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ABSTRACT

Financial Literacy and Preparation for Retirement[1]

The economic and financial landscape facing individuals as they move through their life-cycle is becoming increasing complex. Internationally, declines in the coverage and generosity of public programmes mean that individuals now need to assume responsibility for a greater share of their future retirement saving and health and long-term care costs. Financial literacy, defined as knowledge of fundamental financial concepts and the ability to do simple financial calculations, is a key skill required to ensure adequate financial protection in older age. In this paper, we investigate the extent to which financial literacy is an important determinant of financial protection in the older pre-retirement population in Ireland. Using data from the Irish Longitudinal Study on Ageing (TILDA), we find significantly higher levels of financial literacy among men, those with higher levels of education and cognition, and the self-employed. Financial literacy is in turn associated with higher total household wealth, lower financial stress and higher expected retirement income. We find little evidence that those with higher levels of financial literacy are more likely to have various forms of supplementary pension cover however, which may reflect a limited role for financial literacy over and above other important determinants such as income and education.

JEL Classification: J32, E21

Keywords: financial literacy, retirement, Ireland

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1. Introduction

The economic and financial landscape facing individuals as they move through their life-cycle is becoming increasing complex. Internationally, declines in the coverage and generosity of public programmes mean that individuals now need to assume responsibility for a greater share of their future retirement saving and health and long-term care costs (Banks, 2010). In addition, financial products are increasing in number and complexity (Lusardi and Tufano, 2015, Skagerlund et al., 2018). In this context, the skills required to ensure adequate financial protection in older age are demanding, requiring an understanding of discounted values, interest rates, the role of inflation, survival probabilities, *etc*. (Lusardi and Mitchell, 2007, Lusardi and Mitchell, 2008).

Lusardi and Mitchell (2011a; 510) define financial literacy as 'knowledge of fundamental financial concepts and the ability to do simple financial calculations'. It is a multidimensional concept, capturing elements of financial knowledge, attitudes and behaviour (OECD, 2016). A related skill is numeracy, defined as the ability to process basic numerical concepts, quantitative estimations, probabilities and ratios (Skagerlund et al., 2018). However, while numeracy and financial literacy are highly correlated (Skagerlund et al., 2018), the correlation between financial literacy and other aspects of cognition such as episodic memory is much lower (Smith et al., 2010). Studies examining the association between financial literacy and wealth or other indicators of financial well-being generally find that financial literacy is as important as education and cognition in determining financial outcomes (Banks and Oldfield, 2007). Differences in levels of financial literacy across the adult population (e.g., between men and women) have been documented across numerous countries (van Rooij et al., 2012, OECD, 2017, Lusardi and Mitchell, 2011b, Klapper et al., 2016).

Ensuring that individuals have the required numeracy and financial literacy skills to navigate this complex environment is increasingly regarded as a public policy priority (OECD, 2017).[2] Differences in levels of financial literacy across the population also have distributional consequences as more financially-literate individuals may be better able to manage and diversify risks as a result of economic shocks. In addition, the risks associated with economic shocks may be especially severe for the older

[2] While Ireland does not have a national strategy on financial education (OECD, 2015), a National Steering Group on Financial Education, which was established by the Financial Regulator in late 2006, brought together a range of stakeholders with an interest in personal finance and/or education (National Steering Group on Financial Education, 2009). A recent report on financial capability for the Competition and Consumer Protection Commission (CCPC) noted that financial education is one component of a wider series of policies to ensure financial wellbeing (Competition and Consumer Protection Commission, 2018).

population whose asset accumulation decisions were made largely in the past and whose margins for adjustment (e.g., by increasing labour supply) are smaller (Jappelli, 2010).

As in many other countries, policymakers in Ireland are concerned with pension adequacy. While the flat-rate state pension in Ireland provides basic protection against pensioner poverty, it is not designed to ensure a high level of pension adequacy (Government of Ireland, 2018). A particular concern is the low level of supplementary pension cover; in 2015, less than 50 per cent of men and women aged 20-69 years in employment had access to an occupational or private pension (CSO, 2016). Previous research has found that while the median retirement income replacement rate in Ireland is 50 per cent, this masks considerable heterogeneity across the income distribution (Nivakoski and Barrett, 2017).[3] Of course, pension income is not the only way in which individuals can ensure financial protection in retirement; individuals can draw down asset wealth in retirement to fund their consumption (Modigliani, 1986). Therefore, in order to ensure financial protection in retirement, the pre-retired population need to carefully plan their future pension and wealth portfolio.

In this paper, we investigate the extent to which financial literacy is an important determinant of financial protection in the older pre-retirement population in Ireland. We contribute to the growing international literature on the importance of financial literacy by focusing on a population for whom retirement financial protection is of particular concern. We use data from the Irish Longitudinal Study on Ageing (TILDA), which contains detailed information on pensions, wealth and debt, in addition to other demographic and socio-economic correlates of financial wellbeing. We find significantly higher levels of financial literacy among men, those with higher levels of education and cognition, and the self-employed. Financial literacy is in turn associated with higher household wealth, lower financial stress and higher expected retirement income. We find little evidence that those with higher levels of financial literacy are more likely to have various forms of supplementary pension cover however, suggesting a more limited role for financial literacy over and above other important determinants of supplementary pension cover such as income, education and employment/occupational type.

The paper is structured as follows. Section 2 provides an overview of previous literature on financial literacy, with a particular focus on the older population. Section 3 introduces the data and methods. Section 4 presents results while Section 5 summarises the findings and discusses policy implications.

[3] The average replacement rate was 78 per cent. There was a U-shaped relationship between retirement income replacement rates and pre-retirement income. At the bottom of the income distribution, this reflected both the flat-rate nature of the state pension and the low earnings of this group prior to retirement.

2. Previous Literature

A large literature has examined differences in levels of financial literacy across the population, with largely consistent results despite differences in the instruments used to assess financial literacy. Surveying financial literacy levels across a number of developed countries, Lusardi and Mitchell (2011b) find an inverted U-shaped relationship between age and financial literacy, with a peak in the middle of the life cycle (although with cross-sectional data they cannot distinguish between age and cohort effects). Across all countries, the scores for women are consistently lower than those for men (and women are also much more likely to respond 'don't know' to financial literacy questions).[4] The exception is Russia and the former East Germany, where men and women both score very low in terms of financial literacy. Higher levels of education are associated with greater financial literacy. Using data from the US National Financial Capabilities Study, Lusardi and Mitchell (2011a) demonstrate that financial literacy is particularly low among the young, women and the less-educated. Delavande et al. (2008) find that older individuals, men, those with high education, and with high income all have higher financial literacy scores (based on data from the American Life Panel and the Cognitive Economics Survey). Fonseca et al. (2012) also use data from the American Life Panel on a sample of those aged 18+ to show that those who are older, male, with higher education and income have higher levels of financial literacy.

Even in relatively homogenous groups, large differences in financial literacy can be observed. For example, Clark et al. (2017), using administrative data on all active employees of the Federal Reserve (FR) in the US, finds that financial literacy does not differ significantly by age, but is strongly associated with sex, marital status and salary (with males, married employees, and those with higher salaries, scoring higher). They find that FR employees are more financially literate than the population at large. Jappelli (2010) use survey data on business leaders to examine cross-country differences in financial literacy over the period 1995-2008, and finds that financial literacy levels are positively correlated with education but negatively with levels of mandated social security contributions. However, Lusardi and Tufano (2015), in an analysis of 'debt literacy' (i.e., financial literacy with respect to knowledge about debt) in a sample of US individuals, find that while older individuals display the lowest level of knowledge about interest compounding, there are no significant differences across age groups in the other two questions fielded (about credit card interest rates, and time horizons). Men score

[4] Similar differences are also evident in low- and middle-income countries (Klapper et al., 2016).

consistently higher than women on all three questions, largely accounted for by the much higher tendency for women to answer 'don't know'. Income is positively associated with debt literacy.

Focusing in particular on the older population, using data from the Survey of Health, Ageing and Retirement in Europe (SHARE), Christelis et al. (2010) notes that numeracy is positively associated with education and income, and negatively associated with age and self-assessed health. Using data from the 2008 Health and Retirement Study (HRS), Lusardi et al. (2014) find that men and the better-educated are more financially literate. However, they find only weak evidence that age is related to financial literacy scores in a regression analysis (although they also control for highly correlated variables such as cognition, risk aversion and planning horizon). Similarly, Li et al. (2017), also using data from the HRS, finds that high financial literacy is associated with being male, younger, having a higher level of education and having both a defined benefit (DB) and defined contribution (DC) pension (relative to just a DB pension) (although the latter effect is only significant for men).

