



Contents lists available at ScienceDirect

# Journal of Financial Economics

journal homepage: [www.elsevier.com/locate/jfec](http://www.elsevier.com/locate/jfec)



## Financial literacy and stock market participation<sup>☆</sup>

Maarten van Rooij<sup>a,b</sup>, Annamaria Lusardi<sup>c,b,d,\*</sup>, Rob Alessie<sup>e,b,f</sup>

<sup>a</sup> Dutch Central Bank, The Netherlands

<sup>b</sup> Netspar, The Netherlands

<sup>c</sup> Department of Economics, Dartmouth College, Hanover, NH 03755, United States

<sup>d</sup> NBER, United States

<sup>e</sup> University of Groningen, The Netherlands

<sup>f</sup> Tinbergen Institute, The Netherlands

### ARTICLE INFO

#### Article history:

Received 9 October 2008

Received in revised form

1 March 2010

Accepted 2 August 2010

Available online 10 March 2011

#### JEL classification:

D91

G11

D83

#### Keywords:

Portfolio choice

Knowledge of economics and finance

Financial sophistication

Risk diversification

Learning from peers

### ABSTRACT

We have devised two special modules for De Nederlandsche Bank (DNB) Household Survey to measure financial literacy and study its relationship to stock market participation. We find that the majority of respondents 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 respondents do not know the difference between bonds and stocks, the relationship between bond prices and interest rates, and the basics of risk diversification. Most importantly, we find that financial literacy affects financial decision-making: Those with low literacy are much less likely to invest in stocks.

© 2011 Elsevier B.V. All rights reserved.

<sup>☆</sup> We are grateful to James Banks, Johannes Binswanger, Marcello Bofondi, Henrik Cronqvist, Dimitris Georgarakos, Michael Haliassos, Lex Hoogduin, Adriaan Kalwij, Arie Kapteyn, Mauro Mastrogiacomo, Theo Nijman, Gerard van den Berg, Peter van Els, Arthur van Soest, and participants in the Program on the Global Demography of Aging Seminar Series at the Harvard School of Public Health, the CERP/Netspar European Pension Challenges Conference (London, September 2006), the Netspar Workshop on the Micro-economics of Ageing (Utrecht, November 2006), the Plenary Session at the Italian Congress of Econometrics and Empirical Economics (Rimini, January 2007), the Workshop on Behavioral Approaches to Consumption, Credit, and Asset Allocation (European University Institute, May 2007), the Netspar Workshop (Groningen, June 2007), and the Conference on the Luxembourg Wealth Study: Enhancing Comparative Research on Household Finance (Rome, July 2007) for suggestions and comments. We also thank the staff of CentERdata and, in particular, Corrie Vis for their assistance in setting up the survey and the field work. The views expressed in this paper are those of the authors and do not necessarily reflect the views of De Nederlandsche Bank.

\* Corresponding author at: Department of Economics, Dartmouth College, Hanover, NH 03755, United States. Tel.: +1 603 646 2099; fax: +1 603 646 2122.

E-mail address: [Annamaria.Lusardi@Dartmouth.edu](mailto:Annamaria.Lusardi@Dartmouth.edu) (A. Lusardi).

## 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 to social security and pensions have caused an ongoing shift in decision-making responsibility away from the government and employers and 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, 2007a, 2008, *in press*; National Council on Economic Education (NCEE), 2005; 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; 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, 2007a, *in press*) and are more likely to take up high-interest mortgages (Moore, 2003) or have problems with debt (Lusardi and Tufano, 2009).

To measure financial literacy and assess its relationship to financial decision-making, we have devised two special modules for the DNB (De Nederlandsche Bank) 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 financial 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 respondents 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 respondents do not know the difference between bonds and stocks, the relationship between bond prices and interest rates, and the basics of risk diversification. 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. Most importantly, low-literacy individuals 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 workings 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 respondents’ current levels of literacy but also the experiences of respondents’ family and peers, who can influence respondents’ acquisition of knowledge. 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 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 (*in press*) devised a module on financial literacy for the 2004 U.S. Health and Retirement Study (HRS). Their questions aimed to test basic financial knowledge related to the workings 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 educational attainment (Lusardi and Mitchell, 2008, *in press*). These results are surprising not only because the literacy questions were rather 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 in surveys by the National Council on Economic Education (NCEE), which 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; Moore, 2003).

While these studies focus on data from the United States, surveys from other countries show very similar results. Studies by the Organisation for Economic Co-operation and Development (OECD) (2005) and 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 (2010), which uses data very similar to the U.S. 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.<sup>1</sup> Similarly, Lusardi and Mitchell (2007a, in press) 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 (2009), 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 (2009) further show that financial mistakes are prevalent among the young and the elderly, which are the groups displaying the lowest amount of financial knowledge. Calvet, Campbell, and Sodini (2009) examine data from Sweden and construct an index of financial sophistication based on the actions of investors. They found that poorer, less educated, and immigrant households—demographic characteristics that are strongly associated with low financial literacy—are more likely to make financial mistakes.

The measures of financial literacy used in existing studies are often crude. For example, Lusardi and Mitchell (2007a, 2008, in press) rely on only three questions to measure financial literacy, and Stango and Zinman (2009) 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 2005 survey). In this paper, we overcome the problems of some of the previous

studies by providing comprehensive measures of financial literacy as well as an evaluation of the quality of the literacy data. In addition, we link financial literacy to 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 explanations that have been offered are short sale constraints, income risk, inertia, and departures from expected utility maximization (Haliassos and Bertaut, 1995), but it has proven difficult 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, 2008) and the influence of neighbors and peers (Hong, Kubik, and Stein, 2004; Brown, Ivkovic, Smith, and Weisbenner, 2008). Yet other authors have started to consider limited numeracy, intelligence quotient (IQ), and cognitive ability (Christelis, Jappelli, and Padula, 2010; Kezdi and Willis, 2008; Grinblatt, Keloharju, and Linnainmaa, in press) and lack of asset awareness (Guiso and Jappelli, 2005). 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 that provide information to assess the direction of causality between financial literacy and stock market participation.

### 3. Data

We use data from the 2005 De Nederlandsche Bank's Household Survey (DHS). The 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.<sup>2</sup> The data set is representative of the Dutch population, and it contains over 2,000 households.

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

<sup>1</sup> However, see the findings of Cole and Shastry (2008).

<sup>2</sup> <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.

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 was first done by phone with a randomly selected sample of households. Households without an Internet connection were provided with a connection or with a set-top box for their television (for those who did 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, 2009).

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 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.<sup>3</sup>

#### 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 workings 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 the stock market, the workings 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 financial literacy.<sup>4</sup> Households are instructed to answer the questions without consulting additional information or using a calculator.<sup>5</sup>

The exact wording of the questions measuring basic financial literacy is reported 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 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 1 (Panel A). Most respondents answer the first question correctly; 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% (see Panel B of Table 1). Thus, while many respondents display knowledge of a few financial concepts, basic financial literacy is not widespread.

<sup>3</sup> Throughout our empirical analysis, we always use household weights to ensure that our statistics are representative of the population.

