework at the moment of retirement in a degree similar other factors previously documented in the literature, for example gender differences among cohabiting couples. The evidence provided here supports the predictions of a theoretical set-up that includes home-production as part of an individual's life-time wealth and integrates non-cognitive skills as components of individuals' preferences over consumption and actions that affect how they accomplish effortful tasks conditional on a situation. At the moment of retirement, the reallocation of resources involving home-production and consumption presents an increase in the time devoted to housework tasks that is simultaneously accompanied by a decrease in expenditures that can be easily substituted by home-production, for instance eating-out at restaurants and grocery and food (also documented by Luengo-Prado and Sevilla, 2013). However, individual expenditures that cannot be directly substituted by home production of goods and services, for example leisure expenditures, remain stable, suggesting that housework helps to substitute meals at restaurants and to economize money to sustain habits of leisure and social activity developed before retirement.

The trait of extraversion was shown as a key determinant of the changes in the time new retirees devote to housework tasks, which is also linked with preferences over consumption expenditures before retirement. When still in the labour market, more extroverted individuals devote less time to domestic chores than an average individual, and spend more of their income socializing activities like eating at restaurants and paying for leisure activities, consistently with the adjectives of the extroverted of being outgoing and oriented towards people. The "do-it-yourself" and economically rewarding nature of housework tasks might allow more extroverted retirees to sustain their pre-retirement levels of leisure and entertainment habits by acting as a substitute for other services that they otherwise would have to pay for, in line with previous evidence that extraverted retirees present higher social activity (Lockenhoff et al., 2009). Moreover, this insight corroborates with the evidence (Oerlemans and Bakker, 2014) suggesting that extraverts do not experience boosts in momentary happiness when spending time in merely pleasurable activities as relaxing, watching TV, and reading, but report higher levels of satisfaction with life because they engage on motivationally salient and rewarding activities, e.g. physical exercises and economically rewarding work, especially when executed with others.

When considering retirement-savings adequacies and the mechanisms through which the ageing population cope with finances, policymakers in the field of pensions should account for the fact that an individual's ability to perform housework tasks is part of life-time wealth and, as a consequence, it is an economic mechanism that act as a potential buffer for income shocks or unexpected replacement rates. In addition, non-cognitive skills are personal abilities developed across the life span (Heckman, 2011) that also determine retirees' personal outcomes. This implies that social care providers and policymakers in the area of housing need to better visualize the heterogeneity embedded on retirees' personal characteristics when they spend more time at home. For example, Hayes and Finney (2014) reported the existence of a cluster of households composed by older members with constrained income that present a particularly high expenditure on food and non-alcoholic drinks, suggesting a preference for dining at home, entertaining others, or age-related dietary needs supplied at home. In summary, conditionally on personal psychological differences, home-production has the economic role of allowing retirees to sustain habits, preferences and desired standards of living.

3.5 Appendix

The fifteen questions measuring non-cognitive skills were part of BHPS's Wave 15 self-completion questionnaire. Respondents were presented the following text.

> *The following questions are about how you see yourself as a person. Please tick the number which best describes how you see yourself where 1 means 'does not apply to me at all' and 7 means 'applies to me perfectly'.*
>
> *I see myself as someone who . . .*
>
> *a) Is sometimes rude to others*
> *b) Does a thorough job*
> *c) Is talkative*
> *d) Worries a lot*
> *e) Is original, comes up with new ideas*
> *f) Has a forgiving nature*
> *g) Tends to be lazy*
> *h) Is outgoing,*
> *i) Gets nervously easily*
> *j) Values artistic, aesthetic experiences*
> *k) Is considerate and kind to almost everyone*
> *l) Does things efficiently*
> *m) Is reserved*
> *n) Is relaxed, handles stress well*
> *o) Has an active imagination*

Questions *e*, *j*, and *o* related to openness to experience; *b*, *g*, and *l* relate to conscientiousness; *c*, *h*, and *m* relate to extraversion; *a*, *f* and *k* relate to agreeableness; and *d*, *i*, and *n* relate to neuroticism. Scores for each of the traits are obtained by aggregating across each of the three-items by trait after reverse codes for questions *a*, *g*, *m*, and *n*.

Conclusions

This dissertation addressed workers' preparation and adaptation to the economic circumstances of retirement. We highlighted that national pension systems in developed countries have incentivised workers to accumulate pension wealth through workplace pension schemes. This is expected to help nations face the consequences of the ageing population on governmental expenditures on social security and on the insolvency risk of national pension systems. Prudent regulation indicates that workers as the major target group within the modern multi-pillared typology towards pension system modalities suggested by international organizations like the World Bank, the OECD and the European Union (World bank, 1994; Willmore, 2000; Holzmann, 2000, 2012; OECD, 2006; Holzmann et al, 2008; Davies, 2013).