These differences in financial literacy scores across the population have been shown to be associated with clear differences in financial outcomes. For example, using data from the US National Financial Capabilities Study, Lusardi and Mitchell (2011a) show that those who score higher on the financial literacy questions are much more likely to plan for retirement (based on the question 'have you ever tried to figure out how much you need to save for retirement?'), which is likely to leave them in a better position in older age. Analysing the relationship between financial literacy and retirement planning behaviour across eight developed countries, Lusardi and Mitchell (2011b) find that financial literacy is consistently significant, even when controlling for other possible confounders such as education. van Rooij et al. (2012) find a positive association between financial literacy and wealth holdings after controlling for other determinants of wealth, such as income, age, education, family composition, risk tolerance, patience and attitudes towards saving in a sample of Dutch adults aged 16+.[5] Descriptive statistics suggest that more financially literate individuals spread their wealth over a richer class of assets and hold more diversified portfolios. Clark et al. (2017) find that financially literate employees of the Federal Reserve in the US are more likely to contribute to a supplementary

[5] Similar results are found using an instrumental variables approach to identify causal relationships (see Section 3.2 for a description of the use of instrumental variables approaches in economics). They use 'how much of your education was devoted to economics' as an instrument for advanced financial literacy, but caution that accumulating wealth and becoming financially literate or being exposed to an economics education are choice variables that are potentially correlated with an omitted variable that explains the association between financial literacy and wealth (and so they control for cognition).

defined contribution pension plan[6], contribute a higher percentage of their salaries, and have higher equity in their plans, than less financially literate employees. They also examine behaviour one year after employees completed a Learning Module about retirement planning, and find a significant positive effect on the probability of contributing.

Despite its importance and potentially damaging consequences, the debt side of financial literacy has received less research attention than the asset side (Jappelli, 2010). An exception is Lusardi and Tufano (2015) who show a strong relationship between debt literacy and adverse debt outcomes (such as incurring credit card fees, self-assessed debt levels, etc.), even after controlling for demographic characteristics. Gerardi et al. (2010) investigate whether financial literacy plays a role in the level of defaults and foreclosures in the US subprime mortgage market. They find a large and statistically significant negative effect of numeracy on various measures of delinquency and default.[7] The relationship between numerical ability and mortgage default is robust to controlling for a broad set of sociodemographic variables, and is not driven by other aspects of cognitive ability.

Banks (2010) note that it may be optimal for less numerate individuals to save less, if there is some unobserved factor that captures need or desire for savings (for example, life expectancy). Agarwal and Mazumder (2013) add to this discussion by considering two outcomes that are clearly considered sub-optimal (balance transfer[8] and rate-changing[9] mistakes). They find, among a sample of US military, that those with higher scores on the Armed Forces Qualifying Test (AFQT), and specifically higher maths scores, are significantly less likely to make balance transfer and rate-changing mistakes. They

[6] All FR employees are covered by a relatively generous defined benefit (DB) plan and Social Security. In addition, the FR System offers its employees the opportunity to participate in a DC plan (and 84 per cent do so).

[7] Two indicators are used: percentage of months behind on at least one mortgage repayment, and lender initiating foreclosure process.

[8] When a borrower makes a balance transfer to a new credit card with a 'teaser rate', they pay substantially lower APRs on the balance transferred to the new card for a specified period. However, new purchases on the card typically have a much higher APR. At the time these data were collected, the catch was that payments on the new card first paid down the (low interest) transferred balance, and then only paid down the (high interest) debt accumulated on new purchases. For borrowers who transfer the entire balance from an old credit card, and who makes only transactions that they aim to pay off in the teaser period, the optimal strategy is to make new purchases only on the old card.

[9] In determining the APR for a loan, the amount of collateral offered by the borrower, as measured by the loan-to-value (LTV) ratio, is a key determinant. In this case, both the financial institution and borrower provide an estimate of the LTV; a rate-changing mistake occurs when the borrower LTV category differs from the bank LTV category and the borrower proceeds with the loan, despite the fact that they have the information which would prompt them to re-apply for the loan, from either the same or a different financial institution.

also find that verbal scores are not associated with balance transfer mistakes, and only weakly associated with rate-changing mistakes.

Focusing on the older population, Banks and Oldfield (2007) examine numerical ability and other dimensions of cognitive function in a sample of older adults in England, and the extent to which these abilities are correlated with various measures of wealth and retirement saving outcomes. As well as finding that relatively large fractions of the older population have low levels of numeracy (and that it varies significantly by age, sex and education), they show that numeracy levels are strongly correlated with measures of retirement saving and investment portfolios, even when controlling for other dimensions of cognitive ability as well as educational attainment. Numeracy is also associated with knowledge of pension arrangements, and with perceived financial security.[10] Using data from the SHARE, Christelis et al. (2010) find that numeracy score is positively (linearly) associated with the probability of stockholding (and is significant even when controlling for education and other indicators of cognition such as verbal fluency and memory). Gousia (2016) investigate the impact of financial literacy on long-term care insurance cover, using data from the SHARE. They find that the effect of financial literacy on the probability of holding a private insurance policy for long-term care is large and significant, and distinct from other factors such as risk and time preferences.[11]

A number of papers have attempted to identify a causal effect of financial literacy on a variety of financial outcomes. For example, Christiansen et al. (2008) use data from a 10 per cent random sample of the adult Danish population to assess whether exposure to an economics education increases stock market participation. They find that becoming an economist is associated with a positive and significant increase in the probability of investing in the stock market. They use a variety of strategies for identification: random effects, difference-in-difference and IV[12], and find consistently positive results. IV methods have also been employed by Lusardi and Mitchell (2011a)[13], Behrman et al.

[10] Other outcomes examined include 'don't know' responses to the accrual rate for their pension plan; how much they expect to get from the pension when they retire (both only asked of those with DB plans); type of indexation; whether they have received enough information about their pension; and retirement expectations (enough resources to meet their needs, on a scale of 0 to 100).

[11] They also use an instrumental variable (IV) approach, using self-reported relative performance in language in school at the age of 10 as an instrument for financial literacy.

[12] Another instrument used is the opening of a new university (Aalborg University in 1974).

[13] They use state-level variation in mandated high school financial education as an instrument for financial literacy in their analysis of the impact of financial literacy on retirement planning in the US; they find a large and significant IV effect (larger than the OLS effect).

(2012)[14] and van Rooij et al. (2012). Lusardi et al. (2014) note that IV analyses generally show that ordinary least squares (OLS) estimates tend to underestimate the true effect of financial literacy on financial outcomes.

In the context of financial outcomes in retirement, a number of papers examine the role of financial literacy in increasing retirement planning, which may be an important mechanism linking financial security with better financial wellbeing in older age (Lusardi and Mitchell, 2008, van Rooij et al., 2012). Lusardi and Mitchell (2007) compare wealth holdings across two cohorts of the HRS: the early Baby Boomers in 2004, and individuals in the same age group in 1992. Levels and patterns of total net worth have changed relatively little over time, though Boomers rely more on housing equity than their predecessors. Most important, planners in both cohorts arrive close to retirement with much higher wealth levels and display higher financial literacy than non-planners. They also explore the possibility that it is wealth that affects planning (i.e., reverse causality) rather than planning that affects wealth, but tests using IV methods indicate this is not the case.[15]

A number of papers focus on gender differences in financial literacy. Bucher-Koenen et al. (2017) provide an overview of the literature on gender differences in financial literacy, and examine the gender gap in financial literacy in a cross-country context. They note that not only do women answer a lower percentage of questions correctly but that a higher proportion answer 'don't know' to financial literacy questions. They find a persistent gender gap in financial literacy in the US, Germany and the Netherlands (using the same three questions but different fieldwork methods) that is independent of socioeconomic background and cultural and institutional context. They also find a significant gender gap among younger individuals, and argue therefore that differences in financial literacy in older age are not purely driven by a cohort effect associated with traditional gender roles among older women. Looking at financial literacy differences within couples, they find that even when women are the financial decision-maker, they display lower levels of financial literacy than men.

[14] They isolate the causal effects of financial literacy and schooling on wealth accumulation in Chile using a variety of instruments, many of which are age-related (e.g., exposure to a 1981 school voucher reform). Financial literacy and schooling attainment are both strongly positively associated with wealth outcomes in linear regression models, whereas the IV estimates reveal even larger effects of financial literacy.

[15] They use regional house prices as an instrument for housing wealth in a regression of the impact of wealth accumulation on planning.