<sup>4</sup> For an analysis of the module on financial literacy in the 2004 HRS, see Lusardi and Mitchell (2011). For a review of financial literacy surveys across countries, see Lusardi and Mitchell (2007b).

<sup>5</sup> This facilitates the comparison with other surveys, which are normally done via telephone. Moreover, this procedure better enables researchers to assess what respondents know.

**Table 1**

Basic financial literacy.

Panel A reports the proportion of households providing correct, incorrect, and “do not know” answers to each of the five basic literacy questions. Panel B reports the distribution of the number of correct, incorrect, and “do not know” answers on the five basic literacy questions. The data are from the 2005–2006 DNB Household Survey.

<i>Panel A: Basic financial literacy</i>						
Weighted percentages of correct and incorrect answers ( $N=1,508$ )						
	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.						
<i>Panel B: Summary of responses</i>						
Weighted number of correct and incorrect answers ( $N=1,508$ )						
Number of correct, incorrect, and do not know answers (out of five questions)						
	None	1	2	3	4	All
Correct	2.3	2.8	6.7	15.1	32.8	40.2
Incorrect	45.2	35.7	13.6	4.4	1.1	0.0
Do not know	88.9	5.9	1.7	1.4	0.7	1.5
Mean						

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

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 in Box 2.<sup>6</sup>

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; and the workings 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 workings of mutual funds, and the relationship between bond prices and interest rates.

Responses to these questions are reported in Table 2 (Panel A). The pattern of answers is much different than that from the previous set of questions. For example, the

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 difficulty 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 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 respond incorrectly to or state they do not know answers to questions about stocks, bonds, and the workings of mutual funds. Panel B of Table 2 shows that only a tiny fraction of respondents (5%) is 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 1 and 2 show that financial literacy should not be taken for granted. These findings echo the results found in U.S. surveys such as the HRS and the Survey of Consumers (see Lusardi and Mitchell, in press; Hilgert and Hogarth, 2002).

When lack of financial knowledge is so widespread, one has to worry about whether respondents even understand the meaning of the questions and about the prevalence of guessing and random answers. To assess the relevance of these problems, we used the following strategy: We inverted

<sup>6</sup> 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 behavior of Dutch financial markets). Specifically, we took question 6 from the National Council of Economic Education Survey (2005); questions 7 and 9 from the National Association of Securities Dealers (NASD) Investor Knowledge Quiz; question 15 from the 2004 Health and Retirement Study module on financial literacy; and questions 8, 10, 11, 12, 13, 14, and 16 from the Survey of Financial Literacy in Washington State (Moore, 2003), the Survey of Consumers (Hilgert and Hogarth, 2002), and the John Hancock Financial Services Defined Contribution Plan Survey (2002). We took the questions that best reflect financial sophistication related to financial instruments and the workings 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; (v) 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.

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 (shown in Table 3) tells us that the wording of the question matters, particularly for the difficult questions. When comparing the responses 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 is inverted. For example, the number of correct answers is very low when respondents are asked whether “buying a stock mutual fund usually provides a safer return than a company stock,” but it doubles when respondents are asked the same question but in inverted order: “buying a company stock usually provides a safer return than a stock mutual fund.” 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).<sup>7</sup> 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 16 questions in the financial literacy module. Consistent

the wording of questions and exposed two randomly chosen groups of respondents to the same question but with different wording. We did so for three types of questions: A simple question about the riskiness of bonds versus stocks,

<sup>7</sup> It is consistent, however, with another rule of thumb that was mentioned to us regarding the behavior of students. They tend to reply “false” to a true-false question when they are not sure about the answer.

**Table 2**

Advanced financial literacy.

Panel A reports the proportion of households providing correct, incorrect, and “do not know” answers to each of the 11 advanced literacy questions. Panel B reports the distribution of the number of correct, incorrect, and “do not know” answers on the 11 advanced literacy questions. The data are from the 2005–2006 DNB Household Survey.

Panel A: 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? <sup>1)</sup>											67.0	12.9	19.7
What happens if somebody buys the stock of firm B in the stock market? <sup>1)</sup>											62.2	25.6	11.0
Which statement about mutual funds is correct? <sup>1)</sup>											66.7	11.2	21.7
What happens if somebody buys a bond of firm B? <sup>1)</sup>											55.5	17.7	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, or 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? <sup>2)</sup>											60.2	15.1	24.3
Buying a company fund usually provides a safer return than a stock mutual fund. True or false? <sup>2)</sup>											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? <sup>2)</sup>											24.6	37.1	37.5
<sup>1)</sup> See exact wording in Section 3 of the text.													
<sup>2)</sup> 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.													
Panel B: 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% and means do not sum up to 11 due to rounding and refusals.

**Table 3**

Advanced literacy: Responses to questions with inverted wording.

This table reports the proportion of households providing correct, incorrect, and “do not know” answers to the three advanced literacy questions that were asked in two versions with a slightly different wording. For each of these three questions, households were assigned randomly to one of the two versions. The table shows weighted percentages and the Pearson chi-square statistic to test the null hypothesis that the wording of the question is irrelevant for the distribution of correct and incorrect answers ( $p$ -values reported in parentheses). The data are from the 2005–2006 Household Survey.

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

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.”

with the way we have devised the financial literacy questions, the factor analysis indicates there are two main factors with different loading on two types of questions: The simple literacy questions (first five 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 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 (in press), it is important to exploit this information to differentiate among degrees of financial knowledge. Details about the factor analysis are reported in Appendix A. Interestingly, the factor loadings of the financial literacy index are not heavily tilted toward the question that stocks outperform bonds in the long run. Thus, the index does more than capture beliefs about investment opportunities.

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 Table 4. As expected, basic financial literacy increases strongly with education. Those with the lowest level of basic financial literacy are concentrated in the lowest educational categories: primary and preparatory intermediate vocational schools. Conversely, those with a higher vocational education (similar to a college degree in the United States) or a university education fall in the highest quartiles of the basic literacy index. The profile of basic literacy has a hump shape with regard 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 (2009). Table 4 also shows that there are large gender differences in basic literacy: Women display much lower basic knowledge than men. These findings are similar to those reported by Lusardi and Mitchell (2008) and the findings in other literacy surveys (Lusardi and Mitchell, 2007b).

Considering more advanced financial knowledge in Table 4 (Panel B), again we find a strong relationship to 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% are at the top quartile of advanced literacy (the proportion is 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 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 (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 Panel C of Table 4 we report the relationship between these measures of literacy and a subjective



Basic and advanced financial literacy across demographics (weighted percentages).

Panel A: Basic financial literacy across demographics

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

Advanced literacy quartiles

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

Table 4 (continued)

Panel C: Basic and advanced literacy versus self-assessed literacy						
	Basic literacy quartiles					
Self-assessed literacy	1 (low)	2	3	4 (high)	Mean	N
Panel C: Basic and advanced literacy versus self-assessed literacy						
	Basic literacy quartiles					
Self-assessed literacy	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)		
	Advanced literacy quartiles					
Self-assessed literacy	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.

measure of financial knowledge. In our module we asked respondents to report on a scale from 1 to 7 their understanding of economics.<sup>8</sup> Such a question has the advantage of being simple and direct. Moreover, it does not mention stock market participation. Note also that the question is located at the beginning of the literacy module, before any of the questions included in the basic and advanced financial literacy indices are asked. Thus, respondents have to assess their own knowledge before they answer the literacy questions. Most respondents assessed their economic knowledge as being above 3: 25.38% of respondents put their level at 4; 32.75% at 5; and 24.27% at 6. Only 2.71% reported their knowledge of economics as being very high (7). 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 self-reported levels of 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 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 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.

