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Financial Literacy and Stock Market Participation

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September 2007

Abstract
Individuals are increasingly put in charge of their financial security after retirement. Moreover, the supply of complex financial products has increased considerably over the years. However, we still have little or no information about whether individuals have the financial knowledge and skills to navigate this new financial environment. To better understand financial literacy and its relation to financial decision-making, we have devised two special modules for the DNB Household Survey. We have designed questions to measure numeracy and basic knowledge related to the working of inflation and interest rates, as well as questions to measure more advanced financial knowledge related to financial market instruments (stocks, bonds, and mutual funds). We evaluate the importance of financial literacy by studying its relation to the stock market: Are more financially knowledgeable individuals more likely to hold stocks? To assess the direction of causality, we make use of questions measuring financial knowledge before investing in the stock market. We find that, while the understanding of basic economic concepts related to inflation and interest rate compounding is far from perfect, it outperforms the limited knowledge of stocks and bonds, the concept of risk diversification, and the working of financial markets. We also find that the measurement of financial literacy is very sensitive to the wording of survey questions. This provides additional evidence for limited financial knowledge. Finally, we report evidence of an independent effect of financial literacy on stock market participation: Those who have low financial literacy are significantly less likely to invest in stocks.

1. Introduction

Individuals have become increasingly active in financial markets, and market participation has been accompanied or even promoted by the advent of new financial products and services. However, some of these products are complex and difficult to grasp, especially for financially unsophisticated investors. At the same time, market liberalization and structural reforms in Social Security and pensions have caused an ongoing shift in decision power away from the government and employers toward private individuals. Thus, individuals have to assume more responsibility for their own financial well-being.

Are individuals well-equipped to make financial decisions? Do they possess adequate financial literacy and knowledge? There has been little research on this topic and the few existing studies indicate that financial illiteracy is widespread and individuals lack knowledge of even the most basic economic principles (Lusardi and Mitchell (2006, 2007a), National Council on Economic Education (NCEE, 2005), and Hilgert, Hogarth and Beverly (2003)). At the same time, there are concerns that households are not saving enough for retirement, are accumulating excessive debt, and are not taking advantage of financial innovation (Lusardi and Mitchell (2007b) and Campbell (2006)). The existing studies have also shown that those who are not financially literate are less likely to plan for retirement and to accumulate wealth (Lusardi and Mitchell (2006, 2007a)), and are more likely to take up high-interest mortgages (Moore (2003)).

To measure financial literacy and assess its relationship with financial decision-making, we have devised two special modules for the DNB Household Survey (DHS), a panel data set covering a representative sample of the Dutch population and providing information on savings and portfolio choice. We have designed an extensive list of questions aimed at measuring and differentiating among different levels of literacy and financial sophistication. These questions can be linked to a rich set of data on demographic characteristics and wealth holdings. Our data show that the majority of households display basic financial knowledge and have some grasp of concepts such as interest compounding, inflation, and the time value of money. However, very few go beyond these basic concepts; many households do not know the difference between bonds and stocks, the relationship between bond prices and interest rates, and the basics of risk diversification. Most important, we find that financial literacy affects financial decision-making: Those with low literacy are more likely to rely on family and friends as their main source of financial advice and are less likely to invest in stocks.

This paper makes three contributions to the existing literature. First, we develop two indices of financial literacy and knowledge, which allow us to differentiate among different

levels of financial sophistication. Adding this information to existing data sets can substantially enhance the studies on saving and portfolio choice. Second, we contribute to the methodology of measuring financial knowledge. There is a lot of noise in the responses to financial literacy questions and we show that the wording of the questions is critically important for measuring financial knowledge. Third, we provide a contribution toward solving the so-called "stock-holding" puzzle, i.e., the fact that many households do not hold stocks (Campbell (2006), Haliassos and Bertaut (1995)). We show that many families shy away from the stock market because they have little knowledge of stocks, the working of the stock market, and asset pricing. To address the direction of causality between literacy and stock market participation, we designed questions to measure not only current levels of literacy but also levels of literacy in the past. Moreover, we designed questions to measure cognitive ability in an attempt to disentangle the effects of knowledge from talents and skills.

Our findings have important policy implications. First, we show that financial literacy should not be taken for granted. A majority of households possesses limited financial literacy. Second, financial literacy differs substantially depending on education, age and gender. This suggests that financial education programs are likely to be more effective when targeted to specific groups of the population. Finally, any privatization programs should take into account that, when put in charge of investing for their retirement, financially unsophisticated individuals may not invest in the stock market. Thus, to work effectively, privatization programs need to be accompanied by well-designed financial education programs.

This paper is organized as follows: In section 2, we provide a review of the current literature on financial literacy and stock market participation. In section 3, we describe our data set. In section 4, we introduce our measures of financial literacy and describe the problems of measuring literacy. In section 5, we report the results of our empirical work. In section 6, we discuss our results and provide several extensions. In section 7, we conclude and examine areas for future research.

2. Literature review

There exist very few surveys that provide information on both financial literacy and variables related to financial decision-making (for example saving, portfolio choice, and retirement planning). To remedy this lack of data, Lusardi and Mitchell (2006) devised a module on financial literacy for the 2004 US Health and Retirement Study (HRS). Their questions aimed to test basic financial knowledge related to the working of interest compounding, the effects of inflation, and risk diversification. They found that financial

illiteracy is widespread and particularly acute among specific groups of the population, such as women, the elderly, and those with low education. These results are surprising not only because the literacy questions were rather simple and basic, but also because their sample was composed of respondents who are 50 or older. Most respondents in that age group have checking accounts, credit cards, and have taken out one or two mortgages. However, similar results are found in the work by Hilgert and Hogarth (2002), which examines financial literacy in a sample covering all age groups, and on surveys by the National Council on Economic Education (NCEE), that cover financial literacy among high school students and the adult population. Findings of widespread illiteracy are also reported in studies on smaller samples or specific groups of the population (Agnew and Szykman (2005), Bernheim (1995, 1998), Mandell (2004), and Moore (2003)).

While these studies focus on data from the US, surveys from other countries show very similar results. A study by the OECD (2005) and work by Lusardi and Mitchell (2007b) review the evidence on financial literacy across countries and show that financial illiteracy is a common feature in many other developed countries, including European countries, Australia, and Japan. These findings are echoed in the work of Christelis, Jappelli and Padula (2007), which uses data very similar to the US HRS, and finds that most respondents in Europe score low on numeracy scales.

Financial illiteracy has implications for household behavior. Bernheim (1995, 1998) was the first to point out not only that most households cannot perform very simple calculations and lack basic financial knowledge, but also that the saving behavior of many households is dominated by crude rules of thumb. In more recent works, Bernheim, Garrett and Maki (2001) and Bernheim and Garrett (2003) show that those who were exposed to financial education in high school or in the workplace save more. Similarly, Lusardi and Mitchell (2006, 2007a) show that those who display low literacy are less likely to plan for retirement and, as a result, accumulate much less wealth (see also Hilgert, Hogarth and Beverly (2003)). This finding is confirmed in the work by Stango and Zinman (2007), which shows that those who are not able to correctly calculate interest rates out of a stream of payments end up borrowing more and accumulating lower amounts of wealth. Agarwal, Driscoll, Gabaix and Laibson (2007) further show that financial mistakes are prevalent among the young and elderly, who are those displaying the lowest amount of financial knowledge.

The measures of financial literacy used in existing studies are often crude. For example, Lusardi and Mitchell (2006, 2007a) rely on only three questions to measure financial literacy, and Stango and Zinman (2007) rely on one question. Moreover, the surveys

that provide more extensive information about financial literacy often have little or no data on wealth, saving, or other important economic outcomes (see, for example, the NCEE survey). In this paper, we overcome the problems with some of the previous studies by providing comprehensive measures of financial literacy as well as providing an evaluation of the quality of the literacy data. In addition, we link financial literacy with an important economic outcome: participation in the stock market. While extensive research on this topic exists, it is still a "puzzle" why so many households do not hold stocks (Campbell (2006)). Some have argued that short sale constraints, income risk, inertia, and departures from expected utility maximization may explain why so few households hold stocks (Haliassos and Bertaut (1995)), but it has proven hard to account for all these factors in available micro data sets. Others have argued that young people cannot borrow and thus do not have wealth to invest in stocks (Constantinides, Donaldson and Mehra (2002)). These life-cycle considerations and the wedge between borrowing and lending rates can provide some explanation for lack of stock ownership (Davis, Kubler and Willen (2006)), but even these reasons cannot fully explain why such a large proportion of families do not hold stocks. More recent papers have incorporated other reasons, such as trust and culture (Guiso, Sapienza and Zingales (2005)), and the influence of neighbors and peers (Hong, Kubik and Stein (2004), and Brown, Ivkovich, Smith, and Weisbenner (2007)). Yet other authors have started to consider limited numeracy and cognitive ability (Christelis, Jappelli and Padula (2007)), lack of asset awareness (Guiso and Jappelli (2005)), and lack of financial sophistication (Kimball and Shumway (2006)). Our work improves substantially upon these studies by considering more refined indices of financial literacy and financial sophistication that we have explicitly designed for a survey of Dutch households. Moreover, to better understand the relationship between financial literacy and stock market participation, we have designed questions to measure economic knowledge before entering the stock market.

3. Data

We use data from the 2005 DNB Household Survey (DHS). DHS is an annual household survey covering information about demographic and economic characteristics and focusing on wealth and saving data. The panel is run by CentERdata, a survey research institute at Tilburg University that specializes in internet surveys.[1] The data set is representative of the Dutch population, and it contains over 2,000 households.

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[1] http://www.uvt.nl/centerdata/en/. See Nyhus (1996) for a detailed description of this survey and an assessment of the quality of the data.

In addition to using data from the main core of the DHS, we also use data from two modules we designed, which were added to the survey in 2005 and 2006. The first financial literacy module was in the field from September 23 until September 27, 2005 and was repeated a week later for those who did not respond during that time. A total of 1,508 out of 2,028 households completed the financial literacy module, implying a response rate of 74.4% (in line with the response rate from the main survey). A second module was fielded in January 2006, and 1,373 out of the original 1,508 respondents completed that module. The respondent to the financial literacy questions is the member of the household in charge of household finances.