Fonseca et al. (2012) note that understanding how and why men and women have different levels of financial literacy is crucial to developing policies aimed at reducing the gender gap in financial outcomes at older age. Using data from the American Life Panel on a sample of those aged 18+, they find that the effects of age, race and income do not differ by gender, but that men gain more from education in terms of financial literacy than women. Marriage has a particularly strong association with financial literacy for women, with married women having higher rates of financial literacy than married men, suggesting selection into marriage for financially literate women. Using a Blinder-Oaxaca decomposition method, they find that the majority of the gender gap in financial literacy is not explained by differences in observed covariates, but rather by differences in the returns to those covariates, i.e., in how financial literacy is produced. They suggest that this may be due to the division of labour for financial decisions within couples, although find little evidence to support this hypothesis.

Focusing on the possibility that the gender gap in financial literacy may be due to the division of labour within couples, Smith et al. (2010) use data on married couples from the HRS to assess the association between observed wealth outcomes for households and cognitive abilities of both spouses.[16] To illustrate the importance of numeracy for wealth, they note that wealth is $1.7m for couples where both answer all three numeracy questions correctly, but only $200,000 for couples where both partners answer all questions incorrectly. The divergence is even greater for financial wealth (more than ten times). They also find a tendency for financial wealth to be higher when the financial respondent has the higher numeracy score. The associations also hold for the outcome of the proportion of the wealth portfolio held in stocks. For regression analyses, they examine both levels and changes in levels of wealth between 2000 and 2006, and once again, the effect for the numeracy score of the financial respondent is much larger than the numeracy score for the non-financial respondent. Of the three broad measures of cognition they use, numeracy has by far the largest impact on wealth.

McArdle et al. (2011), using data from the HRS, also use the spousal information in HRS to assess whether cognitive abilities of both spouses predict wealth holdings, and whether cognition of one spouse is more important than the other for financial outcomes. Similar to Smith et al. (2010), they show all measures of wealth are more strongly related with the numeracy of the financial respondent,

[16] The cognitive abilities they examine are: memory (immediate and delayed recall); mental status (from the telephone interview of cognitive status, which incorporates both crystallised and fluid intelligence); and numeracy.

rather than the non-financial respondent. Banks and Oldfield (2007) also show that the association between numeracy and wealth is stronger when numeracy reflects the maximum of the values for the two individuals in a benefit unit.[17]

3 Data and Methods

3.1 Data

In this paper, we use data from the Irish Longitudinal Study on Ageing (TILDA). TILDA is a nationally representative sample of community-dwelling individuals aged 50 years and over, and their spouses or partners of any age (i.e., individuals living in nursing homes or other institutions were excluded at baseline). The study is harmonised with other international longitudinal studies of ageing, such as the US Health and Retirement Study (HRS), the Survey of Health, Ageing and Retirement in Europe (SHARE) and the English Longitudinal Study on Ageing (ELSA). Data collection for the first wave took place over the period October 2009 to February 2011, when 8,504 individuals were sampled, of which 8,175 were aged 50+ years (Donoghue et al., 2018). Further waves have been conducted every two years, with fieldwork for wave 5 ongoing in 2018. The dataset contains an extensive set of variables on the demographic, health and socio-economic circumstances of older people in Ireland. Data are collected primarily via computer-aided personal interviewing (CAPI). As data on numeracy/financial literacy is available in wave 3 of TILDA only, the analysis in this paper focuses on wave 3, which was conducted between March 2014 and October 2015 (McGarrigle et al., 2017). A total of 6,294 individuals aged 54+ completed the wave 3 questionnaire in person.

In order to analyse the financial situation of pre-retirement individuals, we further restrict the sample to focus on individuals in households with at least one respondent who is employed or self-employed, i.e., those households who may be considered 'pre-retirement'. This results in a final sample size of 2,430 individuals. After deletion of observations with missing values on at least one variable of interest (mainly wealth), 1,346 observations are left for analysis.[18] Table A1 in the Appendix illustrates how the final analytic sample of 1,346 individuals differs from the full sample at wave 3; individuals in pre-

[17] See Doorley and Nolan (2018) for an analysis of the relationship between couple financial literacy and wealth using TILDA.

[18] A comparison of columns (1) and (2) in Table A1 shows that while the excluded observations do not differ from the final sample in terms of financial literacy score, age, sex, education level or cognition score, excluded individuals are significantly more likely to be married, self-employed, with lower household incomes and resident in rural areas.

retirement households are younger, more likely to be male, more highly educated, more likely to be married, employed or self-employed and have higher cognition and financial literacy scores.[19]

As noted, wave 3 of TILDA included a module on 'numeracy/financial literacy'. The module consisted of three questions, as follows:

- If the chance of getting a disease is 10 percent, how many people out of 1,000 would be expected to get the disease? (Q1)
- If 5 people all have the winning numbers in the lottery and the prize is two million euro, how much will each of them get? (Q2)

If the respondent answered Q1 and/or Q2 correctly, then the respondent is also asked Q3:

- Let's say you have €200 in a savings account. The account earns 10 percent interest per year. How much would you have in the account at the end of two years? (Q3)

Table 1 presents the distribution of responses for each of three questions. The proportions answering correctly are 88.9 per cent (Q1), 72.7 per cent (Q2) and 17.7 per cent (Q3). The proportion of respondents answering the compound interest question (Q3) correctly is particularly low (data not presented here show that nearly two-thirds of those answering Q3 incorrectly actually answered as if the question referred to a simple interest calculation).[20] As the questions increase in difficulty, the proportion of respondents refusing to answer the question or answering 'don't know' increases.[21]

[insert Table 1 here]

Our primary independent variable is a derived variable indicating the sum of the number of correct responses, ranging from 0 to 3 (the mean is 1.8, and the median is 2). Even within this group of pre-retirement households, levels of financial literacy vary significantly. Table 2 illustrates that there are large and significant differences between men and women in pre-retirement households in levels of financial literacy, with women scoring significantly lower than men. Older individuals exhibit

[19] The derivation of the financial literacy score is described in the subsequent paragraphs.

[20] Lusardi and Tufano (2015) also found that a higher proportion of US adults answered a compound interest question as if it referred to simple interest.

[21] While it may seem counterintuitive that the proportion of 'refused and don't knows' falls for Q3, it must be remembered that a smaller proportion of the population answer Q3. For ease of comparison across the three questions, we assume that anyone answering Q1 or Q2 incorrectly, who do not get asked Q3, would also answer Q3 incorrectly.

significantly lower scores, as do those with lower levels of education, widow(er)s, those not retired, in employment or self-employment, and those resident in rural areas. In a multivariate regression model of financial literacy, the effects for sex, education, self-employment status, cognition[22] and household location remain statistically significant (see Table A2 in the Appendix).

[insert Table 2 here]

Three broad groups of outcome variables relating to wealth, financial stress and retirement preparedness are examined in this paper. To reduce household response burden in TILDA, wealth information is collected only from one respondent in each household, the nominated financial respondent. As wealth is self-reported, levels of non-response are non-trivial. To reduce non-response to the income and wealth questions in TILDA, the technique of 'unfolding brackets' was used. Those who refused or claimed not to know the relevant amount in relation to an income or wealth question were asked a follow-up question which gave the option of providing a banded answer rather than a point estimate. Using data from wave 1 of TILDA, O'Sullivan et al. (2014) show that the use of unfolding brackets was a relatively successful interview strategy as the non-response was reduced significantly, especially in relation to housing wealth. We use the mid-points of the unfolding brackets as the values for those who did not answer the original questions.

We first calculate three broad indicators of household wealth, namely net financial wealth, net housing wealth and net total wealth. Net financial wealth is derived by aggregating data on savings, stocks/shares, investment property, other assets (e.g., land, art, jewellery, *etc.*) and cars, and subtracting non-mortgage debt. Non-annuitized pension wealth is not included. Net housing wealth is derived by subtracting mortgage debt from the value of the principal private residence. Financial and housing wealth are also summed to generate net total household wealth. All wealth measures are then assigned to all respondents in the household, and adjusted for household size and composition using the national equivalence scale.[23] As all wealth variables are highly skewed, the inverse hyperbolic sine transformation is applied to each wealth indicator to reduce the influence of outliers

[22] The measure of cognitive function we employ is the total score from the Mini Mental State Examination (MMSE), a well-established test used to screen for cognitive impairment that includes measures of orientation, registration, attention, calculation, recall, and language. Scores range from 0 to 30 (Kenny et al., 2013).