<sup>8</sup> See Appendix B for the precise wording of this question.

**Table 5**

Most important source of advice for different levels of literacy.

This table shows, for different levels of basic and advanced financial literacy, the sources of advice used in making important financial decisions. We group the basic and advanced literacy measures in four quartiles and report weighted percentages of households within each literacy quartile using a specific source of information ( $N=1,135$ ). The data are from the 2005–2006 DNB Household Survey.

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.

This table shows stock ownership across different levels of education and different age groups, across gender and marital status, and across different levels of net household income, wealth (excluding equity wealth), and basic as well as advanced literacy. Income, wealth, and literacy are grouped in four quartiles. The table reports weighted percentages and stock ownership is defined as owning individual stocks and/or mutual funds ( $N=1,189$ ). The data are from the 2005–2006 DNB Household Survey.

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

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 advisers, 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 reported 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 United States, many households do not participate in the stock market. This figure, however, hides major differences among demographic groups. As reported in Table 6, stock ownership increases sharply with education levels.<sup>9</sup> 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 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 Haliassos and Bertaut, 1995) and consistent with the sharp differences in literacy between women and men (Lusardi and Mitchell, 2008, *in press*). 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 benefits, social security and pension benefits, 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, additional real estate, and other financial assets minus total debt.<sup>10</sup> These findings are similar to those reported in many other papers on stock-ownership (see the review in Guiso, Haliassos, and Jappelli, 2002; Campbell, 2006).

<sup>9</sup> 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.

<sup>10</sup> 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).

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 workings of the stock market.<sup>11</sup> 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 advanced 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 importantly, we will address the direction of causality between stock ownership and financial literacy.

Our empirical specification recognizes that 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; Campbell, 2006). We added a dummy for respondents who are retired to account for the fact that some households may be in the decumulation 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.<sup>12</sup>

Most importantly, 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 workings of financial markets—stay away from the stock market. We use the index for advanced literacy to account for financial knowledge. However, in our preferred specification we also add an index of basic knowledge to account for different levels of literacy (basic versus advanced) as well as to control for cognitive ability, as was done in previous work (Christelis, Jappelli, and Padula, 2010).<sup>13</sup> Given the richness of data in our survey,

<sup>11</sup> Previous studies that acknowledge the link between financial knowledge and stock ownership, such as Haliassos and Bertaut (1995) and Vissing-Jorgensen (2004), had to refer to crude, noisy proxies for financial sophistication such as education, income, or wealth. An important contribution to this literature is provided by Christiansen, Joensen, and Rangvid (2008), who show that economics education—which is more closely related to financial literacy than the level of schooling itself—is an important predictor of stock ownership.

<sup>12</sup> 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.

**Table 7**

Multivariate analysis of stock market participation: OLS results.

This table reports OLS estimates of the effect of financial literacy and several control variables on stock market participation. The data are from the 2005–2006 DNB Household Survey.

	OLS (1)		OLS (2)		OLS (3)	
Advanced literacy index			0.0892***	(0.0118)	0.0756***	(0.0125)
Age dummies (Base group: age ≤ 30)						
30 < age ≤ 40	−0.0250	(0.0456)	−0.00850	(0.0452)	−0.0119	(0.0451)
40 < age ≤ 50	0.0261	(0.0469)	0.0353	(0.0467)	0.0335	(0.0464)
50 < age ≤ 60	0.0133	(0.0480)	0.0165	(0.0474)	0.0202	(0.0474)
Age > 60	0.0604	(0.0617)	0.0734	(0.0595)	0.0898	(0.0597)
Education dummies (Base group: < int. vocational)						
Intermediate vocational	0.0352	(0.0372)	0.0247	(0.0363)	0.0279	(0.0365)
Secondary pre-university	0.0760*	(0.0411)	0.0298	(0.0414)	0.0242	(0.0427)
Higher vocational	0.110***	(0.0369)	0.0717*	(0.0366)	0.0651*	(0.0372)
University	0.153***	(0.0467)	0.102**	(0.0472)	0.0969**	(0.0471)
Male	0.109***	(0.0277)	0.0715***	(0.0275)	0.0591**	(0.0278)
Married	−0.0367	(0.0315)	−0.0267	(0.0312)	−0.0302	(0.0311)
Number of children	−0.00159	(0.0154)	0.00290	(0.0151)	0.00247	(0.0150)
Retired	−0.0252	(0.0550)	−0.0311	(0.0530)	−0.0305	(0.0533)
Self-employed	0.0458	(0.0557)	0.0319	(0.0574)	0.0206	(0.0579)
Ln(household income)	0.0916***	(0.0270)	0.0848***	(0.0263)	0.0813***	(0.0260)
Second wealth quartile (€2,300 < wealth ≤ €45,500)	0.100***	(0.0353)	0.0749**	(0.0346)	0.0834**	(0.0344)
Third wealth quartile (€45,500 < wealth ≤ €197,300)	0.155***	(0.0368)	0.117***	(0.0366)	0.124***	(0.0364)
Fourth wealth quartile (wealth > €197,300)	0.212***	(0.0419)	0.160***	(0.0425)	0.162***	(0.0422)
Basic literacy index					0.0147	(0.0104)
Economics education dummies (Base group: A lot)						
Some					−0.0200	(0.0418)
Little					−0.0117	(0.0456)
Hardly at all					−0.0282	(0.0478)
Daily use of economics dummies (Base group: A lot)						
Some					−0.103**	(0.0442)
Little					−0.142***	(0.0480)
Hardly at all					−0.0536	(0.0628)
Constant	−0.886***	(0.258)	−0.760***	(0.251)	−0.608**	(0.255)
Observations		1115		1115		1115
R-squared		0.103		0.135		0.146
p-Value test age coefficients=0		0.613		0.598		0.448
p-Value test education coefficients=0		0.00343		0.163		0.240
p-Value test economics education coefficients=0						0.931
p-Value test daily use of economics coefficients=0						0.0183

Note: Robust standard errors are reported in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

we can also account for other controls. For example, we include information on economics education, as the findings of Christiansen, Joensen, and Rangvid (2008) show that it is more important to control for economics education than for the level of schooling. To account for the fact that respondents can learn by doing and that current or past literacy can proxy for “interest in economics,” we use information on how much understanding of economics individuals need during daily activities (job, hobbies, etc.), which is available in the survey.<sup>13</sup> Those who are not interested in economics are unlikely to choose a job that requires a lot of economic knowledge.

In Table 7 we report the estimates using three different specifications: a basic specification similar to the one used in the majority of previous studies (Ordinary Least Squares (OLS)1), a second specification in which we add our measure of financial knowledge (OLS(2)), and a third specification in

which we add not only an index of basic literacy but also a set of dummies for whether the respondent has some economics education and for the understanding of economics required in his/her daily activities (OLS(3)).