Survey participants are interviewed via the internet. Although the internet connection rate in the Netherlands is one of the highest in Europe (80% of Dutch households are connected to the internet at their home), households need not have an internet connection to participate in the survey. Recruitment and selection of households is first done by phone with a randomly selected sample of households. Households without an internet connection are provided with a connection or with a set-top box for their television (for those who do not have access to a personal computer). This method of data collection presents several advantages. For example, data collected with internet surveys suffer less from reporting biases than those collected via telephone interviews (Chang and Krosnick (2003)).

The age of the respondents in our sample varies from 22 to 90 (mean age is 49.6); 51.5% of respondents are male; 34.5% have a college education (which includes vocational training in addition to university degrees). In regards to household composition, 56.8% of respondents are married or living together with a partner, and one third have children living at home. Overall, 18.4% of respondents are retired (including early retirees), 10.8 % are disabled or unemployed, and 4.4% are self-employed.[2]

4. The measurement of literacy

As mentioned before, we designed two modules to measure and evaluate financial literacy. The financial literacy questions are composed of two parts. The first set of questions aims to assess basic financial literacy. These questions cover topics ranging from the working of interest rates and interest compounding to the effect of inflation, discounting and nominal versus real values. The second set of questions aims to measure more advanced financial knowledge and covers topics such as the difference between stocks and bonds, the function of

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[2] Throughout our empirical analysis, we always use household weights to ensure that our statistics are representative of the population.

the stock market, the working of risk diversification, and the relationship between bond prices and interest rates. These questions were designed using similar modules in the HRS and a variety of other surveys on financial literacy. However, a few questions are unique to our module on literacy.[3] Households are instructed to answer the questions without consulting additional information or using a calculator.[4]

The exact wording of the questions measuring basic financial literacy is reported below in Box 1:

Box 1. Basic Literacy Questions

1) Numeracy
Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? (i) More than €102; (ii) Exactly €102; (iii) Less than €102; (iv) Do not know; (v) Refusal.

2) Interest compounding
Suppose you had €100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total? (i) More than €200; (ii) Exactly €200; (iii) Less than €200; (iv) Do not know; (v) Refusal.

3) Inflation
Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? (i) More than today; (ii) Exactly the same; (iii) Less than today; (iv) Do not know; (v) Refusal.

4) Time value of money
Assume a friend inherits €10,000 today and his sibling inherits €10,000 3 years from now. Who is richer because of the inheritance? (i) My friend; (ii) His sibling; (iii) They are equally rich; (iv) Do not know; (v) Refusal.

5) Money illusion
Suppose that in the year 2010, your income has doubled and prices of all goods have doubled too. In 2010, how much will you be able to buy with your income? (i) More than today; (ii) The same; (iii) Less than today; (iv) Do not know; (v) Refusal.

These questions measure the ability to perform simple calculations (in the first question), the understanding of how compound interest works (second question), and the effect of inflation (third question). We also designed questions to assess the knowledge of

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[3] For an analysis of the module on financial literacy in the 2004 HRS, see Lusardi and Mitchell (2006). For a review of financial literacy surveys across countries, see Lusardi and Mitchell (2007b).
[4] This facilitates the comparison with other surveys, which are normally done via telephone. Moreover, this procedure better enables researchers to assess what respondents know.

time discounting (fourth question) and whether respondents suffer from money illusion (fifth question). These concepts lie at the basis of basic financial transactions, financial planning, and day-to-day financial decision-making.

Responses to these questions are reported in Table 1A. Most respondents answer the first question correctly, where the percentage of incorrect responses is only 5.2%. However, the proportion of correct answers decreases considerably, to a little more than 70%, when we consider questions on interest compounding, time discounting, and money illusion; the proportion of incorrect answers on questions measuring the time value of money or money illusion is around 24%. Note also that, while many respondents answer each individual question correctly, the proportion of respondents who answered all five questions correctly is only 40.2% (Table 1B). Thus, while many respondents display knowledge of a few financial concepts, basic financial literacy is not widespread.

To be able to classify respondents according to different levels of financial sophistication, we added several other questions to the module. The exact wording of these questions is reported below:[5]

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[5] Because we could not perform a pilot study to assess how respondents perform on these questions and how well they understood them, we use the wording of questions from other existing surveys (with some modifications to reflect the characteristics of the Dutch financial system and the behaviour of Dutch financial markets). Specifically, we took question 6 from the National Council of Economic Education Survey, questions 7 and 9 from the NASD Investor Knowledge Quiz, question 15 from the 2004 Health and Retirement Study module on financial literacy, questions 8, 10, 11, 12, 13, 14 and 16 from the Survey of Financial Literacy in Washington State, the Survey of Consumers, and the John Hancock Financial Services Defined Contribution Plan Survey. We took the questions that best reflect financial sophistication related to financial instruments and the working of the stock market. As explained later, we have also experimented with the wording of some of these questions.

Box 2. Advanced Literacy Questions

6) *Which of the following statements describes the main function of the stock market?* (i) The stock market helps to predict stock earnings; (ii) The stock market results in an increase in the price of stocks; (iii)The stock market brings people who want to buy stocks together with those who want to sell stocks; (iv) None of the above; (v) Do not know; (vi) Refusal.

7) *Which of the following statements is correct? If somebody buys the stock of firm B in the stock market:* (i) He owns a part of firm B; (ii) He has lent money to firm B; (iii) He is liable for firm B's debts; (iv) None of the above; (v) Do not know; (vi) Refusal.

8) *Which of the following statements is correct?* (i) Once one invests in a mutual fund, one cannot withdraw the money in the first year; (ii) Mutual funds can invest in several assets, for example invest in both stocks and bonds; (iii) Mutual funds pay a guaranteed rate of return which depends on their past performance; (iv) None of the above; (v) Do not know; (vi) Refusal.

9) *Which of the following statements is correct? If somebody buys a bond of firm B*: (i) He owns a part of firm B; (ii) He has lent money to firm B; (iii) He is liable for firm B's debts; (iv) None of the above; (v) Do not know; (vi) Refusal.

10) *Considering a long time period (for example 10 or 20 years), which asset normally gives the highest return*? (i) Savings accounts; (ii) Bonds; (iii) Stocks; (iv) Do not know; (vi) Refusal.

11*) Normally, which asset displays the highest fluctuations over time*? (i) Savings accounts; (ii) Bonds; (iii) Stocks; (iv) Do not know; (v) Refusal.

12) *When an investor spreads his money among different assets, does the risk of losing money:* (i) Increase; (ii) Decrease; (iii) Stay the same; (iv) Do not know; (v) Refusal.

13) *If you buy a 10-year bond, it means you cannot sell it after 5 years without incurring a major penalty. True or false*? (i) True; (ii) False); (iii) Do not know; (iv) Refusal.

(14) *Stocks are normally riskier than bonds*. True or false? (i) True; (ii) False; (iii) Do not know; (iv) Refusal.

(15) *Buying a company stock usually provides a safer return than a stock mutual fund. True or false?* (i) True; (ii) False; (iii) Do not know; (iv) Refusal.

(16) *If the interest rate falls, what should happen to bond prices*? (i) Rise; (ii) Fall; (iii) Stay the same; (iv) None of the above; (v) Do not know; (vi) Refusal.

Clearly, these are much more complex questions than the previous set. The purpose of these questions is to measure more advanced financial knowledge related to investment and portfolio choice. Specifically, these questions were devised to assess knowledge of financial assets, such as stocks, bonds and mutual funds, the returns and riskiness of different assets, as well as the working of the stock market. Moreover, we attempt to measure whether

respondents understand the concept of risk diversification (which was asked in two separate questions), the working of mutual funds, and the relationship between bond prices and interest rates.

Reponses to these questions are reported in Table 2A. The pattern of answers is much different than in the previous set of questions. For example, he proportion of correct answers on each question is much lower; only a quarter of respondents know about bond pricing and only 30% know how long-term bonds work. Respondents also display difficulties in grasping the concept of risk diversification: Less than 50% of respondents know that a stock mutual fund is safer than a company stock. Not only do a sizable proportion of respondents answer these questions incorrectly, but also many respondents state they do not know the answers to these questions. For example, while 30% of respondents are incorrect about which asset (among savings accounts, bonds and stocks) gives the highest return over a long time period, an additional 22% do not know the answer to this question. Similarly, more than 37% are incorrect about the relationship between bond prices and interest rates and the same high percentage (37.5%) state they do not know the answer to that question. Many respondents are incorrect or do not know the definition of stocks, bonds, and the working of mutual funds. Table 2B shows that only a tiny fraction of respondents (5%) are able to answer all the advanced literacy questions correctly, while the fraction of incorrect responses or "do not know" answers on several questions is sizable. These are important findings; most models of portfolio choice assume that investors are knowledgeable and well-informed. Instead, the findings in Tables 1A, 1B, 2A, and 2B show that financial literacy should not be taken for granted. These findings echo the results found in US surveys, such as the HRS and the Survey of Consumers (see Lusardi and Mitchell (2006) and Hilgert, Hogarth and Beverly (2003)).

When lack of financial knowledge is so widespread, one has to worry about whether respondents even understood the meaning of the questions, and the prevalence of guessing and random answers. To assess the relevance of these problems, we used the following strategy: We inverted the wording of questions and exposed two randomly chosen groups of respondents to the same question but with a different wording. We did so for three types of questions: A simple question about the riskiness of bonds versus stocks, a more difficult question about the riskiness of a company stock versus a stock mutual fund, and an even more complex question on the effect of interest rate changes on bond prices. This allows us to assess how incorrect and perhaps random answers are connected to the difficulty of the questions. The precise wording of the questions is reported below:

(14a) *Stocks* are normally riskier than *bonds*. True or false?
(14b) *Bonds* are normally riskier than *stocks*. True or false?

(15a) Buying a *company stock* usually provides a safer return than a *stock mutual fund*. True or false?
(15b) Buying a *stock mutual fund* usually provides a safer return than a *company stock*. True or false?

(16a) If the interest rate *falls*, what should happen to bond prices? Rise/fall/stay the same/none of the above?
(16b) If the interest rate *rises*, what should happen to bond prices? Rise/fall/stay the same/none of the above?

The pattern of responses in Table 3 shows that the wording of the question matters, particularly for the difficult questions. When comparing the response to a simple question on the riskiness of stocks versus bonds, we find that respondents give rather similar answers regardless of the wording of the question (differences are not significant at the 5% level of significance). However, this is not the case for complex questions. The pattern of answers changes dramatically when the order of the wording was inverted. For example, the number of correct answers doubles when respondents are asked whether "buying a company stock usually provides a safer return than a stock mutual fund" versus the same question with the inverted order: "buying a stock mutual fund provides a safer return than a company stock." Note that this is not the result of following a crude rule of thumb, such as picking the first answer as the correct one. This would lead to a lower rather than higher percentage of correct answers for question (15a).[6] This finding provides evidence that respondents often do not understand the question or do not know what stocks, bonds, and mutual funds are, and some correct answers are simply the result of guessing. It also shows that answers to advanced financial literacy questions should not be taken at face value and the empirical work should take into account that these measures are often noisy proxies of the true level of financial knowledge. We will address these issues in the empirical work.