[23] The national equivalence scale assigns a value of 1 to the first adult in a household, 0.66 to all other adults aged 14+ and 0.33 to all children under the age of 14.
See https://www.cso.ie/en/methods/surveybackgroundnotes/surveyonincomeandlivingconditions/.

and to retain zero and negative values in regression models (Mosca and McCrory, 2016). We also examine each of the five components of financial wealth separately, as well as the two debt indicators.[24]

Table 3 presents summary statistics for each of the various outcome variables used in our analysis. It indicates that in this sample of pre-retirement households, the mean (median) level of equivalised net financial wealth is €120,052 (€31,879), the mean (median) level of equivalised net housing wealth is €136,958 (€100,000) and the mean (median) level of equivalised net total wealth is €256,955 (€158,190). Nearly 90 per cent of individuals in pre-retirement household report positive savings, while just over one third report positive stock values. Over one-third have non-mortgage debt, with an average value of €16,860, and just over one-fifth have outstanding mortgage debt, with an average value of €8,834.

To complement the wealth variables, we also examine the individual's experience of financial stress, gathered from one of the items used to derive the CASP-12 quality of life score.[25] The item 'shortage of money stops me from doing the things I want to do', with responses 'always', 'sometimes', 'rarely' and 'never', is used to proxy financial stress. We create a binary variable with the value 1 indicating those who 'always' or 'sometime' experience a shortage of money, and 53.6 per cent of individuals in pre-retirement households report doing so.

A second set of outcomes captures a number of other broad dimensions of retirement planning behaviour among the pre-retired. We construct three variables that indicate pension scheme cover, by occupational, private retirement saving account (PRSA) or private pension schemes. While the private pension cover question is asked of all non-retired respondents, only those in employment are asked about occupational pension cover, while those who are retired or in employment are not asked the PRSA pension cover question. Of those who are currently employed, 52.0 per cent have occupational pension cover. Of those currently self-employed or in another non-employed status (e.g., looking after home or family), 13.5 per cent have a PRSA pension plan. For all those in pre-retirement households who are not yet retired, 6.2 per cent have a private pension plan. Finally, those who have

[24] We also run a series of robustness checks using dummy variables that indicate ownership of each wealth component; see also Section 4.3.

[25] The CASP-12 is a 12-item self-report inventory specifically developed to assess quality of life for older people (Sexton et al., 2013).

not yet retired are also asked their expectations about future retirement income; we combine this categorical[26] variable with their current weekly income to derive a variable that indicates their expected future retirement income. On average, those that are currently non-retired expect to receive a weekly income of €382 in retirement.

[insert Table 3 here]

3.2 Methods

We estimate cross-sectional models of the form presented in equation (1) for each of our outcomes:

$$y_i = \propto + \beta f_i + \gamma X_i + \varepsilon_i \quad (1)$$

where y_i refers to our outcome of interest (e.g., net financial wealth); f_i refers to the individual's financial literacy score (range 0-3); X_i is a vector of other control variables such as age, sex, marital status, education level, employment status, cognitive score, household equivalised income and household location; and ε_i is the error term. Depending on the form of the outcome variable, we use OLS (for continuous variables such as wealth) or probit (for binary variables such as pension cover) regression methods to estimate the models. We begin by estimating models that control just for financial literacy score, age and sex. We then add the full set of control variables; the results of these models will indicate the extent to which financial literacy is associated with various indicators of financial wellbeing in the pre-retirement older population in Ireland, controlling for other influences on financial wellbeing such as age, sex, income, etc.

However, the relationship between financial literacy and financial wellbeing is likely to be endogenous. As noted in Section 2, in addition to the possibility that financial literacy *causes* better financial outcomes, it is also possible that the relationship is characterised by reverse causality (e.g., higher levels of wealth may lead individuals to become more financially literate).[27] It is also possible that the association between financial literacy and financial outcomes is due to common unobserved factors (e.g., attitudes towards risk, time preferences, etc.).[28] While we control for many observable

[26] Response categories are 'more than my income now', 'about the same as my income now', 'two thirds of my income now', 'half of my income now', 'a third of my income now', 'less than a third of my income now'.

[27] Data from the Standard and Poor Global Financial Literacy Survey provide some support for this possibility; the proportion of the population answering the inflation question correctly was higher in countries such as Argentina that had experience of hyperinflation (Klapper et al., 2016).

[28] Agarwal and Mazumder (2013) demonstrate an association between a survey-based measure of patience and mathematical scores on the AFQT (armed forces qualifying test), while Dohmen et al. (2010) find that both risk

characteristics (e.g., education) that may explain the association between financial literacy and the various outcomes examined in this paper, we cannot interpret these results as causal. While previous research has investigated the use of statistical methods such as instrumental variables to identify the causal effect of financial literacy, the difficulty in identifying an appropriate instrumental variable for financial literacy has been well documented in previous research (Lusardi and Mitchell, 2011a, van Rooij et al., 2012, Behrman et al., 2012). Reassuringly however, where instrumental variable methods have been employed, they provide consistent results with those of OLS models of the type estimated in equation (1) in this paper (see for example, Lusardi and Mitchell (2011a) and van Rooij et al. (2012)).[29]

4 Results

4.1 Descriptive Patterns

Before presenting the results from the multivariate OLS models, we show how our various indicators of wealth, financial stress and retirement preparedness vary with financial literacy. Table 4 describes the relationship between financial literacy score and the various indicators of wealth. In general, higher financial literacy is associated with higher levels of wealth. For example, individuals who answer all three financial literacy questions correctly have an average value of equivalised total household wealth that is over twice as high as those who answer none of the questions correctly. The patterns for debt are worth noting; those with higher financial literacy have higher levels of both non-mortgage and mortgage debt. Figure 1 shows that levels of financial stress are lower for those with higher financial literacy scores. Table 5 illustrates the relationship between financial literacy score and supplementary pension cover; in general, those with higher financial literacy scores have higher rates of supplementary pension cover. Finally, Figure 2 shows that expectations of income in retirement are higher for those with higher financial literacy scores.

[insert Tables 4 and 5 here]

[insert Figures 1 and 2 here]

aversion and impatience are related to cognitive ability, even after controlling for demographics and personality (using data on a sample of the German population) (higher cognition is associated with more risk-taking and lower impatience).

[29] We investigated the use of a number of possible instruments for this paper, primarily related to educational reforms (e.g., 1967 free secondary school reform) or other policy changes (e.g., 1971 decimalisation) that would be expected to result in an exogenous change in financial literacy. However, none of the proposed instrumental variables passed the statistical specification tests.

4.2 Multivariate Regression Results

However, these patterns are descriptive and do not take account of other characteristics of individuals with higher financial literacy (e.g., sex, cognition, etc.) that may explain the association with financial outcomes. In the section, we report the results of OLS and probit models that estimate the effect of financial literacy on wealth, financial stress and retirement preparedness (see equation 1). For each outcome, we estimate two versions of each model; the results in column (1) control just for financial literacy score, age and sex, while column (2) adds controls for marital status, education, employment status, cognition, household income and household location. The results for the models presented in column (2) will indicate the extent to which financial literacy is associated with various indicators of financial wellbeing in pre-retirement households, while controlling for other characteristics that may explain these financial outcomes.[30] Table 6, panel (a), shows that a higher financial literacy score is associated with significantly higher total household wealth, even in the fully adjusted models. In contrast, financial literacy is not associated with net financial wealth, nor with net housing wealth once other characteristics such as education or household income are taken into account. Panel (b) focuses on the components of financial wealth in more detail. While financial literacy is associated with savings, stocks, investment property and cars in the models adjusting for age and sex only, only the association with investment property remains statistically significant after full adjustment. Panel (c) shows that while there is no association between financial literacy and non-mortgage debt, higher financial literacy is associated with significantly higher levels of mortgage debt.

[insert Table 6 here]

Focusing on the experience of financial stress, the results in Table 7 indicate that higher financial literacy is associated with significantly lower levels of financial stress, even after adjustment for other covariates. In terms of retirement preparedness, the models in Table 8 show that there is no association between financial literacy and the probability of occupational, PRSA or private pension cover.[31] However, those with higher financial literacy expect to receive significantly higher incomes in

[30] See Appendix Tables A3-A5 for full model results.

[31] The other variables have effects that are consistent with expectations and previous research (Nivakoski, 2014); women, those with lower levels of education and income, and those living outside Dublin are less likely to have an occupational pension. See Table A5.

retirement, even after adjustment for other characteristics such as education and current household income.

[insert Tables 7 and 8 here]

4.3 Robustness Checks

We run a number of additional analyses to check the robustness of our results. First, rather than estimating models of wealth levels, we estimate models of wealth holdings, i.e., whether or not the individual is in a household that reports having positive savings, stocks, etc. Second, we adjust the wealth values the take account of remaining life expectancy; for each individual of a given age and sex, we adjust their wealth holdings to take account of their remaining life expectancy as presented in Irish Life Tables (CSO, 2015). The results are robust when using these different definitions of wealth.