The first two studies used longitudinal data of workers from the United Kingdom to empirically investigate the pertinence of enforcing workplace pension schemes as a policy mechanism to improve retirement savings adequacy. During the sample's period (1992 to 2012), automatic enrolment of employees into a workplace pension's scheme was not a practice enforced by law, as it came later by the Pensions Act 2008's legislation. Until 2012, most British workers still had to actively choose to opt in workplace pension plans and the provision of such schemes was still a decision of employers. The first study found that providing workers with the opportunity to join a pension scheme at their workplace could generate a major impact on aggregate participation rates. Such success seems to not be conditional on the existence of policy rules concerning the way workers are enrolled or incentivized to join a scheme or whether the employing firm is of the public or private sector. In this sense, pension reforms could still obtain major impacts on participation rates by prescribing mandatory provision of pension schemes in every workplace while letting other components of a scheme to be determined privately by firms and workers.

The predicted beneficial impact of universal provision of workplace schemes on aggregate participation rates is of particular interest of policymakers who desire to preserve some degree of individual choice autonomy (see Felsen et al., 2013; Arad and Rubinstein, 2015; Hagman et al., 2015; Sunstein, 2015; Reisch and Sunstein, 2016; Jung and Mellers,

2016) while still helping the population to smooth consumption from work life into retirement and to mitigate poverty risks in old age. It has been also shown that libertarian-paternalistic interventions like automatic enrolment might be helpful to reduce the time an employee takes to join a scheme, but they come with the cost of a "one-size-fits-all" impersonal default option that might not be appropriate due to heterogeneous characteristics of the population.

While extending the provision of workplace pension schemes, with or without automatic enrolment, is expected to boost schemes membership rates, the effect on overall savings and individual attitudes towards other types of savings cannot be perfectly anticipated. For instance, an increase in workplace pension savings could be funded by a reduction in the amount households would save in other forms (Crawford et al, 2012). Hence, the second study estimated the causal effect of workplace pensions on other forms of savings, for example, personal pension plans and financial vehicles. The analysis hasn't found evidence that providing employees with access to workplace pension schemes would make them less likely to save through non-pension financial instruments. While workplace schemes and personal plans are reasonably interchangeable pension products, other non-pension financial savings seem not to be affected. Overall, the findings from the first two studies support the idea that earnings-related privately managed occupational pension schemes are a suitable mechanism in the apparatus of national pension systems, either as a mandatory tier or a voluntary pillar.

These policy propositions on workplace plans could be empowered by further research making use of administrative data, instead of self-reported responses, of individual finances, and clearer information about a pension plan's characteristics and the enrolment process faced not only by those workers who opted to join the scheme but also those who opted-out. For example, one of the limitations of the first study is that the characteristics of the pension plan offered to the employee are omitted in the data, e.g. whether there are matching contributions by the employer, how simplified the enrolment process is or which kind of occupational pension scheme is offered (defined benefit or defined contribution). Also, the causal effect of workplace pensions on other forms of savings could be identified by implementing the same instrumental variable estimation proposed in the second study, but with administrative data and a richer set of continuous measures of individual finances. The aforementioned instrumental variable was validated in this study in two British samples, but could be additionally extrapolated to surveys from

other countries to provide an informative description of their populations' responses to pension reforms which enforce workplace pension schemes provision and/or membership.

Workplace pension plans are part of the financial pillar to a better preparation for retirement, but the World Bank's framework to assess pension systems and reform options (Holzmann et al, 2008) also considers a "non-financial pillar". Hence, the third study of this dissertation assumed that home-production of goods is part of this pillar. It examined the fact that retirees devote more time than workers to economically rewarding "do-it-yourself" housework tasks, for example, the preparation of food at home, cleaning, laundry and grocery shopping. In particular, this study highlighted the relevance of housework as a decision variable in descriptive models of saving for retirement. Therefore, an appropriate evaluation of retirement savings adequacies and the mechanisms through which the ageing population copes with finances, should account for the fact that an individual's ability to produce goods and services at home is part of his life-time wealth.