4.1 Indices of financial literacy

We summarize all of the information about financial literacy resulting from our two sets of questions into a financial literacy index. We first combine the information we have available by performing a factor analysis on the sixteen questions in the financial literacy module. Consistent with the way we have devised the financial literacy questions, the factor

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[6] It is consistent, however, with another rule of thumb that was mentioned to us about the behaviour of students. They tend to reply "false" to a true-false question when they are not sure about the answer.

analysis indicates there are two main factors with different loading on two types of questions: The simple literacy questions (first 5 questions) and the more advanced literacy questions (remaining 11 questions). We decided therefore to split the set of questions into two groups and perform a factor analysis on the two sets separately. In this way, we can construct two types of literacy indices: a first literacy index potentially related to basic knowledge (note that there are no questions in this set about the stock market or about stocks and bonds) and a second index measuring more advanced financial knowledge as well as knowledge related to stocks, the stock market and other financial instruments. In constructing the indices, we explicitly take into account the differences between "incorrect" answers and "do not know" answers. As already reported in Lusardi and Mitchell (2006), it is important to exploit this information to differentiate among degrees of financial knowledge. Details about the factor analysis are reported in Appendix A.

To confirm the validity of these two indices and their features, we report the distribution of the financial literacy indices across demographic variables such as education, age, and gender in Tables 4A and 4B. As expected, basic financial literacy increases strongly with education. Those with the lowest level of basic financial literacy are concentrated on the lowest education categories: primary and preparatory intermediate vocational schools. Conversely, those with a higher vocational education (similar to a college degree in the US) or a university education locate in the highest quartiles of the basic literacy index. The profile of basic literacy has a hump-shape with regards to age, although not very pronounced. Even though in a single cross-section we cannot distinguish between age and cohort effects, this finding is similar to what is reported in Agarwal, Driscoll, Gabaix and Laibson (2007). Table 4A also shows there are large differences in basic literacy between gender: Women display much lower basic knowledge than men. These findings are similar to those reported by Lusardi and Mitchell (2006) and the findings in other literacy surveys (Lusardi and Mitchell, 2007b).

Considering more advanced financial knowledge in Table 4B, again we find a strong relationship with education. A large fraction (48.3%) of respondents with primary education is at the lowest level of literacy (first quartile). As we move to higher quartiles of level of literacy, the proportion of respondents with high levels of education increases, but even when we consider those with a university degree, only 43.4%% of them are at the top quartile of advanced literacy (the proportion was 70.9% when we consider basic literacy). Thus, even respondents with high educational attainment can display a low degree of financial knowledge (more than 30% of respondents with a university degree are in the bottom two quartiles of the

advanced literacy index distribution). Thus, while strongly correlated, education is only an imperfect proxy for financial literacy and empirical studies that account for education may not fully account for the effect of financial knowledge.

Advanced literacy is low among the young, is highest among middle-age respondents (particularly 40 to 60), and declines slightly at an advanced age (61 or older). This suggests that people may be learning as they age and, perhaps, participate in financial markets. Gender differences become even sharper when considering advanced literacy. A large percentage of women display low literacy: 34.5% of women are in the first and lowest quartile of the literacy distribution while only 12.1% are at the fourth quartile; the corresponding figures for men are 15.9% and 37.2% respectively.

To further show that these indices measure economic knowledge, in Table 4C we report the relationship between these measures of literacy and a subjective measure of financial knowledge. In our module we have asked respondents to report on a scale from 1 to 7 their understanding of economics.[7] Such a question has the advantage of being simple and direct. Moreover, it does not mention stock market participation. Note also that the question was located at the beginning of the literacy module, before any of the questions included in the basic and advanced financial literacy indices were asked. Thus, respondents had to assess their own knowledge before they answered the literacy questions. Most respondents assessed their economic knowledge as being above 3: 25.38% of respondents stated their level is 4, 32.75% that their level is 5 and 24.27% that their level is 6. However, only 2.71% reported their knowledge of economics as being very high (7). Most importantly, there is a very strong correlation between objective and subjective literacy. More than 50% of respondents who report knowing a lot about economics (score of 6 or 7) are located in the top quartile of the basic literacy index. The relationship becomes even stronger when we consider the advanced literacy index. More than 50% of respondents who report low levels of economic knowledge (score of 1, 2 or 3) are located in the first two quartiles of the literacy index, while the majority of those with high knowledge are located in the top two quartiles of the literacy index. Thus, while there may be noise and measurement error affecting these indices, they do provide information about economic knowledge.

An important question we aim to answer in our paper is not only whether respondents possess financial literacy, but also whether financial literacy matters in financial decision-making. We do so by first examining whether literacy influences the sources of information

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[7] See appendix B for the precise wording of this question.

households consult when making financial decisions, to shed some light on why literacy affects financial behavior. We then examine whether financial literacy affects participation in the stock market.

Table 5 shows that a high proportion of respondents with low basic literacy rely on informal sources of information, such as family, friends and acquaintances. However, this proportion sharply decreases when we move to higher levels of basic literacy. Conversely, the proportion of households relying on newspapers, financial magazines, guides and books, and financial information on the Internet increases substantially as we move from low levels of literacy to high levels of basic literacy. Households with higher financial literacy are also more likely to rely on professional financial advisers. The effect is similar but stronger when we look at advanced financial literacy. Those who display high levels of advanced literacy are much less likely to rely on informal sources of information such as family and friends, and much more likely to read newspapers and magazines, consult financial advisors, and seek information on the Internet. While correlation does not imply causation, this table shows that financial literacy is strongly connected with sources of financial advice. Insofar as financial advice is an input in financial-decision making and leads to better saving and investment decisions, the findings provided in Table 5 provide a reason why financial literacy matters. In the next section, we look directly at financial behavior by examining whether financial literacy has an effect on stock market participation.

5. Financial literacy and stock market participation

As mentioned before, an important "puzzle" in the literature is why so few households hold stocks. In our sample, 23.8% of households own stocks or mutual funds. Thus, as in the US, many households do not participate in the stock market. This figure, however, hides major differences among demographics groups. As reported in Table 6, stock ownership increases sharply with education levels.[8] Only a small fraction of those with low education own stocks. However, even the large majority of those with a university degree do not participate in the stock market. Thus, impediments to stock ownership go beyond levels of schooling. Note that we found similar results when considering the index of basic and advanced literacy; even those with high levels of schooling did not always score high on financial knowledge. This suggests that schooling is not necessarily a good proxy for literacy and models of portfolio choice may need to incorporate both variables to explain behavior

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[8] Note that by merging the data on stock market participation and the financial literacy module, our sample reduces to 1,189 observations. However, we do not find evidence that our sample suffers from selectivity.

toward stocks. Stock market participation increases with age/cohorts; stock ownership is concentrated among those 40 and older. The large proportion of stock ownership for those older than 70 may simply be the result of differential mortality between richer and poorer households (Hurd (1990)). Stock market participation is much lower among women than men, a finding also reported in other studies (see also Haliasssos and Bertaut (1995)) and consistent with the sharp differences in literacy between women and men (Lusardi and Mitchell (2006)). Stock market participation increases strongly with both income and wealth levels. Income refers to household net disposable income: It is simply household total income (which is the sum of labor income, unemployment and disability payments, social security an pension, other transfers and capital income, minus taxes). Wealth is the sum of checking and savings accounts, employer-sponsored saving plans, cash value of life insurance, home equity, other real estate and other financial assets, minus total debt.[9] These findings are similar to those reported in many other papers on stock-ownership (see the review in Guiso, Haliassos and Jappelli (2002) and Campbell (2006)).

One explanation about lack of stock ownership that has not yet been well-explored in the literature is that stocks are complex assets, and many households may not know or understand stocks and the working of the stock market. At the bottom of Table 6, we report stock ownership across different levels of financial literacy. Stock ownership increases sharply with literacy. Even when considering basic literacy that measures simple knowledge and ability to do calculations, we find that those who score high on basic literacy are disproportionately more likely to participate in the stock market. The relationship becomes much stronger when we consider the index of advanced literacy. Participation in the stock market is concentrated among those with high literacy (fourth quartile), while only 8% and 15% of respondents in the first and second quartile of literacy participate in the stock market. Given that literacy is highly correlated with the demographic variables mentioned above, we now turn to examine whether this relationship holds true even after accounting for many of the determinants of stock market participation, such as age, education, gender, income and wealth. Most important, we will address the direction of causality between stock ownership and financial literacy.

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[9] Because the dependent variable in our empirical work is stock market participation (including participation in mutual funds), in our definition of wealth we do not include stocks and mutual funds (which are clearly correlated with stock market participation). We also do not include business equity because it is a very noisy measure of business wealth. For an analysis of wealth and wealth components in the DHS, see Alessie, Hochguertel and van Soest (2002).

Our empirical specification recognizes there are many determinants of stock ownership, and we consider a wide set of variables that are available in our survey. As in the previous studies, we consider demographics such as age, education, gender, marital status, and number of children (Haliassos and Bertaut (1995), Guiso, Haliassos and Jappelli (2002), and Campbell (2006)). We added a dummy for respondents who are retired to account for the fact that some households may be in the de-cumulation phase of their life-cycle. We also added a dummy for self-employment, to account for those who are already exposed to high risk in the labor market and may therefore be less likely to hold stocks (Heaton and Lucas (2000)). Additionally, we added income (in logs) and dummies for quartiles of wealth.[10] Most important, we added measures of financial literacy. One of the main hypotheses of this paper is that respondents who are not financially knowledgeable—do not know about stocks and bonds and are not familiar with the working of financial markets—stay away from the stock market. We use the index for advanced literacy to account for financial knowledge. However, we also add the index of basic knowledge to account for different levels of literacy as well as to control for cognitive ability.[11]

The empirical estimates in Table 7 show that financial literacy matters for stock ownership, even after controlling for a large set of demographic characteristics and income and wealth. Those who display higher literacy are more likely to participate in the stock market. The estimates are also sizable: A one-standard deviation increase in advanced literacy raises stock market participation by more than 8 percentage points. Note that the effect is as large as the effect of formal education and wealth. For example, having a university degree increases stock market participation by more than 9 percentage points. Compared to the first quartile of wealth (values up to 2,300 Euros), having wealth in the second quartile (up to 45,000 Euros) increases stock market participation by more than 7 percentage points. Note also that when we account for basic literacy the estimate of advanced literacy does not change. The estimates in Table 7 indicate that financial literacy affects stock market participation above and beyond the effect of the traditional determinants of stock ownership.