Third, the indicator of financial literacy that we use is a relatively simple composite score derived from three questions that reflect knowledge of percentages, fractions and simple/compound interest. It could be argued that the first two questions reflect numeracy rather than financial literacy skills per se, and other studies have developed more nuanced indicators of financial literacy that capture knowledge of portfolio diversification, inflation, etc. (see for example, van Rooij et al. (2012)). To isolate the effect of financial literacy, rather than numeracy, we replace our indicator of financial literacy with a variable that indicates whether Q3 was answered correctly. These results indicate that the previously significant results for net household total wealth (in Table 6a), financial stress (in Table 7) and retirement income expectations (in Table 8) become non-significant (although still of the expected sign), suggesting that it is numeracy rather than financial literacy per se that is important for these outcomes. On the other hand, the previously non-significant result for occupational pension (in Table 8) becomes statistically significant when we use giving a correct answer to Q3 rather than the total score to indicate financial literacy.

Finally, TILDA does not record the financial literacy of all household members, but rather the financial literacy of eligible respondents (i.e., those aged 50+). To discount the possibility that the financial literacy of another household member (e.g., an adult child) is influential in determining the financial wellbeing of the household, we restrict our analysis to single households and couple households in which both partners are observed. While the sample size is much smaller (n=622), all significant results

in Section 4.2 with the exception of total household wealth, mortgage debt and retirement income expectations remain significant. Results from all these additional analyses are available on request from the authors.

5 Discussion and Policy Implications

The economic and financial landscape facing individuals as they move through their life-cycle is becoming increasingly complex. In this context, financial literacy is a crucial skill that enables individuals to navigate this increasingly complex environment and ensure financial protection in old age. Two key findings emerge from our analysis of the relationship between financial literacy and financial wellbeing in the older pre-retirement population in Ireland. First, levels of financial literacy vary substantially across this population. In common with findings from other countries using various different indicators of numeracy/financial literacy, we find that women have significantly lower financial literacy than men, and those with higher education and cognition, who are self-employed, and living in urban areas, perform significantly better than those with lower levels of education and cognition. The gender gap in financial literacy is particularly striking, although not unusual in an international context. Potential explanations for the gender gap include the division of labour for financial decisions within couples (Bucher-Koenen et al., 2017, Fonseca et al., 2012), differences in perceptions of mathematical and financial abilities between men and women (Farrell et al., 2016) and early differences in financial socialisation between boys and girls (Agnew and Cameron-Agnew, 2015, Agnew et al., 2018).

Second, we estimate the association between financial literacy and wealth, financial stress and retirement preparedness. We find clear associations between higher financial literacy and higher total household wealth and lower financial stress. In terms of retirement preparedness, while we find no association between financial literacy and supplementary pension cover, higher financial literacy is found to be associated with greater expectations of income in retirement. Previous research findings in relation to wealth have tended to find that financial literacy is related in particular with wealth in stocks/shares (Banks and Oldfield, 2007, van Rooij et al., 2012); while we find that financial literacy is associated with stock wealth in the models adjusted for just age and sex, this association is non-significant after adjustment for other covariates such as education or cognition. In contrast, in this sample, the strongest association is found between financial literacy and investment property wealth. This is perhaps not surprising given the data presented in Table 3 which show that of the disaggregated components of wealth, the average value of wealth in investment property is comparable with that

held in stocks/shares. Data from the Household Finance and Consumption Survey, which is conducted across the Eurozone, also indicates that the proportion of total asset wealth accounted for by financial assets (savings, stocks, etc.) is lower among Irish households than the Eurozone average.[32]

Previous research has also demonstrated that financial literacy is found to be positively associated with retirement planning behaviour (Ameriks et al., 2003, Lusardi and Mitchell, 2007, Lusardi and Mitchell, 2008, Lusardi and Mitchell, 2011a) and our empirical results suggest that those with higher financial literacy have higher expectations of income in retirement. However, we do not find evidence of a strong association between financial literacy and supplementary pension cover (although those who answer Q3 correctly are more likely to have an occupational pension). In the Irish context, it may be the case that the flat-rate state pension is perceived as providing a basic level of income security that in other contexts may be considered inadequate. Jappelli (2010) demonstrates that residents of countries with more generous social security systems are generally less financially literate. It may also be the case that the degree of choice that individuals can exercise in choosing supplementary, in particular, occupational pension cover in Ireland may be relatively limited.

Understanding the precise nature of the link between financial literacy and financial outcomes is important for policy. While we cannot claim that these estimates are causal, previous research using our methods as well as methods for causal analysis (such as instrumental variables) has found largely consistent results. In the context then, how might we increase financial literacy levels among the population? Entorf and Hou (2018) and Lunn (2012) highlight the lack of evidence on the effectiveness of financial education interventions. Fernandes et al. (2014) conducted a meta-analysis of the relationship between financial literacy and financial education and financial behaviours across 201 prior studies. They found that interventions to improve financial literacy explain only 0.1 per cent of the variance in financial behaviours studied, with weaker effects in low-income samples. Like other education, financial education decays over time; even large interventions with many hours of instruction were found to have negligible effects on behaviour 20 months or more from the time of intervention.[33] Given the association between numeracy and financial literacy, Skagerlund et al. (2018;

[32] For example, in 2013, while 12.5 per cent of total asset wealth was accounted for by financial assets in Irish households, the corresponding figure for the Eurozone average was 17.8 per cent. See https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html.

[33] In Ireland, the Competition and Consumer Protection Commission (CCPC) co-ordinates a number of financial education resources, for the Junior Certificate curriculum, the Leaving Certificate Applied Social Education curriculum and a workplace programme. The Money Advice and Budgeting Service (MABS) also offer services, particularly to those in financial difficulty, but also education, e.g., for primary school students.

23) suggest that interventions to increase numeracy, and reduce mathematics anxiety, may be effective in raising levels of financial literacy across the population. They argue that 'while knowledge of financial concepts, such as inflation and risk diversification, is undoubtedly important for being financially literate, if individuals cannot do basic calculations, understand ratios and percentages, any conceptual knowledge of financial matters acquired will be rendered moot'.

TABLES AND FIGURES

Table 1 Financial Literacy Question Responses

	Correct	Incorrect	Don't Know	Refused
Q1	88.9	8.3	2.4	0.4
Q2	72.7	21.8	5.1	0.4
Q3	17.7	80.0	2.3	-

Notes:

1. Sample weights are employed.
2. Respondents who answered Q1 and/or Q2 incorrectly were not asked Q3 (and are coded therefore as 'incorrect' for NU003).

Table 2 Average Financial Literacy Score by Demographic Characteristics

	Financial Literacy Score
All	1.79 [1.75 – 1.84]
Male	1.91 [1.85 – 1.97]
Female	1.65 [1.58 – 1.71]
Age 50-64	1.83 [1.78 – 1.88]
Age 65-74	1.75 [1.65 – 1.86]
Age 75+	1.16 [0.91 – 1.40]
Primary education	1.31 [1.19 – 1.43]
Secondary education	1.77 [1.71 – 1.84]
Third level education	2.06 [2.00 – 2.12]
Married	1.83 [1.79 – 1.88]
Never married	1.70 [1.57 – 1.83]
Separated/divorced	1.74 [1.56 – 1.93]
Widowed	1.48 [1.26 – 1.70]
Retired	1.78 [1.63 – 1.93]
Employed	1.80 [1.75 – 1.86]
Self-employed	1.86 [1.77 – 1.95]
Other status (e.g., unemployed, sick/disabled)	1.53 [1.38 – 1.69]
Dublin	1.97 [1.88 – 2.06]
Other urban	1.75 [1.66 – 1.84]
Rural	1.71 [1.66 – 1.78]

Notes:

1. Sample weights are employed.
2. 95 per cent confidence intervals are presented in parentheses.

Table 3 Outcome Variable Descriptive Statistics

	%	Mean (€)	Median (€)
Net Financial Wealth	91.1	120,052	31,879
Net Housing Wealth	92.3	136,958	100,000
Total Net Wealth	97.2	256,955	158,190
Savings	87.2	25,989	7,229
Stocks	35.9	22,041	0
Investment Property	18.0	20,872	0
Other Assets	29.0	64,891	0
Cars	86.4	4,737	3,012
Non-Mortgage Debt	34.3	-16,860	0
Mortgage Debt	21.9	-8,834	0
Financial Stress	53.6	-	-
Occupational Pension	52.0	-	-
PRSA Pension	13.5	-	-
Private Pension	6.2	-	-
Expected Retirement Income	-	382	275

Notes:

1. Sample weights are employed.
2. 95 per cent confidence intervals are presented in parentheses
3. All wealth variables are adjusted for household size and composition using the national equivalence scale (1 for the first adult, 0.66 for all other adults aged 14+, 0.33 for children under the age of 14).
4. Financial stress is derived from the 'shortage of money stops me from doing the things that I want to do' item from the CASP-12 quality of life questionnaire; 1='often' or 'sometimes and 0='rarely' or 'never'.
5. Occupational pension cover is only asked of those who are employed (n=782).
6. PRSA pension cover is only asked of those who are not retired or employed (n=427).
7. Private pension cover is asked of all those who are not retired (n=1,212).
8. Expected income in retirement is derived by multiplying current individual weekly income by responses to the question 'Now thinking about your retirement, how much money do you think you will have to live on?