According to the basic specification (OLS(1)), education, gender, income, and wealth are important predictors of participation in the stock market. However, even after controlling for the large set of demographic characteristics listed in the first specification, we find that financial literacy also matters for stock ownership (OLS(2)); those who display higher literacy are more likely to participate in the stock market. The estimates are sizable: A one-standard deviation increase in advanced literacy raises stock market participation by about 9 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 about 10 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 after accounting for basic literacy, economics

<sup>13</sup> 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.

<sup>14</sup> For the precise wording of these questions, see Appendix B.



education, and the need for understanding of economics in daily activities (OLS(3)), the estimate of advanced literacy does not change much. A notable finding is that economics education is not statistically significant. A possible interpretation is that once current advanced financial knowledge is taken into account, information on past education is less relevant, as economic training is an important but not an exclusive tool through which one can accumulate knowledge, and respondents could potentially learn from other activities. In this regard, the results indeed show that use of economic knowledge enters significantly into the regression; respondents who need a solid understanding of economics during daily activities are more likely to hold stocks. All in all, 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, even after accounting for past economic knowledge or need for economic knowledge.

There are several potential problems in relying on OLS estimates.<sup>15</sup> First, the index of literacy may be measured with substantial error. As we have argued before, many responses are imprecise and may result from 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 Table 7 to assess the effect of literacy.<sup>16</sup>

In devising the survey questionnaires, 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 and interest in economics) 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 the financial experiences of their siblings and parents.<sup>17</sup> Specifically, we collected information on whether the financial situation of the oldest sibling is “better,” “the same,” or “worse” than the financial situation of the respondent. We used this information as an instrument for the financial literacy of the respondent. The experience of others is not under the control of the respondent and is thus exogenous with respect to his or

her actions, but respondents can learn from those around them, thus increasing their own literacy.

One may argue that the experience of siblings can proxy for a common set of preferences or for a family fixed effect. While plausible in theory, the first-stage results reported in the first column of Table 8A do not show a positive but rather a negative correlation between financial literacy and the financial condition of siblings. In other words, if siblings are in worse financial condition than respondents, respondents are more likely to have higher financial literacy. This argues in favor of a learning channel rather than a proxy for unobserved family effect.

In addition to the financial situation of siblings, we also consider parents’ understanding of financial matters. While these data could proxy for family fixed effects (such as talents and ability), the first-stage regressions in the second column of Table 8A show again that respondents learn from the negative experience of parents: those who have parents with low understanding of financial matters are more likely to have high literacy.

These findings are consistent with the evidence of Lusardi (2003), who uses these instruments to assess the impact of retirement planning on saving; she finds that people whose older siblings and parents experience negative shocks are more likely to plan for retirement. Throughout all of the empirical specifications we use and the many robustness checks we perform, we consistently find that financial difficulties of siblings and low level of financial knowledge of parents are associated with higher levels of financial knowledge of the respondents.

The first-stage regressions reported in Table 8A show that not only are our instruments statistically significant but the *F*-statistics are high and above or in range with the value recommended to avoid the weak instruments problem (Staiger and Stock, 1997; Bound, Jaeger, and Baker, 1995). The first-stage results also continue to confirm the correlation between financial literacy and demographic characteristics such as education and gender, reported in Panel B of Table 4. Moreover, the estimates display the expected positive relationship between advanced financial literacy and basic cognitive ability, economics education, and the use of economics in daily activities.

The estimates in the second stage reported in Table 8B show that the relationship between literacy and stock market participation remains positive and statistically significant in the Generalized Method of Moments (GMM) regression. 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 also 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. Stock market participation and peer effects

Our instrument relies on the interaction with relatives. As in Lusardi (2003), it builds upon the assumption that people learn from negative experiences of others and are

<sup>15</sup> 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.

<sup>16</sup> The OLS estimates may also suffer from omitted variable 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 variable bias later in the text.

<sup>17</sup> For the precise wording of these questions, see Appendix B.

**Table 8A**

First-stage regressions.

This table shows the estimates of the first-stage regressions of advanced financial knowledge on the set of controls and dummy variables indicating the financial situation of the oldest sibling in comparison to the financial situation of the respondent. The reference group consists of those respondents whose oldest sibling is in a better financial situation. In addition to these variables, in the second column, two dummies for the parents' understanding of financial matters are added. The reference group consists of those respondents whose parents have the lowest understanding of financial matters. The data are from the 2005–2006 DNB Household Survey.

	OLS (1)		OLS (2)	
Age dummies (Base group: age $\leq 30$ )				
30 < age $\leq 40$	–0.152	(0.111)	–0.155	(0.112)
40 < age $\leq 50$	–0.0987	(0.106)	–0.101	(0.107)
50 < age $\leq 60$	0.0304	(0.110)	0.0167	(0.110)
Age > 60	0.000778	(0.140)	0.00373	(0.140)
Education dummies (Base group < intermed. vocational)				
Intermediate vocational	0.106	(0.0885)	0.0891	(0.0885)
Secondary pre-university	0.287***	(0.0871)	0.270***	(0.0873)
Higher vocational	0.212***	(0.0741)	0.197***	(0.0734)
University	0.341***	(0.0836)	0.332***	(0.0833)
Male	0.281***	(0.0607)	0.292***	(0.0607)
Married	–0.129*	(0.0678)	–0.119*	(0.0677)
Number of children	–0.0278	(0.0297)	–0.0297	(0.0298)
Retired	0.0649	(0.108)	0.0490	(0.108)
Self-employed	0.0732	(0.0947)	0.0706	(0.0922)
Ln(household income)	0.0614	(0.0564)	0.0436	(0.0560)
Second wealth quartile ( $\text{€}2,300 < \text{wealth} \leq \text{€}45,500$ )	0.260***	(0.0982)	0.256***	(0.0976)
Third wealth quartile ( $\text{€}45,500 < \text{wealth} \leq \text{€}197,300$ )	0.377***	(0.0945)	0.364***	(0.0938)
Fourth wealth quartile ( $\text{wealth} > \text{€}197,300$ )	0.447***	(0.0996)	0.438***	(0.0999)
Basic literacy index	0.258***	(0.0298)	0.255***	(0.0295)
Economics education dummies (Base group: A lot)				
Some	–0.152**	(0.0634)	–0.163**	(0.0635)
Little	–0.214***	(0.0739)	–0.227***	(0.0739)
Hardly at all	–0.452***	(0.0876)	–0.468***	(0.0882)
Daily use of economics dummies (Base group: A lot)				
Some	–0.149**	(0.0754)	–0.146*	(0.0747)
Little	–0.299***	(0.0845)	–0.294***	(0.0842)
Hardly at all	–0.273*	(0.143)	–0.272*	(0.143)
Financial situation oldest sibling (Base group: no sibling)				
Worse	0.385***	(0.0889)	0.308***	(0.0877)
The same or better	0.184**	(0.0838)	0.113	(0.0827)
Parents' understanding of financial matters (Base: low)				
Intermediate or high			–0.230**	(0.101)
Don't know			–0.553***	(0.155)
Constant	–0.881	(0.557)	–0.381	(0.562)
Observations		1035		1035
R-squared		0.332		0.342
F-statistic first-stage regression		11.52		8.818
p-Value test instruments=0		1.13e–05		5.35e–07
p-Value test education coefficients=0		0.272		0.314
p-Value test age coefficients=0		0.000456		0.000691
p-Value test education coefficients=0		5.19e–06		2.40e–06
p-Value test economics education coefficients=0		0.00408		0.00459
p-Value test daily use of economics coefficients=0		8.02e–05		0.000138