There are several potential problems in relying on OLS estimates.[12] First, the index of literacy may be measured with substantial error. As we have argued before, many responses

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[10] Wealth measures are rather noisy in the DHS. The use of dummies allows us to overcome this problem and also to measure how much stock-ownership increases over the wealth distribution.

[11] By merging together the data on literacy, income, wealth and all the demographics needed for the empirical work, we end up with a final sample of 1,115 observations.

[12] Note that we estimate a simple linear probability model. It is well-known that the error term of a linear probability model is heteroskedastic. Therefore, we correct the standard errors of the OLS estimates for the presence of heteroskedasticity. For the same reason, we use Generalized Method of Moments (GMM) estimation when we perform Instrumental Variables (IV) estimation.

are imprecise and may result from simple guessing; this is particularly true for questions measuring high levels of financial knowledge. Thus, OLS estimates may be biased downward. On the other hand, there may also be learning and improvement in knowledge (and familiarity with the questions asked in the module) via participation in the stock market. This alternative argument leads to OLS estimates that are biased upward. In either case we cannot simply rely on the estimates reported in the two columns of Table 7 to assess the effect of literacy.[13]

When we devised the module on financial literacy, we took into account the fact that financial literacy is not an exogenous characteristic; in fact, literacy can itself be affected by financial behavior (for example, if individuals learn via experience). To remedy this problem, we have collected additional information (beyond current levels of economic knowledge) that can serve as instruments for advanced financial literacy. To be able to rely on measures of literacy that are exogenous with respect to stock market participation, we asked respondents about their exposure to financial knowledge before entering the job market. Specifically, we asked how much of their education was devoted to economics.[14] Note that economics is part of the high school curriculum at the majority of schools in the Netherlands and it is possible to specialize in economics/business at the high school level (economics degrees can be pursued in college as well, of course).[15] Our strategy is to rely on exposure to economic education in the early stages of life. This measure should be correlated with current advanced knowledge while it should be uncorrelated with stock market participation. As mentioned before, advanced knowledge may be a crude proxy of actual knowledge. Moreover, it may simply reflect how much respondents have learned from their personal experiences and from their success in the stock market. For example, if financially knowledgeable respondents are more likely to invest successfully and stay in the market, while low knowledge respondents are more likely to lose money and exit the market, the relationship between literacy and market participations may simply reflect the higher knowledge of those who stay in the market.

The first stage regressions are reported in Table 8. Responses to how much of education was devoted to economics range from "hardly at all" to "a lot" and we construct

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[13] The OLS estimates may also suffer from the omitted variables bias. For example, the error term may include 'ability' which is also correlated with financial literacy. As long as our measure of basic literacy index is a good proxy for '(financial) ability,' we should not suffer from this problem. However, we address omitted variables bias later in the text.

[14] For the precise wording of this question, see Appendix B.

[15] In contrast to the US, there are no initiatives at the employer-level to improve financial literacy and economic knowledge of workers in the Netherlands. There are no retirement seminars, as the vast majority of Dutch employees participate in Defined Benefit retirement plans and have no say in their pension savings or the way their pension wealth is invested (see van Rooij, Kool and Prast (2007)). Thus, the supply of economic education is restricted to the school system in the Netherlands. Bernheim, Garrett and Maki (2001) show that those who were exposed to financial education in high school in the US were more likely to save later in life.

dummies for different levels of economics education while in school. These instruments have a strong predictive power: Those who have had less exposure to economics education in school are less likely to display advanced knowledge, and this holds true even when we account for basic literacy, which we consider a measure of cognition and ability. The F-statistic in the first stage regressions is high (with values close to 20) and beyond the values recommended to avoid the weak instruments problem (Staiger and Stock (1997) and Bound, Jaeger and Baker (1995)). The first stage results also continue to confirm the correlation between literacy and demographic characteristics, such as education and gender, reported in Table 4B.

The estimates in the second stage reported in the last two columns of Table 7 show that the relationship between literacy and stock market participation remains positive, statistically significant, and is even larger in the Generalized Method of Moments (GMM) estimates. Moreover, the exogeneity test is not rejected. Thus, the OLS estimates do not differ significantly from the GMM estimates. The results of the Hansen J-test show that the over-identifying restrictions are not rejected. Overall, our estimates indicate that financial literacy is an important determinant of stock market participation: Those who have low financial knowledge are less likely to hold stocks.

6. Discussion and extensions

6.1 Exploiting stock market participation in the past

One of the potential objections concerning our instruments is that the exposure to economics in school could be a choice variable, depending for example on tastes toward risk, or perhaps simply reflecting "interest in the stock market", i.e., how much respondents were interested in becoming knowledgeable in economics to invest in the stock market. While this may be the case for young generations, it can hardly be the case for middle-aged and older respondents. Investing in the stock market is a recent phenomenon for many Dutch families and it would be hard if not impossible for these families to have anticipated the current changes in financial markets and the increase in individual responsibility.

To better understand and document household participation in the stock market, we have examined other surveys that provide information about stock holdings in the 1980s. The first wave of the Dutch Socio-Economic Panel, which covers a representative sample of the population, shows that in 1987 only approximately 6% of families owned stocks (see also Alessie, Lusardi and Aldershof (1997)), and that stock-ownership grew to only approximately

8% by 1990. Stock-ownership began to take off during the 1990s and it increased to more than 20% by the end of the 1990s (see Guiso, Haliassos and Jappelli (2002)). We exploit the behavior of the stock market and the very recent increase in the fraction of families who own stocks to further sharpen our understanding of the relationship between literacy and stock market participation.

In Table 9A, we report the OLS and GMM estimates for respondents who are older than 35. In this case, we concentrate on people who went to high school before 1990 during a period when the stock market did not play any major role in the portfolios of most Dutch families. Both the OLS and (most importantly) the GMM estimates remain positive and statistically significant. Note that these estimates do not depend on the age split. We get estimates of similar size when we split the sample at age 40 or at 45.

While it is admittedly hard to find good instruments for financial literacy, the historical experience of the Netherlands provides us with a unique opportunity to rely on information about financial literacy *before* the stock market became important and *before* individuals took an active interest in the stock market. Since estimates of financial literacy do not change significantly in size when considering respondents older than 35, in the next sections we perform our estimates in the total sample.

To pursue this argument further and also investigate other instrument sets, we have considered the information in the survey about advice from parents during childhood on how to budget and save money in lieu of exposure to economics in school. However, we found no relationship between this variable and advanced literacy. This provides further evidence that the behavior of the stock market is a new experience and that current generations may be unable to learn about investing in the stock market from previous generations. We turn next to other potential sources of learning.

6.2 Stock market participation and peer effects

Another potential issue with the instruments we use is that respondents who were exposed to economics during their schooling may be more likely to have friends (perhaps their classmates) that invest in the stock market. Because of "peer effects" in investing, respondents exposed to these friends may themselves be more likely to invest in the stock market. Although we have previously documented that more financially knowledgeable individuals are more likely to rely on formal sources of financial advice rather than relying on family and friends, it is important to disentangle how much our variable measures "financial knowledge" versus "peer effects." Several studies have documented that peer effects can be

pretty powerful determinants of portfolio choice (Hong, Kubik and Stein (2004) and Brown, Ivkovich, Smith and Weisbenner (2007)) and those peer effects can start early in the life-cycle. We have information in the data set on the level of education that most of the respondents' acquaintances have. While this does not necessarily reflect knowledge of economics, education is very strongly correlated with financial literacy as shown in Tables 4A and 4B.

In Table 9B, we report OLS and GMM estimates in a new empirical specification where, in addition to the education of the respondents, we add the education of their peers (for simplicity we only report the estimates of these new controls and the estimates for financial literacy). The education level of peers does matter for stock-ownership. Those who have friends that have a college degree are 12 to 14 percentage points more likely to own stocks. Thus, there may be information-provision and learning via social interaction. Note, however, that both the OLS and GMM estimates of literacy are barely affected by the addition of this variable. Thus, financial literacy has an effect on stock ownership above and beyond the effects of peers.

6.3 Self-assessed literacy versus objective literacy

Measuring literacy is clearly a difficult task. For example, we do not know how many questions one should use to get a proper measure of literacy. Moreover, our questions are focused on stocks and the stock market rather than financial knowledge in general. In this section, rather than relying on our constructed indices, we use the simple measure of financial literacy based on self-assessed economics knowledge. As mentioned before, we have asked respondents to rate their understanding of economics on a scale from 1 to 7. This question is easy to understand and to answer. Moreover, from a theoretical point of view, self-assessed economics knowledge is what should influence household financial decision-making, even though we show there is a strong correlation between subjective and objective measures of knowledge. Finally, there is no mentioning of the stock market or financial market instruments in this question and reverse causality may be less of a problem. On the other hand, since the question refers to current economics knowledge, households may be influenced in their judgment by their experience and success in the stock market. As before, we first perform OLS regressions of stock market participation on financial literacy, this time using self-assessed literacy in lieu of the literacy index. We then instrument self-assessed knowledge, again using as instruments how much of the respondent education was devoted to economics.

The estimates are reported in Table 9C.[16] For brevity, we only report the estimates of the variables of interest. Even when using this simple measure, the estimates of financial literacy are positive and statistically significant. The GMM estimates are higher than the OLS estimate and again the exogeneity test is not rejected. In both OLS and GMM regressions, we account for the basic financial literacy index, which becomes statistically significant. Thus, according to these alternative measures, both basic and self-assessed financial knowledge are important determinants of stock market participation.