- More than my income now
- About the same as my income now
- Two thirds of my income now
- Half of my income now
- A third of my income now
- Less than a third of my income now'

This question is only asked of those who have not already retired (n=1,153).

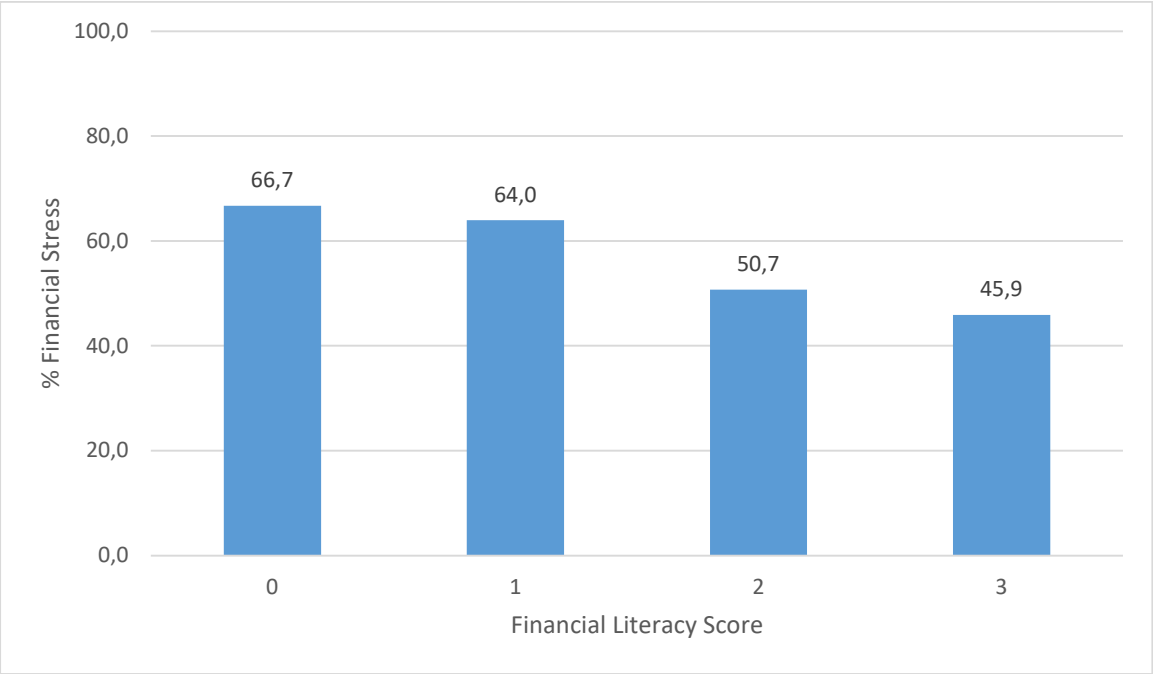
Table 4 Mean Wealth/Debt Values by Financial Literacy Score

	Financial Literacy Score			
	0	1	2	3
Net Financial Wealth	68,579	105,512	128,823	134,362
Net Housing Wealth	86,299	124,201	134,009	187,378
Total Net Wealth	154,724	229,712	262,785	321,631
Savings	14,174	17,460	27,302	38,589
Stocks	7,392	14,977	27,564	20,015
Investment Property	11,733	9,232	24,663	28,202
Other Assets	47,855	64,084	70,567	55,033
Cars	3,059	4,694	4,788	5,403
Non-Mortgage Debt	-7,993	-4,936	-24,253	-12,495
Mortgage Debt	-4,370	-5,697	-7,341	-20,080

Notes:

1. Sample weights are employed
2. All wealth variables are adjusted for household size and composition using the national equivalence scale (1 for the first adult, 0.66 for all other adults aged 14+, 0.33 for children under the age of 14).
3. For debt, higher negative values indicate higher values of debt.

Figure 1 Financial Stress by Financial Literacy Score



Notes:

1. Sample weights are employed
2. Financial stress is derived from the 'shortage of money stops me from doing the things that I want to do' item from the CASP-12 quality of life questionnaire; 1='often' or 'sometimes and 0='rarely' or 'never'.

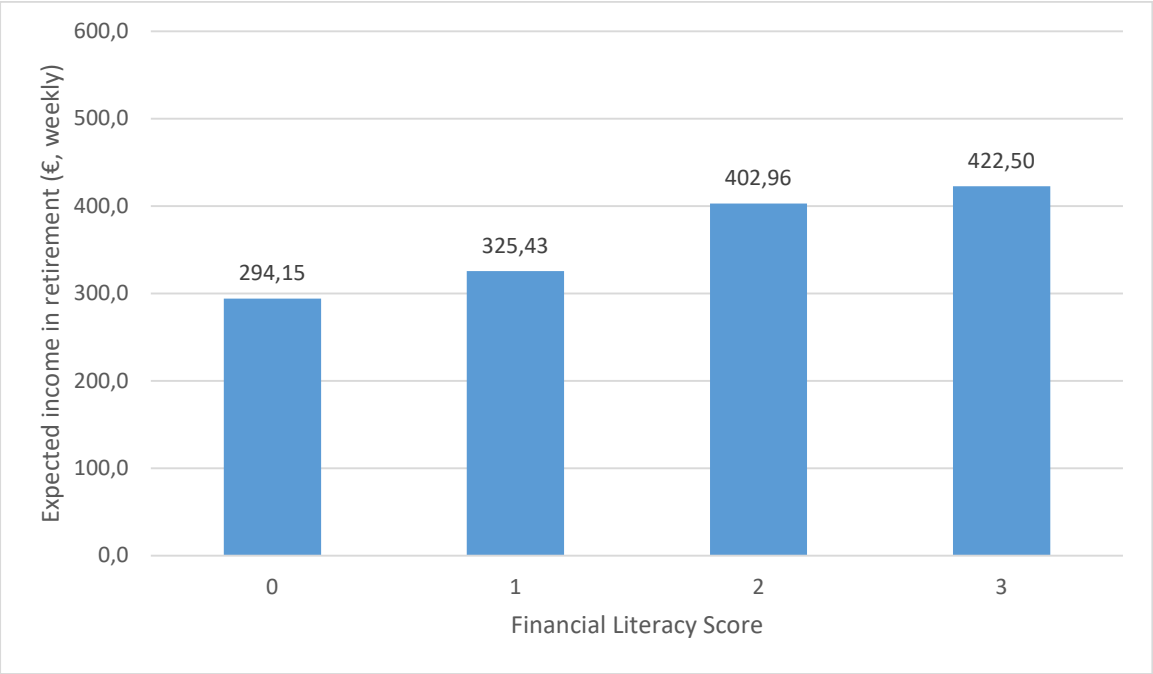
Table 5 Pension Cover Summary Statistics by Financial Literacy Score

	Financial Literacy Score			
	0	1	2	3
Occupational Pension	41.8	48.0	49.4	70.2
PRSA Pension	4.7	15.7	13.2	14.8
Private Pension	0.0	6.9	5.7	9.3

Notes:

1. Sample weights are employed
2. Occupational pension cover is only asked of those who are employed (n=782).
3. PRSA pension cover is only asked of those who are not retired or employed (n=427).
4. Private pension cover is asked of all those who are not retired (n=1,212).

Figure 2 Expected Income in Retirement by Financial Literacy Score



Notes:

1. Sample weights are employed
2. Expected income in retirement is derived by multiplying current individual weekly income by responses to the question 'Now thinking about your retirement, how much money do you think you will have to live on?
   - More than my income now
   - About the same as my income now
   - Two thirds of my income now
   - Half of my income now
   - A third of my income now
   - Less than a third of my income now'

   This question is only asked of those who have not already retired (n=1,153).