Additionally, the integration of non-cognitive skills into the empirical analysis helped to explain heterogeneous changes in the number of hours devoted to housework at the moment of retirement in a degree similar other factors previously documented in the literature, for example gender differences among cohabiting couples. This complements previous works in economics and psychology (Luengo-Prado and Sevilla, 2013; Hayes and Finney, 2014; Kesavayuth et al, 2016) which inform policy choices for counselling programs for retirement and older individuals financial planning.

Table Notes

Chapter 1

Table 1.1: The initial panel of 89,760 person-year observations excludes 1,962 observations (1,112 female and 850 male workers) in which employees responded "Don't know" to question *I*, and another 102 observations (58 female and 44 female workers) in which employees responded "Don't know" to question *II*. Earnings are monthly, adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009), and log transformed.

Table 1.2: Coefficients represent odds-ratios obtained from the estimation of Equation (2). Standard errors were clustered by individuals. Earnings are monthly and adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009) and log transformed. Household income is gross annual equivalized by the number of household members, adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009), and log transformed. The estimations also include wave and region identifiers as covariates.

Table 1.3: Estimates shown in columns (2) to (7) were obtained by applying nearest neighbour one-to-one matching on propensity scores according to the rule presented in Equation (6). Column (1) presents the estimate for the unmatched sample. The standard errors shown inside brackets only reflect the after-matching sample size and variances (see Abadie and Imbens, 2015), but do not reflect the propensity score estimation. Radius represents a caliper distance in probabilistic measure; for example, the radius in column (2) means that only accepts as nearest-neighbour a case in which the propensity scores has a maximum difference of one per cent. Common support drops treatment observations whose propensity score is higher than the maximum or less than the minimum propensity score of the counterfactual group. No replacement means that once a case in the counterfactual group is used to match another case in the group of interest, it cannot be used anymore.

Notes to Table 1.5: Estimates shown in columns (2) to (7) were obtained by applying nearest neighbour one-to-one matching on propensity scores according to the rule

presented in Equation (6) only in cases of private sector workers. Column (1) presents the estimate for the unmatched sample. The standard errors shown inside brackets only reflect the after-matching sample size and variances (see Abadie and Imbens, 2015), but do not reflect the propensity score estimation. Radius represents a caliper distance in probabilistic measure; for example, the radius in column (2) means that only accepts as nearest-neighbour a case in which the propensity scores has a maximum difference of one per cent. Common support drops treatment observations whose propensity score is higher than the maximum or less than the minimum propensity score of the counterfactual group. No replacement means that once a case in the counterfactual group is used to match another case in the group of interest, it cannot be used anymore.

Table 1.6: Coefficients represent odds-ratios obtained from the estimation of Equation (8). Standard errors were clustered by individuals. Earnings are monthly and adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009) and log transformed. Household income is gross annual equivalized by the number of household members, adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009), and log transformed. The estimations also include wave and region identifiers as covariates. The variable "Promotion opportunities" is binomial, indicating whether the worker self-reported having chances to be promoted in his job. The predicted short-term opt-in rate was obtained by averaging the predicted chance of each individual joining the scheme in the same year that provision started to be offered. The predicted likelihood of joining the scheme is given from the estimation of Equation (8) when all the covariates are at their average levels.

Table 1.7: Coefficients represent odds-ratios obtained from the estimation of Equation (9). Standard errors were clustered by individuals. Earnings are monthly and adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009) and log transformed. Household income is gross annual equivalized by the number of household members, adjusted to real terms using quarterly Consumer Price Index ONS/UK (base = 100, average of 2009), and log transformed. The estimations also include wave and region identifiers as covariates. The variable "Promotion opportunities" is binomial, indicating whether the worker self-reported having chances to be promoted in his job. The predicted short-term opt-in rate was obtained by averaging the predicted chance of each individual joining the scheme in the same year that provision started to be offered. The

predicted likelihood of joining the scheme is given from the estimation of Equation (9) when all the covariates are at their average levels.

Chapter 2

Table 2.1: In both Panels, Column 2 reports membership in defined benefit (DB) and defined contribution (DC) schemes. [a] See Appendix A for a detailed description of the questions.