6.4 Knowledge or cognition?

One of the issues about financial literacy is whether it measures knowledge or simply ability and cognition (see Benjamin, Brown and Shapiro (2006) and Stango and Zinman (2007)). This distinction has important implications for public policy and, for example, for the effectiveness of financial education programs. In our work, we try to account for cognition by grouping together questions measuring the ability to perform simple calculations, the understanding of changes in prices, and the time value of money (our basic literacy index). We added this variable separately in the regressions in addition to the advanced knowledge index. However, this is perhaps only a crude proxy of ability. To better account for cognition and ability with calculations, we exploited two important economic changes in the Netherlands. First, like most of the members of the European Union, the Netherlands shifted from their national currency (the Dutch guilder) to the Euro. As of 2002, the Euro replaced the guilder as a legal mean of payment. We exploited this fact in the second module that was added to the DNB survey in January 2006. We asked respondents how difficult it was to do shopping, read bank statements, and do typical daily transactions right after the introduction of the Euro in 2002 (answers range from "very difficult" to "not difficult at all").[17] More than 13% of respondents found the conversion to the Euro to be "very difficult" or "difficult," 21.9% found it "somewhat difficult" and the rest (63%) found it "not very difficult" or "not difficult at all." We constructed dummies for the responses to this question and added them to the regression to account for cognitive ability (these dummies replaced the basic financial literacy index). When we account for these dummies in our regressions, both the OLS and the GMM estimates of the advanced literacy index remain positive, statistically significant and of

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[16] In the regression analysis, we deleted the respondents who did not know the answer to this question or refused to answer.
[17] For the precise wording of this question, see Appendix B.

similar magnitude. Thus, financial literacy affects stock ownership above and beyond the effect of cognition and the ability to perform calculations.

We also considered another important change in the Netherlands, this time concerning the health system. A new law was passed in 2005 that introduced more freedom of choice in the health insurance system. Households were required to make decisions about their health providers, their contributions, and the deductible in their health policy. Decisions had to be made before March 1, 2006 (the ultimate deadline to make changes to previous decisions at no cost). In the new module we added in January 2006, we ask respondents how difficult it was to understand the new health insurance system (again, answers can range from "very difficult" to "not difficult at all").[18] However, contrary to the conversion to the Euro—where respondents were confronted with a currency exchange and had to make simple calculations—there are several reasons why the new health system is difficult to comprehend.[19] We further asked respondents the reasons for their answer, in order to differentiate between those who did not know how to make this kind of decision (low cognitive ability respondents), and those who considered the decision difficult because they had to spend time reading and collecting information and had to figure out what was best for them to do (high cognitive ability respondents).

Overall, 43% of respondents found the health decisions "not very difficult" or "not difficult at all." Of the remaining group who found the decision "very difficult," "difficult" or "somewhat difficult," more than half reported that it was because they had to spend time to make comparisons and reading and collecting information. As before, we constructed dummies for different types of respondents and added these dummies to our regression. Even after controlling for this alternative measure of cognitive ability, we find that both the OLS and GMM estimates of the advanced literacy index remain positive and statistically significant (Table 9D).

6.5 A different financial literacy index

As mentioned before, to assess the quality of the answers to literacy questions, we changed the wording of three questions and exposed two randomly selected groups of respondents to the same question with different wording. From this methodology we inferred that respondents had considerable difficulty understanding the questions about bond pricing

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[18] For the precise wording of these questions, see Appendix B.
[19] People had to choose from a large number of health insurers and had to compare the coverage and price of supplementary health packages, which offered different deductibles.

and the riskiness of a company stock versus a stock mutual fund. In performing the factor analysis, respondents were divided into different subgroups according to the wording of the question they were exposed to. Since there may be a lot of noise in the answers to these questions, in this section we perform the empirical analysis excluding the three questions for which we implemented a different wording.[20] In this way, we can show how sensitive our estimates are not only to our methodology, but also to different measures of literacy. By excluding these questions, we exclude concepts that were rather difficult for respondents to grasp, and we can therefore check whether indices that have a stronger focus on basic economic concepts are still related to stock ownership.

As in the previous tables, we report both OLS and GMM estimates. Since we exclude questions explicitly related to stocks and the pricing of bonds, the problem of reverse causality may be less prevalent. At the same time, we may have decreased the amount of noise in the index, since it is hard to infer a lot from answers related to topics that respondents do not know well. The OLS estimates in Table 9E shows that literacy is still related to stock market participation, even when we focus on an index that excludes several advanced economic concepts. The GMM estimates are also positive and statistically significant and of similar magnitude than the previous estimates.

We have also experimented with excluding questions 12 and 13 from the set of advanced literacy questions since the latter has a very low correct response rate and there is already one question in the set about risk diversification. In addition, we experimented with excluding questions 7 and 9, which simply refer to the definition of stocks and bonds. Estimates for financial literacy remain positive and statistically significant. For example, the GMM estimates are 0.159 (s.e. 0.067) and 0.174 (s.e. 0.074) in the first and second case respectively. Thus, results do not depend on the inclusion or exclusion of a particular question in the literacy index.

6.6 Including measures of risk aversion

Notably, one of the variables which is missing from our empirical specification is a measure of risk aversion. Clearly, preferences for risk are an important determinant of stock ownership and may explain some of the differences among households.[21] Some researchers have further argued that knowledge and cognitive ability may have an effect on preferences,

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[20] See Appendix A for the calculation of the financial literacy index.
[21] However, as reviewed in Haliassos and Bertaut (1995), risk aversion alone cannot explain why so many households do not hold stocks. One has to appeal to different preferences than the general class of HARA preferences to explain lack of stockownership.

such as risk aversion and the rate of time preference (Benjamin, Brown and Shapiro (2006), Dohmen, Falk, Huffman and Sunde (2007)) and, through this channel, affect financial decision-making. We do not investigate this relationship in our paper, but will account for preferences in a new empirical specification. In this way, our indices can better measure the effects of knowledge and information costs rather than the effect of preferences. In a separate module on preferences in the DHS, there are questions that aim to measure attitudes toward risk. These questions are similar to those in the HRS.[22] Barsky, Juster, Kimball and Shapiro (1997) show that, while imperfect, the measure of risk aversion derived from these types of questions is related to financial behavior and correlates with stock ownership. However, one of the disadvantages of using the risk aversion data is that we lose a lot of observations from merging together separate sections of DHS.

From the information provided in the survey, we can distinguish among four types of households, from those unwilling to take any risk (reject any gamble that offers higher but uncertain payoff) to those willing to take substantial risk (willing to take both gambles presented in the questions that offer high but uncertain payoffs). When we examine a simple correlation between stock market participation and our risk aversion dummies, we find that risk is correlated to ownership of stocks: Those who are not willing to take risk are less likely to participate in the stock market. Thus, while a crude measure, the risk aversion dummies seem to be able to proxy for attitudes toward risk.

When including risk aversion in our empirical specification in Table 9F, we find that the estimates of our variables of interest do not change. Both the OLS and GMM estimates of financial literacy remain positive, statistically significant, and do not change appreciably in magnitude. Thus, the exclusion of risk aversion does not take away from the importance of financial literacy in explaining participation in the stock market.

6.7 Other extensions

We have pursued another robustness check to show that financial literacy is an important determinant of stock-ownership and captures information and search costs related to a complex asset such as stocks. In addition to stocks, we have examined the relationship between financial literacy and savings accounts. A much lower degree of financial sophistication and information costs is required to deal with these assets and we would not expect to find a strong relationship with financial literacy. Indeed, in our empirical work, we

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[22] For the precise wording of these questions, see appendix B.

do not find any relationship between our measures of literacy and ownership of savings accounts. The OLS and GMM estimates of advanced literacy are 0.0167 (s.e. 0.014) and 0.0142 (s.e. 0.059) respectively. This confirms the results of Christelis, Jappelli and Padula (2007), who also found no relationship between cognitive ability and savings accounts.

Our results are robust to a variety of other specifications. For example, we have excluded from our sample respondents who are older than 70, which should be in the decumulation phase of their life-cycle. This increases the power of our instruments, since the effect of schooling declines with age. The OLS and GMM estimates of advanced literacy are 0.082 (s.e. 0.013) and 0.167 (s.e. 0.071) respectively. Moreover, rather than simply accounting for self-employment in our specification, we have excluded the self-employed from our sample. Hurst and Lusardi (2007) show that the self-employed/business owners display many differences with respect to other households and we do not have a lot of information in our data set to account for all these differences. However, our OLS estimate of financial literacy is 0.088 (s.e. 0.012) and the GMM estimate is 0.138 (s.e. 0.068). Thus, estimates continue to remain positive and statistically significant.

7. Concluding remarks

In this paper, we show that lack of understanding of economics and finance is a significant deterrent to stock ownership. The different measures of financial knowledge we have employed in our work all show that lack of literacy prevents households from participating in the stock market. Cocco, Gomez and Maenhout (2005) show that the welfare loss from non-participation in the stock market can be sizable. Thus, the role of financial literacy should not be under-estimated. As more workers transition to a system where they have to decide how much to save for retirement and how to invest their retirement wealth, it is important to consider ways to enhance their level of financial knowledge or to guide them in their financial decisions.

We plan to expand this work in several directions. First, we will examine the relationship between financial literacy and retirement planning and explore whether difficulties in performing calculations and low financial sophistication affect also the ability to plan for retirement. Moreover, we will assess whether financial literacy has an effect not only on portfolio choice but also on saving behavior and whether those who display low literacy are less likely to accumulate wealth.

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Table 1A. Basic financial literacy
Weighted percentages of total number of respondents (N=1,508)

	Numeracy	Interest compounding	Inflation	Time value of money	Money illusion
Correct	90.8	76.2	82.6	72.3	71.8
Incorrect	5.2	19.6	8.6	23.0	24.3
Do not know	3.7	3.8	8.5	4.3	3.5

Note: Correct, incorrect, and do not know responses do not sum up to 100% because of refusals.

Table 1B. Basic literacy: Summary of responses
Weighted percentages of total number of respondents (N=1,508)

	Number of correct, incorrect and do not know answers (out of five questions)						
	None	1	2	3	4	All	Mean
Correct	2.3	2.8	6.7	15.1	32.8	40.2	3.94
Incorrect	45.2	35.7	13.6	4.4	1.1	0.0	0.81
Do not know	88.9	5.9	1.7	1.4	0.7	1.5	0.24

Note: Categories do not sum up to 100% because of rounding and means do not sum up to 5 due to refusals.