Table 6 Multivariate Models of Wealth Holdings (OLS Coefficients)

a) Net Financial, Housing and Total Wealth

	Net Financial Wealth		Net Housing Wealth		Total Net Wealth	
	(1)	(2)	(1)	(2)	(1)	(2)
Financial Literacy Score	0.367 (0.231)	0.134 (0.253)	0.379 (0.140)***	0.208 (0.147)	0.412 (0.140)***	0.346 (0.157)**
R^2	0.016	0.071	0.011	0.062	0.019	0.056
N	1,346	1,346	1,346	1,346	1,346	1,346

Notes:

1. Model (1) adjusts for financial literacy score, age and sex.
2. Model (2) adds controls for marital status, highest level of education, household equivalised income and household location. See Table A3a for the full set of results.
3. Standard errors are presented in parentheses.
4. p<0.10; ** p<0.05; *** p<0.01

b) Financial Wealth Components

	Savings		Stocks		Investment Property		Other Assets		Cars	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Financial Literacy Score	0.327 (0.139)**	0.054 (0.150)	0.561 (0.179)***	0.180 (0.196)	0.890 (0.168)***	0.579 (0.180)***	-0.080 (0.193)	-0.059 (0.197)	0.300 (0.121)**	0.066 (0.138)
R^2	0.027	0.080	0.019	0.089	0.023	0.117	0.016	0.217	0.007	0.066
N	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346

Notes:

1. Model (1) adjusts for financial literacy score, age and sex.
2. Model (2) adds controls for marital status, highest level of education, household equivalised income and household location. See Table A3b for the full set of results.
3. Standard errors are presented in parentheses.
4. p<0.10; ** p<0.05; *** p<0.01

c) Debt

	Non-Mortgage Debt		Mortgage Debt	
	(1)	(2)	(1)	(2)
Financial Literacy Score	-0.047 (0.164)	0.201 (0.185)	-0.569 (0.144)***	-0.389 (0.165)**
R^2	0.025	0.046	0.086	0.115
N	1,346	1,346	1,346	1,346

Notes:

1. Model (1) adjusts for financial literacy score, age and sex.
2. Model (2) adds controls for marital status, highest level of education, household equivalised income and household location. See Table A3c for the full set of results.
3. Standard errors are presented in parentheses.
4. p<0.10; ** p<0.05; *** p<0.01

Table 7 Multivariate Models of Financial Stress (Probit Coefficients)

	Financial Stress	
	(1)	(2)
Financial Literacy Score	-0.239 (0.051)***	-0.167 (0.056)***
(Pseudo) R^2	0.032	0.072
N	1,155	1,155

Notes:

1. Model (1) adjusts for financial literacy score, age and sex.
2. Model (2) adds controls for marital status, highest level of education, household equivalised income and household location. See Table A4 for the full set of results.
3. Standard errors are presented in parentheses.
4. p<0.10; ** p<0.05; *** p<0.01

Table 8 Multivariate Models of Pension Cover and Retirement Income Expectations (Probit/OLS Coefficients)

	Occupational Pension		PRSA Pension		Private Pension		Expected Retirement Income	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Financial Literacy Score	0.180 (0.059)***	0.053 (0.067)	-0.028 (0.104)	-0.143 (0.122)	0.101 (0.074)	0.110 (0.089)	0.167 (0.042)***	0.074 (0.040)*
(Pseudo) R^2	0.081	0.142	0.061	0.170	0.044	0.087	0.034	0.383
N	782	782	427	427	1,212	1,212	1,153	1,153

Notes:

1. Model (1) adjusts for financial literacy score, age and sex.
2. Model (2) adds controls for marital status, highest level of education, household equivalised income and household location. See Table A5 for the full set of results.
3. Standard errors are presented in parentheses.
4. p<0.10; ** p<0.05; *** p<0.01

Appendix

Table A1 Sample Characteristics

	(1) Pre-Retirement Sample Complete Case	(2) Pre-Retirement Sample Excluded Observations	(3) Full Wave 3 Sample
Financial literacy score	1.79 [1.75 – 1.86]	1.71 [1.64 – 1.77]	1.52 [1.50 – 1.55]
Male	55.2 [52.4 – 57.9]	54.1 [50.2 – 58.0]	48.2 [46.9 – 49.5]
Female	44.8 [42.1 – 47.5]	45.9 [42.0 – 49.8]	51.8 [50.5 – 53.1]
Age	61.0 [60.7 – 61.3]	61.5 [61.0 – 62.0]	67.4 [67.2 – 67.7]
Primary education	16.8 [14.8 – 18.9]	20.0 [16.8 – 23.1]	29.6 [28.5 – 30.8]
Secondary education	49.8 [47.0 – 52.6]	45.6 [41.7 – 49.6]	45.2 [43.9 – 46.4]
Third level education	34.4 [30.7 – 38.1]	34.4 [30.6 – 38.1]	25.2 [24.1 – 26.3]
Married	73.9 [71.4 – 76.3]	82.7 [79.8 – 85.7]	63.6 [62.4 – 64.8]
Never married	12.1 [10.3 – 13.9]	7.5 [5.4 – 9.5]	12.0 [11.2 – 12.9]

Separated/divorced	8.6 [7.1 – 10.4]	6.1 [4.3 – 8.0]	8.5 [7.8 – 9.2]
Widowed	5.4 [4.2 – 6.7]	3.6 [2.1 – 5.1]	15.9 [14.9 – 16.8]
Retired	9.2 [7.7 – 10.9]	8.5 [6.3 – 10.7]	47.2 [46.0 – 48.5]
Employed	59.6 [56.9 – 62.3]	49.0 [45.1 – 52.9]	20.2 [19.2 – 21.2]
Self-employed	22.7 [20.4 – 25.0]	32.8 [29.2 – 36.5]	10.5 [9.7 – 11.3]
Other employment status	8.4 [6.8 – 9.9]	9.6 [7.3 – 11.9]	22.1 [21.0 – 23.1]
Number of employed/self-employed respondents	1.2 [1.1 – 1.2]	1.2 [1.2 – 1.2]	0.4 [0.4 – 0.5]
Household size	2.5 [2.4 – 2.6]	2.6 [2.5 – 2.6]	2.1 [2.1 – 2.1]
Cognitive score	29.0 [28.9 – 29.0]	28.9 [28.8 – 29.0]	28.3 [28.2 – 28.3]
Total household equivalised income	572.2 [540.0 – 604.5]	485.5 [437.0 – 534.1]	432.4 [414.1 – 450.6]
Dublin	26.3 [23.8 – 28.7]	19.6 [16.5 – 22.7]	25.4 [24.3 – 26.5]

Other urban area	26.5 [24.0 – 28.9]	23.8 [20.5 – 27.2]	30.9 [29.7 – 32.1]
Rural area	47.2 [44.5 – 50.0]	56.6 [52.7 – 60.4]	43.7 [42.4 – 44.9]
N	1,346	681	6,294

Notes:

1. Sample weights are employed
2. 95 per cent confidence intervals are presented in parentheses

Table A2 OLS Model of Financial Literacy Score

	Financial Literacy Score
Male	ref.
Female	-0.330
	(0.042)***
Age	0.029
	(0.042)
Age^2	-0.000
	(0.000)
Married	ref.
Never married	-0.074
	(0.070)
Separated/divorced	-0.053
	(0.084)
Widowed	-0.054
	(0.093)
Primary education	-0.541
	(0.064)***
Secondary education	-0.246
	(0.044)***
Third level education	ref.
Retired	0.039
	(0.066)
Employed	ref.
Self-employed	0.087
	(0.053)*
Other employment status	-0.021
	(0.073)
Cognitive score	0.200
	(0.015)***
Equivalised household income	0.000
	(0.000)
Dublin	ref.
Other Urban area	-0.172
	(0.058)***
Rural area	-0.132
	(0.052)**
R^2	0.25
N	1,346

Notes:

1. Standard errors are presented in parentheses.
2. p<0.1; ** p<0.05; *** p<0.01

Table A3a OLS Models of Net Financial, Housing and Total Wealth

	Net Financial Wealth	Net Housing Wealth	Net Total Wealth
Financial literacy score	0.134	0.208	0.346
	(0.253)	(0.147)	(0.157)**
Age	0.754	0.146	0.300
	(0.430)*	(0.207)	(0.185)
Age^2	-0.005	-0.001	-0.002
	(0.003)	(0.002)	(0.001)
Male	ref.	ref.	ref.
Female	0.511	0.337	0.330
	(0.278)*	(0.189)*	(0.173)*
Married	ref.	ref.	ref.
Never married	0.081	-1.235	-0.211
	(0.548)	(0.506)**	(0.383)
Separated/divorced	-1.786	-1.700	-0.960
	(0.766)**	(0.572)***	(0.507)*
Widowed	0.601	-0.289	0.260
	(0.536)	(0.423)	(0.270)
Primary education	-0.931	-0.438	-0.672
	(0.564)*	(0.345)	(0.333)**
Secondary education	0.134	0.099	-0.133
	(0.359)	(0.227)	(0.214)
Third level education	ref.	ref.	ref.
Retired	0.498	-0.200	-0.259
	(0.460)	(0.331)	(0.310)
Employed	ref.	ref.	ref.
Self-employed	1.683	0.614	0.461
	(0.410)***	(0.240)**	(0.274)*
Other employment status	-0.216	0.438	-0.101
	(0.624)	(0.225)*	(0.359)
Cognitive score	0.096	0.051	-0.057
	(0.142)	(0.087)	(0.074)
Equivalised household income	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)**
Dublin	ref.	ref.	ref.
Other urban area	1.042	-0.221	0.247
	(0.601)*	(0.430)	(0.460)
Rural area	1.918	0.380	1.044
	(0.540)***	(0.339)	(0.401)***
R^2	0.07	0.06	0.06
N	1,346	1,346	1,346