Table 2a: Standard errors clustered at the individual level shown in the brackets. *** *p-value* <0.01, ***p-value* <0.05, **p-value* <0.10. All estimates include within subjects fixed-effects and dummy variables indicating time (survey wave) effects. Alongside with the vector of indicator variables identifying the range of number of employees in the job place, other covariates included in the estimation were: (i) indicator variables denoting whether the employer is a private company, the job type (if managerial, skilled, armed forces etc), the contract type (full time, permanent); (ii) measures of (log transformed) real monthly earning and (log transformed) annual equivalized household net real income; and (iii) individual and household characteristics such as age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Table 2.2b: Standard errors clustered at the individual level shown in the brackets. *** *p-value* <0.01, ***p-value* <0.05, **p-value* <0.10. In Columns 3 and 4, because the outcome variable refers to behavior "in the last two years" we used the lagged values of covariates, including for the instrument variable –number of employees in the workplace. Estimates include dummy variables indicating time (survey wave) effects. Alongside with the vector of indicator variables identifying the range of number of employees in the job place, other covariates included in the estimation were: (i) indicator variables denoting whether the worker is responsible for supervising, whether the job contract is of a full-time position; (ii) measures of individual and household income; and (iii) individual and household characteristics such as gender, age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Table 2.3a: Standard errors clustered at the individual level shown in the brackets. *** *p-value* <0.01, ***p-value* <0.05, **p-value* <0.10. All estimates include within subjects fixed-

effects and dummy variables indicating time (survey wave) effects. Alongside with the vector of indicator variables identifying the range of number of employees in the job place, other covariates included in the estimation were: (i) indicator variables denoting whether the employer is a private company, the job type (if managerial, skilled, armed forces etc), the contract type (full time, permanent); (ii) measures of (log transformed) real monthly earning and (log transformed) annual equivalized household net real income; and (iii) individual and household characteristics such as age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Table 2.3b: Standard errors clustered at the individual level shown in the brackets. *** *p-value* <0.01, ***p-value* <0.05, **p-value* <0.10. In Columns 3 and 4, because the outcome variable refers to behavior "in the last two years" we used the lagged values of covariates, including for the instrument variable –number of employees in the workplace. Estimates include dummy variables indicating time (survey wave) effects. Alongside with the vector of indicator variables identifying the range of number of employees in the job place, other covariates included in the estimation were: (i) indicator variables denoting whether the worker is responsible for supervising, whether the job contract is of a full-time position; (ii) measures of individual and household income; and (iii) individual and household characteristics such as gender, age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Table 2.4: Standard errors clustered at the individual level shown in the brackets. *** *p-value* <0.01, ***p-value* <0.05, **p-value* <0.10. All estimates include within subjects fixed-effects and dummy variables indicating time (survey wave) effects. Alongside with the vector of indicator variables identifying the range of number of employees in the job place, other covariates included in the estimation were: (i) indicator variables denoting whether the employer is a private company, the job type (if managerial, skilled, armed forces etc), the contract type (full time, permanent); (ii) measures of (log transformed) real monthly earning and (log transformed) annual equivalized household net real income; and (iii) individual and household characteristics such as age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Table 2.5: Notes: Standard errors clustered at the individual level shown in the brackets. *** *p-value* <0.01, ***p-value* <0.05, **p-value* <0.10. Because the outcome variable refers to behavior "in the last two years" we used the lagged values of covariates, including for the instrument variable –number of employees in the workplace. Estimates include dummy variables indicating time (survey wave) effects. Alongside with the vector of indicator variables identifying the range of number of employees in the job place, other covariates included in the estimation were: (i) indicator variables denoting whether the worker is responsible for supervising, whether the job contract is of a full-time position; (ii) measures of individual and household income; and (iii) individual and household characteristics such as gender, age in years, education level, household type (married couple, dependent children etc), household tenure (whether pays rent, own home etc).

Chapter 3

Table 3.1: Standard errors are shown in the brackets; Columns 1-2 show average housework levels of those individuals that entered retirement in baseline and follow-up periods, while column 3 shows the corresponding average change in housework; columns 4-5 show average housework levels of those who stayed in the labour market, while column 6 shows the corresponding average change in housework.

Table 3.2: The table provides the ratio of respondents indicating that his/her partner does most of the indicated household jobs or it is done by paid help/other in the baseline and follow-up period. The BHPS asks couples the following question: *Could you please say who mostly does this work here? Is it mostly yourself, or mostly your spouse/partner, or is the work shared equally.* The possible responses are: 1 – mostly self, 2 – mostly spouse/partner, 3 – shared, 4 - paid help only, 5 – other (specify). We created an indicator variable equal to 1 for responses "mostly spouse/partner" and "paid help only" to measure home division of the corresponding domestic activities: grocery shopping, cooking, cleaning/hovering, and washing/ironing. We excluded answers equal to 5 – other (specify); Standard error are shown in the brackets; The different between groups is reported in the last column, calculated as the difference between the average responses in the group that made a transition to retirement and the group that stayed in the labour market, both in the follow-up period; The estimated retirement effect on individual responses was tested against the null-hypothesis with a t-test; (v) * p< 10%, ** p< 5%, *** p<1%.