Table 2A. Advanced financial literacy
Weighted percentages of total number of respondents (N=1,508)

	Correct	Incorrect	Do not Know
Which statement describes the main function of the stock market? [1]	67.0	12.9	19.7
What happens if somebody buys the stock of firm B in the stock market? [1]	62.2	25.7	11.0
Which statement about mutual funds is correct? [1]	66.7	11.1	21.7
What happens if somebody buys a bond of firm B? [1]	55.6	17.8	26.4
Considering a long time period (for example 10 or 20 years), which asset normally gives the highest return: savings accounts, bonds or stocks?	47.2	30.1	22.3
Normally, which asset displays the highest fluctuations over time: savings accounts, bonds, stocks?	68.5	12.7	18.4
When an investor spreads his money among different assets, does the risk of losing money increase, decrease or stay the same?	63.3	17.4	19.0
If you buy a 10-year bond, it means you cannot sell it after 5 years without incurring a major penalty. True or false?	30.0	28.3	37.9
Stocks are normally riskier than bonds. True or false? [2]	60.2	15.1	24.3
Buying a company fund usually provides a safer return than a stock mutual fund. True or false? [2]	48.2	24.8	26.6
If the interest rate falls, what should happen to bond prices: rise/fall/stay the same/none of the above? [2]	24.6	37.1	37.5

1) See exact wording in the text;
2) This question has been phrased in two different ways. See also Table 3.
Note: Correct, incorrect and do not know responses do not sum up to 100% because of refusals.

Table 2B. Advanced literacy: Summary of responses
Weighted percentages of total number of respondents (N=1,508)

	Number of correct, incorrect and do not know answers (out of eleven questions)												
	None	1	2	3	4	5	6	7	8	9	10	All	Mean
Correct	7.6	5.1	5.2	6.4	7.3	10.0	11.1	11.3	10.8	10.6	9.8	5.0	5.93
Incorrect	18.7	20.2	19.8	16.8	10.4	7.1	4.7	1.6	0.6	0.1	0.0	0.0	2.33
Do not know	44.2	11.4	8.0	6.1	5.1	3.7	4.1	4.2	2.8	3.2	3.5	3.6	2.65

Note: Categories do not sum up to 100% because of rounding and means do not sum up to 11 due to refusals.

Table 3. Advanced literacy: Responses to questions with inverted wording
Weighted percentages

	Correct	Incorrect	Do not Know
Stocks are normally riskier than *bonds*. True or false? (N=751)	60.8	17.1	21.7
Bonds are normally riskier than *stocks*. True or false? (N=757)	59.7	13.1	26.9
Pearson chi2(2) = 5.25 (p = 0.072)			
Buying a *company stock* usually provides a safer return than a *stock mutual fund*. True or false? (N=763)	63.4	12.1	24.1
Buying a *stock mutual fund* usually provides a safer return than a *company stock*. True or false? (N=745)	32.3	38.1	29.2
Pearson chi2(2) = 184.59 (p = 0.000)			
If the interest rate *falls*, what should happen to bond prices: rise/fall/stay the same/none of the above? (N=755)	30.5	33.8	34.8
If the interest rate *rises*, what should happen to bond prices: rise/fall/stay the same/none of the above? (N=753)	18.9	40.3	40.3
Pearson chi2(2) = 23.15 (p = 0.000)			

Note: Correct, incorrect, and do not know responses do not sum up to 100% because of refusals. In performing the test, we group together "do not knows" and "refusals."

Table 4A. Basic literacy across demographics
Weighted percentages

| | Basic literacy quartiles | | | | | |
	1 (low)	2	3	4 (high)	Mean	N
Education						
Primary	35.8	31.1	17.1	15.9	2.13	67
Preparatory intermediate voc.	30.5	22.7	21.8	25.0	2.41	345
Intermediate vocational	20.9	20.8	25.2	33.2	2.71	294
Secondary pre-university	11.1	20.8	25.7	42.4	2.99	207
Higher vocational	6.4	18.1	24.0	51.5	3.21	397
University	5.9	9.7	13.5	70.9	3.49	197

Pearson chi2(15) = 147.42   (p=0.000)

| | Basic literacy quartiles | | | | | |
	1 (low)	2	3	4 (high)	Mean	N
Age						
21-30 years	21.6	19.7	19.4	39.4	2.76	179
31-40 years	18.8	18.3	21.1	41.9	2.86	306
41-50 years	13.7	18.0	23.9	44.3	2.99	333
51-60 years	16.6	19.8	21.3	42.3	2.89	311
61-70 years	18.3	22.3	23.8	35.6	2.77	217
71 years and older	18.3	24.1	24.6	33.0	2.72	162

Pearson chi2(15) = 12.23   (p=0.661)

| | Basic literacy quartiles | | | | | |
	1 (low)	2	3	4 (high)	Mean	N
Gender						
Female	22.2	25.4	21.2	31.2	2.62	674
Male	13.3	14.9	23.2	48.6	3.07	834

Pearson chi2(3) = 52.99   (p=0.000)

Note: Percentages may not sum up to 100 due to rounding.

Table 4B. Advanced literacy across demographics
Weighted percentages

Education	Advanced literacy quartiles					
	1 (low)	2	3	4 (high)	Mean	N
Primary	48.3	24.7	17.5	9.5	1.88	67
Preparatory intermediate voc.	35.1	29.4	23.5	12.0	2.12	345
Intermediate vocational	32.8	23.9	26.3	17.0	2.28	294
Secondary pre-university	19.0	21.8	28.4	30.9	2.71	207
Higher vocational	14.6	23.7	25.1	36.7	2.84	397
University	6.0	24.7	26.0	43.4	3.07	197

Pearson chi2(15) = 149.32   (p=0.000)

Age	Advanced literacy quartiles					
	1 (low)	2	3	4 (high)	Mean	N
21-30 years	24.0	33.5	25.4	17.1	2.36	179
31-40 years	34.3	21.3	23.5	20.9	2.31	306
41-50 years	23.4	26.5	20.5	29.7	2.56	333
51-60 years	18.2	24.1	30.6	27.1	2.67	311
61-70 years	25.7	22.5	22.2	29.6	2.56	217
71 years and older	23.2	24.1	28.7	24.1	2.54	162

Pearson chi2(15) = 36.70   (p=0.001)

Gender	Advanced literacy quartiles					
	1 (low)	2	3	4 (high)	Mean	N
Male	15.9	20.2	26.7	37.2	2.85	834
Female	34.5	30.2	23.3	12.1	2.13	674

Pearson chi2(3) = 161.53   (p=0.000)

Note: Percentages may not sum up to 100 due to rounding.

Table 4C. Basic and advanced literacy versus self-assessed literacy
Weighted percentages

| Self-assessed literacy | Basic literacy quartiles | | | | | |
	1 (low)	2	3	4 (high)	Mean	N
1 (very low)	29.6	30.4	16.2	23.8	2.34	9
2	15.1	26.4	13.0	45.5	2.89	56
3	28.6	19.9	24.8	26.7	2.50	137
4	20.4	23.6	18.7	37.4	2.73	366
5	15.5	19.7	25.3	39.6	2.89	499
6	8.6	16.9	22.2	52.3	3.18	355
7 (very high)	7.4	13.4	25.5	53.7	3.25	45
Do not know	53.4	12.7	18.5	15.5	1.96	31
Refusal	52.9	0.0	35.9	11.2	2.05	10

Pearson chi2(24) = 100.38   (p=0.000)

| Self-assessed literacy | Advanced literacy quartiles | | | | | |
	1 (low)	2	3	4 (high)	Mean	N
1 (very low)	55.3	9.4	27.1	8.2	1.88	9
2	24.9	34.9	22.2	18.0	2.33	56
3	29.2	31.8	28.1	10.9	2.21	137
4	31.3	27.5	23.2	18.0	2.28	366
5	21.7	28.1	25.8	24.4	2.53	499
6	15.9	15.6	26.1	42.4	2.95	355
7 (very high)	3.9	10.2	34.8	51.1	3.33	45
Do not know	66.1	18.3	8.6	7.0	1.56	31
Refusal	67.5	24.9	7.6	0.0	1.40	10

Pearson chi2(24) = 189.19   (p=0.000)

Note: Percentages may not sum up to 100 due to rounding.

Table 5. Most important source of advice for different levels of literacy
Weighted percentages (N=1,135)

What is your most important source of advice when you have to make important financial decisions for the household?	Basic literacy quartiles			
	1 (low)	2	3	4 (high)
- Parents, friends or acquaintances	40.2	34.4	28.8	20.8
- Information from the newspapers	3.6	7.8	8.9	9.5
- Financial magazines, guides, books	3.9	7.5	9.3	12.4
- Brochures from my bank or mortgage adviser	10.6	6.8	6.0	8.1
- Advertisements on TV, in papers or other media	3.7	3.2	2.8	3.9
- Professional financial advisers	21.8	21.3	24.2	25.5
- Financial computer programs	0.0	0.3	0.9	0.7
- Financial information on the Internet	4.0	7.5	8.1	10.5
- Other	12.3	11.4	11.0	8.6

What is your most important source of advice when you have to make important financial decisions for the household?	Advanced literacy quartiles			
	1 (low)	2	3	4 (high)
- Parents, friends or acquaintances	40.7	37.4	19.9	17.9
- Information from the newspapers	1.1	6.0	10.6	13.7
- Financial magazines, guides, books	2.1	7.6	9.7	17.0
- Brochures from my bank or mortgage adviser	6.6	6.7	11.3	6.2
- Advertisements on TV, in papers or other media	4.0	3.6	5.0	1.4
- Professional financial advisers	19.4	23.6	27.5	24.1
- Financial computer programs	0.2	0.3	1.1	0.5
- Financial information on the Internet	6.3	6.6	7.6	12.4
- Other	19.7	8.2	7.3	6.9

Note: Percentages may not sum up to 100 due to rounding.

Table 6. Stock market participation across subgroups
Weighted percentages (N=1,189)

Education		Age	
Primary	11.3	21-30 years	14.4
Preparatory intermediate voc.	16.0	31-40 years	19.4
Intermediate vocational	19.1	41-50 years	27.1
Secondary pre-university	22.5	51-60 years	26.8
Higher vocational	33.7	61-70 years	24.3
University	38.8	71 years and older	30.1
Gender		**Marital status**	
Female	16.7	Not-married	19.8
Male	30.3	Married	26.8
Net household income quartiles		**Non-equity net wealth quartiles**	
1 (low)	13.4	1 (low)	7.1
2	17.5	2	20.3
3	29.1	3	29.7
4 (high)	35.9	4 (high)	37.9
Basic literacy quartiles		**Advanced literacy quartiles**	
1 (low)	7.7	1 (low)	7.5
2	21.2	2	15.0
3	22.0	3	26.5
4 (high)	32.8	4 (high)	44.4

Note: Stock market participation is defined as owning individual stocks and/or mutual funds.