Note: Robust standard errors are reported in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

motivated to become financially knowledgeable by witnessing these experiences. Several other studies have documented that peer effects can be powerful determinants of portfolio choice (Hong, Kubik, and Stein, 2004; Brown, Ivkovic, Smith, and Weisbenner, 2008) and those peer effects can start early in the life-cycle. These papers suggest there is another and perhaps more direct effect of the interaction with others; people may get tips, advice, and information about the stock market from their peers. This learning mechanism is likely to be stronger for individuals in communities or social networks with high average stock market participation rates. Thus, we now

turn to see whether our estimates change after we control for this potential channel of learning about the stock market. We have information in the data set on the level of education and income that most of the respondents' acquaintances have. While education and income do not necessarily reflect knowledge of economics or investment in stocks, both variables are very strong predictors of stock market participation, as shown in Tables 6 and 8.

In Table 9, we report OLS and GMM estimates of the effect of literacy on stock market participation to which, in addition to the controls used previously, we add the average education and average income of peers (for

**Table 8B**

Multivariate analysis of stock market participation: GMM results.

This table reports GMM estimates of the effect of financial literacy and several control variables on stock market participation. The advanced literacy index has been instrumented using two dummy variables indicating the financial situation of the oldest sibling (GMM (1)). The reference group consists of those respondents whose oldest sibling is in a better financial situation. Additionally, two dummies measuring parents' understanding of financial matters are used as instruments; the reference group is the respondents whose parents have the lowest understanding of financial matters (GMM (2)). The data are from the 2005–2006 Household Survey.

	GMM (1)		GMM (2)	
Advanced literacy index	0.216*	(0.124)	0.177**	(0.0861)
Age dummies (Base group: age ≤ 30)				
30 < age ≤ 40	0.0171	(0.0541)	0.0106	(0.0507)
40 < age ≤ 50	0.0724	(0.0530)	0.0686	(0.0508)
50 < age ≤ 60	0.0369	(0.0520)	0.0380	(0.0508)
Age > 60	0.0971	(0.0619)	0.0965	(0.0609)
Education dummies (Base group < intermed. vocational)				
Intermediate vocational	0.0109	(0.0410)	0.0150	(0.0392)
Secondary pre-university	−0.00391	(0.0579)	0.00663	(0.0517)
Higher vocational	0.0471	(0.0475)	0.0551	(0.0431)
University	0.0413	(0.0666)	0.0557	(0.0576)
Male	0.0190	(0.0455)	0.0303	(0.0367)
Married	−0.0316	(0.0372)	−0.0371	(0.0347)
Number of children	0.0133	(0.0163)	0.0125	(0.0159)
Retired	−0.00871	(0.0544)	−0.00625	(0.0538)
Self-employed	0.0117	(0.0649)	0.0136	(0.0631)
Ln(household income)	0.0737**	(0.0292)	0.0764***	(0.0279)
Second wealth quartile (€2,300 < wealth ≤ €45,500)	0.0398	(0.0508)	0.0495	(0.0449)
Third wealth quartile (€45,500 < wealth ≤ €197,300)	0.0675	(0.0629)	0.0820	(0.0523)
Fourth wealth quartile (wealth > €197,300)	0.0924	(0.0755)	0.111*	(0.0621)
Basic literacy index	−0.0210	(0.0356)	−0.0105	(0.0265)
Economics education dummies (Base group: A lot)				
Some	0.0224	(0.0467)	0.0170	(0.0448)
Little	0.0324	(0.0540)	0.0238	(0.0497)
Hardly at all	0.0428	(0.0759)	0.0240	(0.0628)
Daily use of economics dummies (Base group: A lot)				
Some	−0.0742	(0.0489)	−0.0803*	(0.0469)
Little	−0.0898	(0.0612)	−0.102*	(0.0552)
Hardly at all	−0.0258	(0.0716)	−0.0349	(0.0678)
Constant	−0.558*	(0.290)	−0.587**	(0.275)
Observations		1035		1035
R-squared		0.090		0.120
p-Value test age coefficients=0		0.387		0.367
p-Value test education coefficients=0		0.780		0.678
p-Value test economics education coefficients=0		0.943		0.972
p-Value test daily use of economics coefficients=0		0.324		0.207
Hansen J-test p-value		0.0663		0.295
F-statistic first-stage regression		11.52		8.818
p-Value exogeneity test		0.299		0.255

Note: Robust standard errors are reported in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

simplicity, we only report the estimates of these new controls and the estimates for financial literacy). We find that the education of peers does matter for stock ownership (Panel A of Table 9); those who have peers with a college degree are 10–14 percentage points more likely to invest in 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 word-of-mouth information of peers. This conclusion does not change once we include the income of peers; these dummies are not statistically significant and do not much affect the effects of literacy on stock market participation (Panel B of Table 9).

## 6.2. Knowledge or cognition?

One of the issues about financial literacy is whether it measures knowledge or simply ability and cognition (Benjamin, Brown, and Shapiro, 2006; Stango and Zinman, 2009; Kezdi and Willis, 2008; Grinblatt, Keloharju, and Linnainmaa, *in press*). This distinction has important implications for public policy and for the effectiveness of financial education programs. In our work, we try to account for cognition by grouping 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

**Table 9**

Stock market participation and the importance of peer effects.

This table reports OLS and GMM estimates of the effect of literacy on stock market participation, controlling for the education of peers. The advanced literacy index has been instrumented using two dummy variables indicating the financial situation of the oldest sibling (GMM (1)). The reference group consists of those respondents whose oldest sibling is in better financial condition. Additionally, two dummies measuring parents' understanding of financial matters are used as instruments; the reference group is the respondents whose parents have the lowest understanding of financial matters (GMM (2)). The data are from the 2005–2006 DNB Household Survey.