Table 3.3: Standard errors are shown in the brackets**;** Cohabiting couples (Demographics) indicates percentage of individuals living in households composed by cohabiting couples or partners, although in the analysis we included household type as a categorical variable describing nine household type; The sample has a negligible percentage of unemployed individuals, so we omitted this information; Household log equivalised household income was obtained by dividing household annual income variable by the household equivalence scale before housing costs (Taylor et al, 2010) present in the BHPS; Paying rent represents the percentage of individuals who pay rent, although in the analysis we included household tenure as a categorical variable describing eight scenarios, for example, household is owned outright, owned with mortgage, and rented from private and furnished.

Table 3.4: Heteroscedasticy-robust standard errors clustered by individuals are shown in the brackets; The table present the estimates of the effect of a transition to retirement on the time devoted by individuals to housework tasks in a week. This is equivalent to the marginal effect of S_it from Equation 11, also described as the parameter δ from Equations 11 and 14. For further information about the covariates, see Table 3.

Table 3.5: Standard errors shown in the brackets; In order to obtain individuals' propensity scores, we first ran a probit model with S_{it} as dependent variable to estimate the likelihood of a given individual to enter retirement in the follow-up period conditional on covariates observed in the baseline period: total household housework hours, gender, age, age^2, whether cohabits with spouse or partner, whether has a full-time job, household log equivalised income, household tenure, educational level, and reported health in the last twelve months. The model also controlled for the five personality traits, wave and geographical region; Probit model's pseudo R-squared = 0.133 and the average probability of entering retirement within the sample (N = 3,650) is 0.089 with standard deviation of 0.086; Exact match was applied on wave and on those covariates with large biases evidenced in the descriptive statistics (Table 3): cohabiting couple, full-time job in the baseline period and gender; Column 1 shows the OLS estimate from Table 4, column 6, as a comparison. Columns 2-5 show the estimates of the effect of a transition to retirement on the time devoted by individuals to housework tasks in a week. This is equivalent to the parameter δ from Equations 11 and 14; The number of observations presented in columns 2-5 represent the sample respecting the requirement of common support, i.e., the occurrence of an overlapping propensity score in both groups indicated by *S*; The standard errors reported in columns 2-5 correspond only to the matching estimation's sample size

and variance, do not take into account the error from the propensity scores previously estimated.

Table 3.6: Heteroscedasticy-robust standard errors clustered by individuals are shown in the brackets. In order to adjust for the multiple comparisons being performed, significance levels were calculated following the Holm-Bonferroni methodology (Holm, 1979); The table present the estimates of the marginal effect of each non-cognitive skill on housework change conditional on the occurrence of a transition to retirement or permanence in the labour market. This is equivalent to the marginal effect of θ_i from Equations 12 and 13, respectively, also described as the parameter ρ in the same equations; We assessed the robustness of the conditional marginal effects of personality traits' results by controlling also for the potential effects of pre-retirement household and individual characteristics observed contemporaneously to non-cognitive skills. Considering that there are a number of factors that may correlate with an individual's personality that they could act as potential confounds or mediators we included covariates observed in wave 15 such as household size, whether the individual cohabits with a spouse or partner, education and job status.

Table 3.7: Heteroscedasticy-robust standard errors clustered by individuals are shown in the brackets. In order to adjust for the multiple comparisons being performed, significance levels were calculated following the Holm-Bonferroni methodology (Holm, 1979); The table present the estimates of the marginal effect of each non-cognitive skill on housework levels, reported monthly leisure and eating out individual expenditures (scale 0-12) and reported weekly household grocery and food bill (scale 1-12) conditional on the occurrence of a transition to retirement or permanence in the labour market.

Table 3.8: Heteroscedasticy-robust standard errors clustered by individuals are shown in the brackets; As from the results in Table 6 and 7, here we also included covariates observed in wave 15 such as household size, whether the individual cohabits with a spouse or partner, education and job status. For further information about the other covariates, see Table 3; the table present the estimates of the effect of a transition to retirement on the time devoted by individuals to housework tasks in a week. This is equivalent to the marginal effect of S_{it} from Equation 11, also described as the parameter δ from Equations 11 and 14, conditional on gender (men and women), household type, job type and standardised extraversion scores equal to one standard deviation above and below the mean.

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