Table 7. Multivariate analysis of stock market participation

	OLS	OLS	GMM	GMM
Advanced literacy index	0.0839***	0.0892***	0.163**	0.155***
	(0.012)	(0.012)	(0.069)	(0.057)
Basic literacy index	0.0112		-0.0138	
	(0.010)		(0.023)	
Dummy (30<age<=40)	-0.0101	-0.00850	0.00600	0.00384
	(0.045)	(0.045)	(0.048)	(0.047)
Dummy (40<age<=50)	0.0326	0.0353	0.0474	0.0438
	(0.047)	(0.047)	(0.049)	(0.048)
Dummy (50<age<=60)	0.0150	0.0165	0.0213	0.0195
	(0.047)	(0.047)	(0.048)	(0.048)
Dummy (age>60)	0.0743	0.0734	0.0832	0.0841
	(0.060)	(0.060)	(0.059)	(0.059)
Intermediate vocational	0.0233	0.0247	0.0163	0.0148
	(0.036)	(0.036)	(0.037)	(0.038)
Secondary pre-university	0.0249	0.0298	-0.0006	-0.0059
	(0.042)	(0.041)	(0.048)	(0.051)
Higher vocational	0.0676*	0.0717*	0.0471	0.0429
	(0.037)	(0.037)	(0.041)	(0.044)
University	0.0977**	0.102**	0.0691	0.0642
	(0.048)	(0.047)	(0.054)	(0.057)
Male	0.0715***	0.0715***	0.0428	0.0433
	(0.027)	(0.027)	(0.036)	(0.035)
Married	-0.0280	-0.0267	-0.0167	-0.0184
	(0.031)	(0.031)	(0.032)	(0.032)
Number of children	0.00371	0.00290	0.00538	0.00628
	(0.015)	(0.015)	(0.015)	(0.015)
Retired	-0.0315	-0.0311	-0.0353	-0.0356
	(0.053)	(0.053)	(0.052)	(0.052)
Self-employed	0.0315	0.0319	0.0232	0.0227
	(0.058)	(0.057)	(0.059)	(0.059)
Ln(household income)	0.0845***	0.0848***	0.0790***	0.0787***
	(0.026)	(0.026)	(0.027)	(0.027)
Second wealth quartile (€2,300<wealth<=€45,500)	0.0743**	0.0749**	0.0570	0.0568
	(0.035)	(0.035)	(0.039)	(0.039)
Third wealth quartile (€45,500<wealth<=€197,300)	0.117***	0.117***	0.0894**	0.0897**
	(0.037)	(0.037)	(0.044)	(0.044)
Fourth wealth quartile (wealth>€197,300)	0.159***	0.160***	0.122**	0.122**
	(0.042)	(0.042)	(0.054)	(0.054)
Constant	-0.752***	-0.760***	-0.664**	-0.657**
	(0.25)	(0.25)	(0.26)	(0.26)
Observations	1,115	1,115	1,115	1,115
R-squared	0.14	0.14	0.11	0.12
Hansen J test p-value			0.673	0.672
F-statistic first stage regression			19.71	22.15
p-value exogeneity test			0.236	0.227

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. This table reports OLS and GMM estimates of the effect of literacy on stock market participation. In the last two columns (GMM estimates), the advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group consists of those respondents whose education was devoted a lot to economics.

Table 8. First stage regressions

	I	II
Basic literacy index	0.290***	
	(0.027)	
Dummy (30<age<=40)	-0.185*	-0.166
	(0.10)	(0.12)
Dummy (40<age<=50)	-0.121	-0.0577
	(0.099)	(0.11)
Dummy (50<age<=60)	-0.0241	0.0155
	(0.10)	(0.12)
Dummy (age>60)	-0.0189	-0.0457
	(0.13)	(0.14)
Intermediate vocational	0.0481	0.0943
	(0.086)	(0.095)
Secondary pre-university	0.229***	0.412***
	(0.086)	(0.090)
Higher vocational	0.210***	0.365***
	(0.073)	(0.077)
University	0.357***	0.555***
	(0.080)	(0.086)
Male	0.299***	0.345***
	(0.058)	(0.062)
Married	-0.119*	-0.0988
	(0.064)	(0.068)
Number of children	-0.0247	-0.0534
	(0.029)	(0.033)
Retired	0.0476	0.0656
	(0.11)	(0.11)
Self-employed	0.119	0.151
	(0.087)	(0.10)
Ln(household income)	0.0512	0.0703
	(0.054)	(0.057)
Second wealth quartile (€2,300<wealth<=€45,500)	0.217**	0.269***
	(0.093)	(0.100)
Third wealth quartile (€45,500<wealth<=€197,300)	0.342***	0.409***
	(0.090)	(0.097)
Fourth wealth quartile (wealth>€197,300)	0.439***	0.547***
	(0.097)	(0.10)
Economics education: some	-0.207***	-0.255***
	(0.057)	(0.064)
Economics education: little	-0.300***	-0.352***
	(0.067)	(0.073)
Economics education: hardly at all or "don't know"	-0.597***	-0.723***
	(0.081)	(0.092)
Constant	-0.642	-0.979*
	(0.53)	(0.56)
Observations	1,115	1,115
R-squared	0.33	0.22
p-value test age coeff=0	0.282	0.434
p-value test education coeff=0	0.000	0.000
p-value test wealth coeff=0	0.000	0.000
F statistic first stage regression	19.71	22.15
p-value test instruments =0	0.000	0.000

Note: Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group consists of those respondents whose education was devoted a lot to economics.

Table 9A. Stock market participation among respondents older than 35

	OLS	OLS	GMM	GMM
Advanced literacy index	0.0908***	0.0964***	0.146*	0.145**
	(0.015)	(0.014)	(0.066)	(0.069)
Basic literacy index	0.0136		-0.0015	
	(0.012)		(0.025)	
Demographics (see table 7)	yes	yes	Yes	yes
Observations	884	884	884	884
R-squared	0.12	0.12	0.11	0.11
Hansen J test p-value			0.951	0.951
F-statistic first stage regression			18.97	20.11
p-value exogeneity test			0.476	0.466

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group in the instrument set consists of those respondents whose education was devoted a lot to economics.

Table 9B. Stock market participation and the importance of peer effects

	OLS	OLS	GMM	GMM
Advanced literacy index	0.0874***	0.0930***	0.158*	0.155**
	(0.012)	(0.012)	(0.086)	(0.074)
Basic literacy index	0.0145		-0.0039	
	(0.011)		(0.024)	
Education of peers: intermediate vocational, second. pre-university	0.0748	0.0748	0.0539	0.0545
	(0.046)	(0.046)	(0.054)	(0.054)
Education of peers: higher vocational, university	0.143***	0.144***	0.119*	0.120*
	(0.055)	(0.055)	(0.064)	(0.063)
Demographics (see table 7)	yes	yes	Yes	yes
Observations	1054	1054	1054	1054
R-squared	0.16	0.16	0.14	0.14
p-value test education coeff=0	0.861	0.847	0.842	0.842
p-value test education peers coeff=0	0.030	0.029	0.102	0.101
Hansen J test p-value			0.842	0.840
F-statistic first stage regression			13.15	13.96
p-value exogeneity test			0.399	0.391

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group in the instrument set consists of those respondents whose education was devoted a lot to economics.

Table 9C. Stock market participation and self-assessed literacy

	OLS	GMM
Self-assessed literacy	0.0629***	0.0914**
	(0.012)	(0.038)
Basic literacy index	0.0332***	0.0288**
	(0.011)	(0.012)
Demographics (see table 7)	yes	Yes
Observations	1,083	1,083
R-squared	0.13	0.13
Hansen J test p-value		0.624
F-statistic first stage regression		37.99
p-value exogeneity test		0.424

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The self-assessed literacy question is reported in appendix B. The self-assessed literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group consists of those respondents whose education was devoted a lot to economics.

Table 9D. Stock market participation and alternative measures of basic literacy

	Euro Introduction		Change Health Insurance System	
	OLS	GMM	OLS	GMM
Advanced literacy index	0.0848***	0.141**	0.0880***	0.156**
	(0.012)	(0.061)	(0.012)	(0.065)
Dealing with Euro: somewhat difficult	-0.0469	-0.0521		
	(0.045)	(0.046)		
Dealing with Euro: not very difficult	-0.0138	-0.0240		
	(0.042)	(0.044)		
Dealing with Euro: Not difficult at all	0.0450	0.0289		
	(0.048)	(0.052)		
Difficulty health care system: making comparisons and collecting information			-0.0105	-0.00622
			(0.030)	(0.031)
Difficulty health care system: figuring out what the best for me to do			-0.0257	-0.00807
			(0.036)	(0.040)
Difficulty health care system: I don't know how to make these decisions & DK			0.0755	0.131
			(0.075)	(0.088)
Demographics (see table 7)	yes	yes	Yes	yes
Observations	1,053	1,053	1,053	1,053
R-squared	0.14	0.13	0.14	0.12
p-value test euro coeff=0	0.156	0.236		
p-value test health insurance coeff=0			0.590	0.398
Hansen J test p-value		0.960		0.970
F-statistic first stage regression		18.37		17.26
p-value exogeneity test		0.343		0.280

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. In the first two columns, the reference group consists of those respondents who found dealing with the Euro transition "very difficult" or who answered the question with "do not know." In the last two columns, the reference group consists of those respondents who have no difficulty understanding the health care system change (see question H1 in appendix B). The three dummy variables are based on question H2 in appendix B. The advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group consists of those respondents whose education was devoted a lot to economics.

Table 9E. Stock market participation and an alternative advanced literacy index

	OLS	OLS	GMM	GMM
Advanced literacy index (alternative)	0.0767***	0.0823***	0.182**	0.166***
	(0.012)	(0.012)	(0.078)	(0.062)
Basic literacy index	0.0113		-0.0243	
	(0.010)		(0.028)	
Demographics (see table 7)	yes	yes	yes	yes
Observations	1,115	1,115	1,115	1,115
R-squared	0.13	0.13	0.09	0.10
Hansen J test p-value			0.684	0.682
F-statistic first stage regression			16.15	19.07
p-value exogeneity test			0.163	0.156

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The (alternative) advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group consists of those respondents whose education was devoted a lot to economics.