Panel A: Education of peers		OLS	GMM (1)		GMM (2)	
Advanced literacy index	0.0828***	(0.0127)	0.202	(0.125)	0.187**	(0.0828)
Education of peers (Base group: primary)						
(Prep.) intermediate vocational and sec. pre-university	0.0587	(0.0483)	0.0194	(0.0585)	0.0221	(0.0540)
Higher vocational and university	0.135**	(0.0569)	0.103	(0.0679)	0.106*	(0.0626)
Demographics and other control variables (see Table 7)	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1044		979		979
R-squared		0.165		0.132		0.143
p-Value test education coefficients=0		0.900		0.879		0.877
p-Value test education peers coefficients=0		0.0351		0.0728		0.0608
Hansen J-test p-value				0.0796		0.358
F-statistic first-stage regression				10.10		8.415
p-Value exogeneity test				0.383		0.212
Panel B: Income of peers		OLS	GMM (1)		GMM (2)	
Advanced literacy index	0.0850***	(0.0130)	0.280*	(0.146)	0.229**	(0.0959)
Income of peers (Base group: income < €20,000)						
€20,000 ≤ income < €28,000	−0.0242	(0.0450)	−0.0769	(0.0584)	−0.0643	(0.0505)
€28,000 ≤ income < €38,000	0.0435	(0.0481)	0.0298	(0.0525)	0.0337	(0.0504)
Income ≥ €38,000	0.0565	(0.0506)	0.0522	(0.0554)	0.0574	(0.0530)
Do not know	0.0150	(0.0382)	0.0769	(0.0556)	0.0653	(0.0471)
Demographics and other control variables (see Table 7)	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1044		979		979
R-squared		0.163		0.059		0.113
p-Value test income peers coefficients=0		0.488		0.165		0.124
Hansen J-test p-value				0.132		0.457
F-statistic first-stage regression				8.802		6.786
p-Value exogeneity test				0.214		0.140

Note: Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

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 means of payment. In the second module, added to the DHS in January 2006, we asked respondents how difficult it was to shop, read bank statements, and perform typical daily transactions right after the introduction of the euro in 2002 (possible answers range from “very difficult” to “not difficult at all”).<sup>18</sup> 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 similar magnitude. Thus, financial literacy affects stock ownership above and beyond the effect of cognition and the ability to perform calculations.

The second important change in the Netherlands that we considered concerns the health system. A new law was passed in 2005 that introduced more freedom of choice into the Dutch health insurance system. Households were required to make decisions about their health providers, their contribution levels, and their policy deductible. 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, added in January 2006, we asked respondents how difficult it was to understand the new health insurance system (again, possible answers range from “very difficult” to “not difficult at all”).<sup>19</sup> However, contrary to the conversion to the euro—in which 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.<sup>20</sup> We further asked respondents the reasons for their answers, 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

<sup>19</sup> For the precise wording of these questions, see Appendix B.

<sup>20</sup> 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.

<sup>18</sup> For the precise wording of this question, see Appendix B.

**Table 10**

Stock market participation and alternative measures of basic literacy.

This table reports OLS and GMM estimates of the effect of financial literacy on stock market participation, using two different controls for ability: the difficulty faced with the currency transition from the Dutch guilder to the euro and with the introduction of a new health care system, respectively. In Panel A, 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 (DK).” In Panel B, the reference group consists of those respondents who report 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 two dummy variables indicating the financial situation of the oldest sibling (GMM (1)). The reference group consists of those respondents whose oldest sibling is in better financial condition. Additionally, two dummies measuring parents’ understanding of financial matters are used as instruments; the reference group is respondents whose parents have the lowest understanding of financial matters (GMM (2)). The data are from the 2005–2006 DNB Household Survey.

Panel A: Euro introduction		OLS	GMM (1)		GMM (2)	
Advanced literacy index	0.0801***	(0.0123)	0.166*	(0.0893)	0.157**	(0.0664)
Dealing with euro (Base group: very difficult or DK)						
Somewhat difficult	–0.0466	(0.0452)	–0.0377	(0.0472)	–0.0370	(0.0468)
Not very difficult	–0.0108	(0.0417)	–0.0129	(0.0447)	–0.0118	(0.0438)
Not difficult at all	0.0430	(0.0487)	0.0389	(0.0523)	0.0404	(0.0509)
Demographics and other control variables (see Table 7)	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1053		1035		1035
R-squared		0.148		0.130		0.135
p-Value test euro coefficients=0		0.190		0.335		0.317
Hansen J-test p-value				0.0685		0.334
F-statistic first-stage regression				17.51		11.56
p-Value exogeneity test				0.370		0.259
Panel B: Change health insurance system		OLS	GMM (1)		GMM (2)	
Advanced literacy index	0.0829***	(0.0126)	0.179**	(0.0892)	0.167**	(0.0677)
Difficulty health care system (Base group: not difficult)						
Making comparisons and collecting information	–0.00787	(0.0305)	–0.00291	(0.0312)	–0.00389	(0.0309)
Figuring out what the best is for me to do	–0.0230	(0.0365)	–0.00777	(0.0410)	–0.00984	(0.0398)
I don't know how to make these decisions & DK	0.0831	(0.0738)	0.0734	(0.0805)	0.0685	(0.0778)
Demographics and other control variables (see Table 7)	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1053		1035		1035
R-squared		0.145		0.119		0.127
p-value test health insurance coefficients=0		0.562		0.768		0.779
Hansen J-test p-Value				0.0622		0.306
F-statistic first-stage regression				18.18		11.85
p-value exogeneity test				0.304		0.221

Note: Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

because they had to spend time reading and collecting information (high cognitive ability respondents).

Overall, 43% of respondents found the health decisions “not very difficult” or “not difficult at all.” Of the remaining group, which reported the decision to be “very difficult,” “difficult,” or “somewhat difficult,” more than half reported that it was because they had to spend time making 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 10).

### 6.3. Including measures of risk aversion

Notably, one of the variables that 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.<sup>21</sup> Some researchers have further argued that knowledge and cognitive ability may have an effect on preferences such as risk aversion and the rate of time preference (Benjamin, Brown, and Shapiro, 2006; Dohmen, Falk, Huffman, and Sunde, 2010) 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 financial literacy index can 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.<sup>22</sup>

<sup>21</sup> 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 preferences different from the general class of Harmonic Absolute Risk Aversion (HARA) preferences to explain lack of stock ownership.

<sup>22</sup> For the precise wording of these questions, see Appendix B.



**Table 11**

Stock market participation, literacy, and risk aversion.

This table reports OLS and GMM estimates of the effect of literacy on stock market participation, controlling for risk aversion. In this regression, the reference group consists of those respondents who exhibit the highest degree of risk aversion according to the questions reported in Appendix B. The advanced literacy index has been instrumented using two dummy variables indicating the financial situation of the oldest sibling (GMM (1)). The reference group consists of those respondents whose oldest sibling is in better financial condition. Additionally, two dummies measuring parents' understanding of financial matters are used as instruments with the respondents whose parents have the lowest understanding of financial matters (GMM (2)) as a reference group. The data are from the 2005–2006 DNB Household Survey.

	OLS		GMM (1)		GMM (2)	
Advanced literacy index	0.0915***	(0.0145)	0.233*	(0.130)	0.188**	(0.0897)
Risk aversion (Base group: highest degree of aversion)						
Low	0.0555	(0.0458)	0.0306	(0.0534)	0.0398	(0.0489)
Medium	0.000791	(0.0547)	−0.0437	(0.0713)	−0.0292	(0.0631)
High	−0.0504	(0.0834)	−0.0768	(0.100)	−0.0618	(0.0939)
Don't know	0.00977	(0.0637)	0.0388	(0.0737)	0.0309	(0.0687)
Demographics and other control variables (see Table 7)	Yes	Yes	Yes	Yes	Yes	Yes
Observations		888		837		837
R-squared		0.138		0.090		0.120
p-Value test risk aversion coefficients=0		0.736		0.741		0.762
Hansen J-test p-value				0.0204		0.0879
F-statistic first-stage regression				12.72		9.114
p-Value exogeneity test				0.324		0.289

Note: Robust standard errors in parentheses; \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

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 the 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 respondent attitude toward risk is correlated to ownership of stocks: Those who are not willing to take risks 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 11, 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.