Notes:

1. Standard errors are presented in parentheses.
2. p<0.1; ** p<0.05; *** p<0.01

Table A3b OLS Models of Financial Wealth Components

	Savings	Stocks	Investment Property	Other Assets	Cars
Financial literacy score	0.054	0.180	0.579	-0.059	0.066
	(0.150)	(0.196)	(0.180)***	(0.197)	(0.138)
Age	0.557	-0.193	-0.069	0.325	-0.296
	(0.240)**	(0.293)	(0.358)	(0.369)	(0.197)
Age^2	-0.004	0.001	0.000	-0.002	0.002
	(0.002)**	(0.002)	(0.003)	(0.003)	(0.001)
Male	ref.	ref.	ref.	ref.	ref.
Female	0.197	-0.245	0.473	0.374	0.075
	(0.171)	(0.237)	(0.213)**	(0.249)	(0.159)
Married	ref.	ref.	ref.	ref.	ref.
Never married	0.626	-1.215	-1.094	-0.271	-0.914
	(0.358)*	(0.448)***	(0.421)***	(0.506)	(0.383)**
Separated/divorced	-0.414	-0.674	-1.846	-1.831	-1.495
	(0.383)	(0.518)	(0.367)***	(0.427)***	(0.413)***
Widowed	0.472	-0.570	-0.936	-0.432	-0.731
	(0.389)	(0.563)	(0.522)*	(0.660)	(0.463)
Primary education	-0.894	-1.434	-0.471	-0.535	-0.732
	(0.351)**	(0.415)***	(0.388)	(0.484)	(0.323)**
Secondary education	-0.170	-0.181	-0.384	-0.573	-0.381
	(0.235)	(0.332)	(0.302)	(0.332)*	(0.190)**
Third level education	ref.	ref.	ref.	ref.	ref.
Retired	0.058	0.744	0.398	0.312	0.473
	(0.316)	(0.449)*	(0.429)	(0.478)	(0.260)*
Employed	ref.	ref.	ref.	ref.	ref.
Self-employed	-0.025	1.675	0.826	3.728	0.714
	(0.275)	(0.379)***	(0.348)**	(0.417)***	(0.240)***
Other employment status	-0.568	0.659	0.015	1.758	0.125
	(0.358)	(0.463)	(0.398)	(0.514)***	(0.267)
Cognitive score	0.016	-0.037	-0.140	-0.081	0.037
	(0.083)	(0.109)	(0.099)	(0.120)	(0.075)
Equivalised household income	0.001	0.002	0.002	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)**	(0.000)***
Dublin	ref.	ref.	ref.	ref.	ref.
Other urban area	-0.300	0.404	-0.809	-0.017	0.196
	(0.334)	(0.484)	(0.475)*	(0.387)	(0.285)
Rural area	-0.532	-0.085	-0.974	3.533	0.310
	(0.313)*	(0.419)	(0.415)**	(0.407)***	(0.257)
R^2	0.08	0.09	0.12	0.22	0.07
N	1,346	1,346	1,346	1,346	1,346

Notes:

1. Standard errors are presented in parentheses.
2. p<0.1; ** p<0.05; *** p<0.01

Table A3c OLS Models of Debt

	Non-mortgage debt	Mortgage debt
Financial literacy score	0.201	-0.389
	(0.185)	(0.165)**
Age	0.431	1.156
	(0.282)	(0.228)***
Age^2	-0.002	-0.007
	(0.002)	(0.002)***
Male	ref.	ref.
Female	0.405	0.931
	(0.214)*	(0.205)***
Married	ref.	ref.
Never married	1.578	0.868
	(0.415)***	(0.368)**
Separated/divorced	0.810	-0.991
	(0.498)	(0.509)*
Widowed	0.914	0.189
	(0.514)*	(0.432)
Primary education	0.718	0.137
	(0.426)*	(0.395)
Secondary education	0.503	0.613
	(0.309)	(0.291)**
Third level education	ref.	ref.
Retired	0.419	-0.006
	(0.400)	(0.361)
Employed	ref.	ref.
Self-employed	-0.115	-0.183
	(0.346)	(0.311)
Other employment status	0.078	-0.873
	(0.438)	(0.409)**
Cognitive score	-0.012	-0.037
	(0.105)	(0.090)
Equivalised household income	-0.000	-0.000
	(0.000)	(0.000)
Dublin	ref.	ref.
Other urban area	0.593	-0.424
	(0.453)	(0.432)
Rural area	0.696	0.457
	(0.409)*	(0.358)
R^2	0.05	0.12
N	1,346	1,346

Notes:

1. Standard errors are presented in parentheses.
2. p<0.1; ** p<0.05; *** p<0.01

Table A4 Probit Models of Financial Stress

	Financial Stress
Financial literacy score	-0.167
	(0.056)***
Age	0.133
	(0.095)
Age^2	-0.001
	(0.001)*
Male	ref.
Female	-0.168
	(0.081)**
Married	ref.
Never married	-0.062
	(0.139)
Separated/divorced	0.388
	(0.161)**
Widowed	-0.042
	(0.179)
Primary education	0.003
	(0.135)
Secondary education	-0.065
	(0.089)
Third level education	ref.
Retired	0.021
	(0.131)
Employed	ref.
Self-employed	-0.220
	(0.106)**
Other employment status	0.192
	(0.139)
Cognitive score	-0.043
	(0.036)
Equivalised household income	-0.001
	(0.000)***
Dublin	ref.
Other urban area	0.136
	(0.119)
Rural area	0.076
	(0.102)
N	1,155

Notes:
1. Standard errors are presented in parentheses.
2. p<0.1; ** p<0.05; *** p<0.01

Table A5 Probit/OLS Models of Pension Cover and Retirement Income Expectations

	Occupational Pension	PRSA Pension	Private Pension	Retirement Income Expectations
Financial literacy score	0.053	-0.143	0.110	0.074
	(0.067)	(0.122)	(0.089)	(0.040)*
Age	0.097	0.061	0.745	-0.074
	(0.343)	(0.254)	(0.314)**	(0.052)
Age^2	-0.001	-0.001	-0.006	0.001
	(0.003)	(0.002)	(0.003)**	(0.000)*
Male	ref.	ref.	ref.	ref.
Female	-0.431	-0.335	-0.289	-0.135
	(0.105)***	(0.228)	(0.121)**	(0.054)**
Married	ref.	ref.	ref.	ref.
Never married	-0.040	0.140	0.503	0.102
	(0.169)	(0.255)	(0.169)***	(0.084)
Separated/divorced	-0.148	0.605	-0.232	-0.084
	(0.158)	(0.371)	(0.277)	(0.109)
Widowed	0.154	0.423	0.127	-0.081
	(0.209)	(0.345)	(0.261)	(0.115)
Primary education	-0.580	-0.267	-0.310	-0.119
	(0.189)***	(0.282)	(0.211)	(0.105)
Secondary education	-0.496	-0.150	-0.037	-0.080
	(0.106)***	(0.214)	(0.135)	(0.066)
Third level education	ref.	ref.	ref.	ref.
Retired	-	-	-	-
Employed		-	ref.	ref.
Self-employed		1.180	0.309	-0.279
		(0.297)***	(0.139)**	(0.092)***
Other employment status		ref.	-0.224	0.156
			(0.250)	(0.103)
Cognitive score	-0.027	-0.032	-0.068	-0.041
	(0.045)	(0.074)	(0.053)	(0.019)**
Equivalised household income	0.000	0.000	0.000	0.001
	(0.000)**	(0.000)*	(0.000)**	(0.000)***
Dublin	ref.	ref.	ref.	ref.
Other urban area	-0.087	-0.029	0.039	0.176
	(0.131)	(0.279)	(0.186)	(0.091)*
Rural area	-0.301	-0.347	0.165	0.230
	(0.116)***	(0.233)	(0.152)	(0.089)**
N	782	427	1,212	1,153

Notes:

1. Standard errors are presented in parentheses.
2. p<0.1; ** p<0.05; *** p<0.01

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