Table 9F. Stock market participation, literacy, and risk aversion

	OLS	GMM
Advanced literacy index	0.0974***	0.151*
	(0.014)	(0.080)
Basic literacy index	0.00477	-0.0112
	(0.012)	(0.026)
Risk aversion: low	-0.0431	-0.0627
	(0.084)	(0.094)
Risk aversion: medium	0.0172	-0.00714
	(0.055)	(0.066)
Risk aversion: high	0.0558	0.0451
	(0.045)	(0.047)
Risk aversion: don't know	0.0185	0.0344
	(0.063)	(0.068)
Demographics (see table 7)	yes	Yes
Observations	888	888
R-squared	0.13	0.12
Hansen J test p-value		0.480
F-statistic first stage regression		15.48
p-value exogeneity test		0.493

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The advanced literacy index has been instrumented using three dummy variables indicating how much the respondent's education was devoted to economics. The reference group consists of those respondents whose education was devoted a lot to economics. In this regression the reference group consist of those respondents who exhibit the highest degree of risk aversion according to the questions reported in appendix B.

Appendix A: Constructing indices for basic and advanced financial literacy

The index for basic literacy is based on the first 5 questions reported in Section 4. For each basic literacy question we have constructed a dummy variable for respondents who answered correctly to the question. We have performed a factor analysis on those binary variables using the iterated principal factor method. We were able to retain one factor with a meaningful interpretation; this factor describes basic literacy. The factor loadings are presented in Table A1. Given these factor loadings, we obtained factor scores using the Bartlett method (see Bartlett (1937)).

Table A1. Factor loadings corresponding to the five basic literacy questions

Basic literacy questions	Factor loadings
Numeracy	0.6667
Interest compounding	0.5188
Inflation	0.5513
Time value of Money	0.4267
Money illusion	0.2432

The advanced financial literacy index has been constructed using the next 11 questions presented in Section 4. As we state in the main text, three questions were "randomized" (see Table 3). The following two items presented in Table 3 are very sensitive to the way the question is formulated.

(15a) Buying a *company stock* usually provides a safer return than a *stock mutual fund*?

(15b) Buying *a stock mutual fund* usually provides a safer return than a *company stock*?

(16a) If the interest rate *falls*, what should happen to bond prices: rise/fall/stay the same/none of the above?

(16b) If the interest rate *rises*, what should happen to bond prices: rise/fall/stay the same/none of the above?

Therefore, we decided to split the sample into four groups and to perform the factor analysis on each of those four groups separately. The first group had to answer questions 15a and 16a, the second group 15b and 16a, the third group 15a and 16b and the fourth group 15b and 16b. Since the assignment to those groups occurred randomly with equal probability (25%), the sub-samples are about of equal size. Contrary to the answers to the basic literacy questions, the responses to the advanced literacy questions include many "do not know" answers. To take this response behavior into account, we constructed 2 dummy variables for each of the 11 questions. The first dummy variable indicates whether the question was answered correctly, while the other one refers to the "do not know" answers. In other words, we performed a factor analysis on 22 variables. We were able to retain one factor with a meaningful interpretation: it basically describes advanced literacy. The factor loadings are presented in Table A2.

We have also constructed an alternative index for advanced financial literacy where we do not use the questions that were randomized (see Table 3). The results of the factor analysis (factor loadings) are shown in Table A3. This alternative index has been used in the sensitivity analysis presented in Table 9E.

Table A2. Factor loadings for the advanced literacy questions (four subsamples)

Advanced literacy questions		Factor loadings			
		15a, 16a	15b, 16a	15a, 16b	15b, 16b
If the interest rate falls, what should happen to bond prices: rise/fall/stay the same/none of the above?	Correct	0,3602	0,3903	0,3548	0,3819
	DK	-0,6607	-0,7346	-0,6863	-0,7072
Buying a company stock usually provides a safer return than a stock mutual fund?	Correct	0,6787	0,441	0,6512	0,4177
	DK	-0,7688	-0,8016	-0,7554	-0,7158
Stocks are normally riskier than bonds?	Correct	0,5883	0,6798	0,6036	0,6196
	DK	-0,7257	-0,819	-0,7194	-0,7786
Considering a long time period, which asset described below normally gives the highest return: Savings accounts, Bonds or Stocks?	Correct	0,4684	0,5099	0,5549	0,5293
	DK	-0,6964	-0,7655	-0,7993	-0,7245
Normally, which asset described below display the highest fluctuations over time: Savings accounts, Bonds or Stocks?	Correct	0,6459	0,6731	0,6532	0,6655
	DK	-0,7548	-0,7904	-0,7954	-0,7516
When an investor spreads his money among different assets, does the risk of losing money increase, decrease or stay the same?	Correct	0,4980	0,5804	0,5578	0,6159
	DK	-0,7410	-0,7685	-0,7441	-0,7532
If you buy a 10-year bond, it means you cannot sell it after 5 years without incurring a major penalty. True or false?	Correct	0,4798	0,4658	0,4669	0,5176
	DK	-0,6373	-0,6398	-0,6414	-0,6652
Which of the following statements describes the main function of the stock market? [1]	Correct	0,5646	0,6848	0,5584	0,6003
	DK	-0,7178	-0,7457	-0,6948	-0,7190
What happens if somebody buys the stock of firm B in the stock market? [1]	Correct	0,4489	0,4619	0,3862	0,4452
	DK	-0,6619	-0,6764	-0,6227	-0,5875
Which statement about mutual funds is correct? [1]	Correct	0,5931	0,6754	0,6331	0,6479
	DK	-0,7507	-0,7925	-0,7816	-0,7253
What happens if somebody buys a bond of firm B? [1]	Correct	0,5829	0,6365	0,5852	0,6436
	DK	-0,7178	-0,8032	-0,7434	-0,7402

1) See the exact wording of the question in the text.

Table A3. Factor loadings for the advanced literacy questions excluding the randomized questions

Advanced literacy questions (excluding the three randomized questions)		Factor loadings
Considering a long time period, which asset described below normally gives the highest return: Savings accounts, Bonds or Stocks?	Correct	0,5166
	DK	-0,7527
Normally, which asset described below display the highest fluctuations over time: Savings accounts, Bonds or Stocks?	Correct	0,6522
	DK	-0,7874
When an investor spreads his money among different assets, does the risk of losing money increase, decrease or stay the same?	Correct	0,5820
	DK	-0,7682
If you buy a 10-year bond, it means you cannot sell it after 5 years without incurring a major penalty. True or false?	Correct	0,4545
	DK	-0,6175
Which of the following statements describes the main function of the stock market?	Correct	0,6292
	DK	-0,7443
What happens if somebody buys the stock of firm B in the stock market? [1]	Correct	0,4408
	DK	-0,6615
Which statement about mutual funds is correct? [1]	Correct	0,6521
	DK	-0,7704
What happens if somebody buys a bond of firm B? [1]	Correct	0,5975
	DK	-0,7372

1) See the exact wording of the question in the text.

Appendix B: Exact wording of the questions in the questionnaire and construction of variables used in the empirical work.

Self-assessed literacy
How would you assess your understanding of economics (on a 7-point scale; 1 means very low and 7 means very high)?

Very low   *Very high*
[ ] 1   [ ] 2   [ ] 3   [ ] 4   [ ] 5   [ ] 6   [ ] 7
[ ] Do not know
[ ] Refusal

The index *of self-assessed literacy* used in the regression analysis is constructed by grouping together the two lowest categories (very few respondents have chosen the lowest level), recoding the remaining six levels of self-assessed literacy from 1 to 6 and excluding 'do not know' answers and 'refusals.'

Economics education
How much of your education was devoted to economics?

[ ] A lot
[ ] Some
[ ] Little
[ ] Hardly at all
[ ] Do not know
[ ] Refusal

The instrument variable *economics education in the past* is used in the regression analysis by including three dummy variables for the response categories 'some', 'little' and 'hardly at all,' respectively. The reference group consists of those respondents whose education was devoted 'a lot' to economics. The 'do not knows' and 'refusals' are grouped together with the 'hardly at all' answers.

Conversion to Euro
In 2002 we went from the guilder to the Euro. How difficult was it for you back then to go shopping, read your bank statements and do your usual daily transactions using the Euro?
[ ] Very difficult
[ ] Difficult
[ ] Somewhat difficult
[ ] Not very difficult
[ ] Not difficult at all
[ ] Do not know
[ ] Refusal

The variable *conversion to euro* is used in the regression analysis by including three dummy variables for the response categories 'somewhat difficult', 'not very difficult' and 'not difficult at all,' respectively. The reference group consists of those respondents who found the transition from the guilder to the euro 'very difficult' or 'difficult'. 'Do not knows' and 'refusals' are grouped together with these latter two categories.

Health care system change
H1) This year, the Dutch system of health insurance has changed. How difficult is it for you to understand the new Health Insurance system?
[ ] Very difficult
[ ] Difficult
[ ] Somewhat difficult

[ ] Not very difficult
[ ] Not difficult at all
[ ] Do not know
[ ] Refusal

[If the response to question H1 is not equal to 'not very difficult' or 'not difficult at all' then the following question (H2) is asked]
H2) Could you please indicate which of the following statements best describes what makes the decisions you have to make difficult?
[ ] I have to make comparison and spend time reading and collecting information
[ ] I have to find a way to figure out what is best for me to do
[ ] I do not know how to make this kind of decisions
[ ] Do not know
[ ] Refusal

The variable *health care system change* is used in the regression analysis by including three dummy variables for the first three response categories in question H2. The 'do not know' and 'refusal' answers are grouped together with the group which indicated 'I do not know how to make this kind of decisions'. The reference group consists of those respondents who reported they find the change in the system of health insurance either 'not very difficult' or 'not difficult at all.'

Risk aversion
R1) Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new, equally good job, with a 50% chance it will double your (family) income and a 50% chance that it will cut your (family) income by a third. Would you take the new job?

[ ] Yes
[ ] No
[ ] Do not know

[If R1='yes' then R2]
R2) Suppose the chances were 50% that it would double your (family) income, and 50% that it would cut it in half. Would you take the new job?

[ ] Yes
[ ] No
[ ] Do not know

[If R1='no' or 'do not know' then R3]
R3) Suppose the chances were 50% that it would double your (family) income and 50% that it would cut it by 20 percent. Would you then take the new job?

[ ] Yes
[ ] No
[ ] Do not know

The variable *risk aversion* is used in the regression analysis by including four dummy variables: One for those who choose the most risky option twice (least risk averse), one for those who choose the most risky option the first question but not in the second question (medium risk averse), one for those who choose the safe option in the first question but not in the second question (risk averse) and one for those who do not make a choice in the first question (do not know), respectively. The reference group consists of those respondents who choose the safe option twice (most risk averse).