#### 6.4. Other extensions

We have pursued a variety of robustness checks other than those reported in Sections 5 and 6 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. 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. We found that respondents had considerable difficulty understanding the questions about bond pricing and the riskiness of a company stock versus a stock mutual fund. We performed the empirical analysis excluding the three questions for which we implemented a different wording. By excluding concepts that were rather difficult for respondents to grasp, we can check whether indices that have a stronger focus on basic economic concepts are still related to stock ownership. The OLS estimate of advanced literacy is 0.069 (standard error (s.e.) 0.0123) and the GMM estimates for two different instrument sets (see Table 8A for details) are 0.211 (s.e. 0.127) and 0.0181 (s.e. 0.090), showing that financial literacy is still related to stock market participation, even when we focus on an index that excludes several advanced economic concepts. 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.

We have also examined the relationship between financial literacy and savings account ownership. A much lower degree of financial sophistication and information cost is required to deal with this type of asset, and we would not expect to find a strong relationship with financial literacy. Indeed, in our empirical work, we do not find any relationship between our measures of literacy and ownership of savings accounts. The OLS estimate of advanced literacy is 0.00289 (s.e. 0.0051) and the GMM estimates for two different instrument sets are 0.0197 (s.e. 0.027) and 0.0346 (s.e. 0.021), respectively. This confirms the results of Christelis, Jappelli, and Padula (2010), who also found no relationship between cognitive ability and savings account ownership.

Moreover, rather than simply accounting for self-employment in our specification, we have excluded the self-employed from our sample. [Hurst and Lusardi \(2008\)](#) 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 0.0816 (s.e. 0.013) and the GMM estimates are 0.197 (s.e. 0.126) and 0.177 (s.e. 0.091), respectively. Thus, excluding the self-employed does not take away the importance of financial literacy for stock market participation.

## 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, Gomes, and Maenhout \(2005\)](#) show

that the welfare loss from non-participation in the stock market can be sizable. On the other hand, it is not clear that unsophisticated investors would be able to take full advantage of the stock market and invest efficiently. As reported in [Calvet, Campbell, and Sodini \(2007\)](#), unsophisticated investors are unlikely to make wise choices when investing in financial markets. For example, low-education and low-wealth investors are likely to hold poorly diversified portfolios. The demographic characteristics of the unsophisticated investors are very similar to the low-literacy individuals in our sample. 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 financial sophistication or to guide them in their financial decisions via, for example, financial education programs.

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 also affect 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.

**Table A1**

Factor loadings corresponding to the five basic literacy questions. The data are from the 2005–2006 DNB Household Survey.

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

## Appendix A. Constructing indices for basic and advanced financial literacy

The index for basic literacy is based on the first five questions reported in Section 4. For each basic literacy

**Table A2**

Factor loadings for the advanced literacy questions (four subsamples). DK refers to “do not know.” The data are from the 2005–2006 DNB Household Survey.

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 displays 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? <sup>1)</sup>	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? <sup>1)</sup>	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? <sup>1)</sup>	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? <sup>1)</sup>	Correct	0.5829	0.6365	0.5852	0.6436
	DK	−0.7178	−0.8032	−0.7434	−0.7402

<sup>1)</sup> See Box 2 in Section 3 for the exact wording of the questions.

Factor loadings for the advanced literacy questions, excluding the randomized questions. DK refers to “do not know.” The data are from the 2005–2006 DNB Household Survey.

<sup>1)</sup> See Box 2 in Section 3 for the exact wording of the questions.

The variable *economics education* 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.

### B.3. Daily use of economics

How much of an understanding of economics do you need during your daily activities (job, hobbies, etc.)?

- ☐ A lot
- ☐ Some
- ☐ Little
- ☐ Hardly at all
- ☐ Do not know
- ☐ Refusal

The variable *daily use of economics* 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 who need “a lot” of understanding of economics during daily activities. The “do not knows” and “refusals” are grouped together with the “hardly at all” answers.

### B.4. Sibling's financial situation

Would you say that your oldest [brother/sister] is in worse, better, or about the same financial condition than you?

- ☐ Worse
- ☐ Better
- ☐ About the same
- ☐ Refusal
- ☐ Do not know

The instrument variable *sibling financial situation* is used in the regression analysis by including two dummy variables for the response categories “worse” and “about the same” or “better,” respectively. The reference group consists of “do not knows” and “refusals” and those respondents who have no siblings.

### B.5. Parents' financial knowledge

How would you assess the understanding of financial matters of your parents? Please take the parent that is or was mostly responsible for the major financial decisions (on a 7-point scale; 1 means very low and 7 means very high)?

- |                                      |                            |                            |                            |                            |                            |                            |           |
|--------------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|-----------|
| Very low                             |                            |                            |                            |                            |                            |                            | Very high |
| <input type="checkbox"/> 1           | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |           |
| <input type="checkbox"/> Do not know |                            |                            |                            |                            |                            |                            |           |
| <input type="checkbox"/> Refusal     |                            |                            |                            |                            |                            |                            |           |

The instrument variable *financial knowledge parents* used in the regression analysis is constructed by grouping together the three lowest categories, the four highest categories, and the “do not know” and “refusal” categories, respectively.

### B.6. 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.

### B.7. 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 comparisons 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 decision
- ☐ 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 that indicated “I do not know how to make this kind of decision.” 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.”

### B.8. 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 in 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).

## References

- Agnew, J., Szykman, L., 2005. Asset allocation and information overload: the influence of information display, asset choice and investor experience. *Journal of Behavioral Finance* 6, 57–70.
- Agarwal, S., Driscoll, J., Gabaix, X., Laibson, D., 2009. The age of reason: financial decisions over the lifecycle and implications for regulation. *Brookings Papers on Economic Activity* 2, 51–117.
- Alessie, R., Hochguertel, S., Van Soest, A., 2002. Household portfolios in the Netherlands. In: Guiso, L., Haliassos, M., Jappelli, T. (Eds.), *Household Portfolios*. MIT Press, Cambridge, MA, pp. 341–388.
- Barsky, R., Juster, F., Kimball, M., Shapiro, M., 1997. Preference parameters and behavioral heterogeneity: an experimental study in the Health and Retirement Study. *Quarterly Journal of Economics* 112, 537–579.
- Bartlett, M., 1937. The statistical conception of mental factors. *British Journal of Psychology* 28, 97–104.
- Benjamin, D., Brown, S., Shapiro, J., 2006. Who is “behavioral”? Cognitive ability and anomalous preferences. Working Paper. Cornell University, Harvard University, and University of Chicago (unpublished).
- Bernheim, D., 1995. Do households appreciate their financial vulnerabilities? An analysis of actions, perceptions, and public policy. In: *Tax Policy and Economic Growth*, American Council for Capital Formation, Washington, DC, pp. 1–30.
- Bernheim, D., 1998. Financial illiteracy, education and retirement saving. In: Mitchell, O., Schieber, S. (Eds.), *Living with Defined Contribution Pensions*. University of Pennsylvania Press, Philadelphia, pp. 38–68.
- Bernheim, D., Garrett, D., Maki, D., 2001. Education and saving: the long-term effects of high school financial curriculum mandates. *Journal of Public Economics* 80, 435–565.
- Bernheim, D., Garrett, D., 2003. The effects of financial education in the workplace: evidence from a survey of households. *Journal of Public Economics* 87, 1487–1519.
- Bound, J., Jaeger, D., Baker, R., 1995. Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American Statistical Association* 90, 443–450.
- Brown, J., Ivkovic, Z., Smith, P., Weisbender, S., 2008. Neighbors matter: causal community effects and stock market participation. *Journal of Finance* 63, 1509–1531.
- Calvet, L., Campbell, J., Sodini, P., 2007. Down or out: assessing the welfare costs of household investment mistakes. *Journal of Political Economy* 115, 707–747.
- Calvet, L., Campbell, J., Sodini, P., 2009. Measuring the financial sophistication of households. *American Economic Review* 99, 393–398.
- Campbell, J., 2006. Household finance. *Journal of Finance* 61, 1553–1604.
- Chang, L., Krosnick, J., 2009. National surveys via RDD telephone interviewing versus the Internet: comparing sample representativeness and response quality. *Public Opinion Quarterly* 73, 641–678.
- Christelis, D., Jappelli, T., Padula, M., 2010. Cognitive abilities and portfolio choice. *European Economic Review* 54, 18–38.
- Christiansen, C., Joensen, J., Rangvid, J., 2008. Are economists more likely to hold stocks? *Review of Finance* 12, 465–496.
- Cocco, J., Gomes, F., Maenhout, P., 2005. Consumption and portfolio choice over the life-cycle. *Review of Financial Studies* 18, 490–533.
- Cole, S., Shastry, G., 2008. If you are so smart, why aren't you rich? The effects of education, financial literacy and cognitive ability on financial market participation. Working Paper. Harvard Business School, Wellesley College (unpublished).
- Constantinides, G., Donaldson, J., Mehra, R., 2002. Junior can't borrow: a new perspective on the equity premium puzzle. *Quarterly Journal of Economics* 117, 269–296.
- Davis, S., Kubler, F., Willen, P., 2006. Borrowing costs and the demand for equity over the life cycle. *Review of Economics and Statistics* 88, 348–362.
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., 2010. Are risk aversion and impatience related to cognitive ability? *American Economic Review* 100, 1238–1260.
- Grinblatt, M., Keloharju, M., Linnainmaa, J., 2008. IQ and stock market participation. *Journal of Finance*, in press, <http://www.afajof.org/afa/forthcoming/7875p.pdf>.
- Guiso, L., Haliassos, M., Jappelli, T., 2002. *Household Portfolios*. MIT Press, Cambridge, MA.
- Guiso, L., Jappelli, T., 2005. Awareness and stock market participation. *Review of Finance* 9, 537–567.
- Guiso, L., Sapienza, P., Zingales, L., 2008. Trusting the stock market. *Journal of Finance* 63, 2557–2600.
- Haliassos, M., Bertaut, C., 1995. Why do so few hold stocks? *Economic Journal* 105, 1110–1129.
- Heaton, J., Lucas, D., 2000. Portfolio choice and asset prices: the importance of entrepreneurial risk. *Journal of Finance* 55, 1163–1198.
- Hilgert, M., Hogarth, J., 2002. Financial knowledge, experience and learning preferences: preliminary results from a new survey on financial literacy. *Consumer Interests Annual* 48, 1–7.
- Hilgert, M., Hogarth, J., Beverly, S., 2003. Household financial management: the connection between knowledge and behavior. *Federal Reserve Bulletin* July, 309–322.
- Hong, H., Kubik, J., Stein, J., 2004. Social interaction and stock-market participation. *Journal of Finance* 59, 137–163.
- Hurd, M., 1990. Research on the elderly: economic status, retirement, and consumption and saving. *Journal of Economic Literature* 28, 565–637.
- Hurst, E., Lusardi, A., 2008. Liquidity constraints and entrepreneurship. Household wealth, parental wealth, and the transition in and out of entrepreneurship. In: Furchtgott-Roth, D. (Ed.), *Overcoming Barriers to Entrepreneurship in the United States*. Lexington Books, Lanham, MD, pp. 47–68.
- John Hancock Financial Services, 2002. *Insight into Participant Investment Knowledge and Behavior—Eighth Defined Contribution Survey*.
- Kezdi, G., Willis, R., 2008. Stock market expectations and portfolio choice of American households. Working Paper. University of Michigan (unpublished).
- Lusardi, A., 2003. Planning and saving for retirement. Working Paper. Dartmouth College (unpublished).
- Lusardi, A., Mitchell, O.S., 2007a. Baby boomers retirement security: the role of planning, financial literacy and housing wealth. *Journal of Monetary Economics* 54, 205–224.
- Lusardi, A., Mitchell, O.S., 2007b. Financial literacy and retirement preparedness: evidence and implications for financial education. *Business Economics* 42, 35–44.



- Lusardi, A., Mitchell, O.S., 2008. Planning and financial literacy: how do women fare? *American Economic Review* 98, 413–417.
- Lusardi, A., Mitchell, O.S., 2009. Financial literacy and planning: implications for retirement wellbeing. In: Lusardi, A., Mitchell, O.S. (Eds.), *Financial Literacy: Implications for Retirement Security and the Financial Marketplace*. Oxford University Press, Oxford, U.K., in press, <http://www.dartmouth.edu/~alusardi/Papers/FinancialLiteracy.pdf>.
- Lusardi, A., Tufano, P., 2009. Debt literacy, financial experiences, and overindebtedness. NBER Working Paper No. 14808.
- Mandell, L., 2004. Financial literacy: are we improving? Jump\$tart Coalition for Personal Financial Literacy, Washington, D.C.
- Moore, D., 2003. Survey of financial literacy in Washington State: knowledge, behavior, attitudes and experiences. Technical Report 03-39. Social and Economic Sciences Research Center, Washington State University.
- National Council on Economic Education (NCEE), 2005. What American teens and adults know about economics. Washington, D.C.
- Nyhus, E., 1996. The VSB-CentER saving project: data collection methods, questionnaire and sampling procedures. Progress Report 42. Tilburg University.
- Organization for Economic Co-Operation and Development (OECD), 2005. Improving financial literacy: analysis of issues and policies. Paris, France.
- Staiger, D., Stock, J., 1997. Instrumental variables regression with weak instruments. *Econometrica* 65, 557–586.
- Stango, V., Zinman, J., 2009. Exponential growth bias and household finance. *Journal of Finance* 64, 2807–2849.
- Vissing-Jorgensen, A., 2004. Perspectives on behavioral finance: does “irrationality” disappear with wealth? Evidence from expectations and actions. In: Gertler, M., Rogoff, K. (Eds.), *NBER Macroeconomics Annual 2003*. MIT Press, Cambridge, pp. 139–206.