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Financial Illiteracy and Stock Market Participation: Evidence from the RAND American Life Panel

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RAND

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Abstract

Financially unsophisticated consumers who consistently make sub-optimal financial decisions may suffer lasting consequences for long-term wealth accumulation and welfare. This paper focuses attention on a well-documented area of potentially suboptimal financial decision making: the lack of stock market participation. Using a broad-based assessment of financial literacy administered to a sample of older American respondents in the RAND American Life Panel (ALP), we use a novel strategy for establishing causation between stock-market related financial literacy and stock market participation, using knowledge of other financial topics as instrumental variables. We find that ignorance of stock market investment knowledge significantly reduces propensity to hold stocks. In particular, a decrease of one-standard deviation in the relevant measure suggests a decrease on the order of 10% in participation.

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Comments

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Financial Literacy: Implications for Retirement Security and the Financial Marketplace

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Financial Illiteracy and Stock Market Participation: Evidence from the RAND American Life Panel

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Financially illiterate households who consistently make suboptimal decisions may suffer lasting consequences for long-term wealth accumulation. This is particularly true for the US population given institutional changes shifting the burden of postretirement planning to the individual via the spread of defined contribution (DC) pension plans, leaving those who do not plan for retirement with lower net wealth (Lusardi and Mitchell, 2006, 2007). This population is also increasingly diversified, with a growing number of foreign-born households that face further language, educational, and cultural barriers to entry into formal financial systems (Braunstein and Welch, 2002). Many public and private stakeholders—including the federal government, nonprofit groups, and employers—have responded by supplying more education and tools for planning, under the implicit assumption that increases in financial literacy will lead to changes in behavior.

Evidence regarding the impact of financial illiteracy on financial behavior, however, has been both scarce and mixed (e.g., Martin, 2007; Agarwal et al., 2011). One reason for these limitations is that a substantial fraction of existing studies that address this question are based on the evaluation of specific financial education programs and policies. Bayer et al. (1996) and Bernheim et al. (2001) showed that employer-based financial education increases participation in saving plans, while financial education mandates in high school significantly increase adult propensity to save. Recently, however, other researchers (e.g., Duflo and Saez, 2003; Cole and Shastry, 2009) have found surprisingly small impacts of financial education programs on financial decision-making, particularly in comparison to other factors, such as peer effects and psychological biases. Yet detecting effects of financial literacy in such analyses is problematic: in addition to questions about external validity and program heterogenity, the observed efficacy of such programs depends on not one but two relationships: the ability of the program to affect literacy, and the effect of literacy on behavior. Further,

financial education programs may fail to affect literacy for many reasons. Nevertheless, research that links survey measures of knowledge to observed behavior more consistently finds that financial literacy is correlated with financial behavior, even if causality is difficult to establish. Hilgert et al. (2003) find that individuals with more financial knowledge are more likely to engage in recommended financial practices. Lusardi and Mitchell (2006, 2007) demonstrate that consumers with better financial knowledge are more likely to plan, to try to succeed in planning, and to invest in complex assets, a relationship which the authors show to be causal.

This chapter contributes to the evidence linking financial illiteracy and behavior by focusing attention on one aspect of household investment behavior critical to long-term wealth accumulation: stock market participation. Using a novel instrumental variables (IV) strategy, we establish a negative causal relationship between financial illiteracy and participation.

Standard portfolio theory results imply that all households, regardless of risk preferences, should hold some portion of their portfolio in stock, but 60–70 percent of US households hold no stocks at all (Haliassos and Bertaut, 1995; Campbell, 2006). The 'stockholding puzzle' has been related to features of the environment such as fixed costs (Vissing-Jorgenson and Attanasio, 2003), credit-constraints (Constantinides et al., 2002), and the wedge between borrowing and lending rates (Davis et al., 2006). Other work has examined cognitive, behavioral, and social explanations such as inertia and departures from expected utility maximization (Haliassos and Bertaut, 1995), trust and culture (Guiso et al., 2005), and the effect of social interactions (Hong et al., 2004; Christelis et al., 2005). Christelis et al. (2006) detect a positive relationship between cognitive ability and the decision to invest in stocks using the recent Survey of Health, Ageing, and Retirement in Europe (SHARE), as measured by mathematics, verbal fluency, and recall skills.

Several recent studies specifically address financial illiteracy and stock market participation; Guiso and Jappelli (2005) study the lack of awareness of stocks among Italian households, while Lusardi and Mitchell (2007) find a positive relationship between financial literacy measures and stock market participation in the 2004 US Health and Retirement Study (HRS). Endogenity bias, however, is a concern; for example, unobservable preferences can systematically lead individuals to purposively learn about stocks to participate in the market (Martin, 2007). One study that goes further is that of van Rooij et al. (2007), who use the Dutch DNB Household Survey (DHS) to develop a sophisticated measure of financial literacy. The authors find a significant positive relationship between advanced financial literacy and participation, establishing causality using economics education as an instrument. Nevertheless, their identification approach depends heavily on institutional features particular to the Netherlands that guarantee the exogenity

of economics education, where the authors note that there is virtually no access to financial education outside formal schooling. In the United States, however, this is clearly not the case: Bayer et al. (1996) report that by 1994, the majority of large employers offered some sort of financial education.

In what follows, we build on the work of van Rooij et al. (2007) and Lusardi and Mitchell (2007). We construct a stock-related investment illiteracy score based only on knowledge relevant to stock market participation, and we implement a novel IV strategy for establishing causation between stock-related investment illiteracy and stock market participation.[1]

Data and measurement in the RAND American Family Life Panel

The American Life Panel (ALP) is an ongoing Internet panel modeled after the CentERpanel in the Netherlands. At present, there are approximately 2,500 ALP respondents, representative of the general US population, and as of December 2007 the sample consisted of about 1,000 individuals aged 40 and older. ALP respondents are recruited through the monthly survey of the University of Michigan's Survey Research Center (SRC). This is the leading US consumer sentiment survey, incorporating the long-standing Survey of Consumer Attitudes (SCA), and yields the widely used Index of Consumer Expectations. Respondents in the panel either use their own computer to log on to the Internet or are supplied with a Web TV. This improves representativeness by allowing respondents lacking Internet access to participate in the panel.

About once a month, ALP respondents receive an email with a request to visit the ALP website and fill out questionnaires on the Internet. Typically an interview takes less than 30 minutes. Respondents are paid an incentive of about $20 per thirty minutes of interviewing (and proportionately less if an interview is shorter). Questions cover a wide range of topics, including health status, preferences over retirement, social preferences, and investment games, to study how people make financial decisions. The environment facilitates extensive survey experimentation, aiming for optimal presentation of information to respondents, gauged through the use of visual displays and requests for feedback to and from respondents.

Sample construction and summary statistics

For this analysis, we merged data collected from the same individuals over multiple waves of the ALP Monthly Surveys (MS). Information about income and asset portfolios is collected in wave 1 (MS1), risk aversion

Table 5.1 American Life Panel sample summary statistics

Statistic	Value
Sex (%)	
Female	56.3
Age (years)	
Mean	54.7
Median	54.0
*Annual 2002 Income**	
Mean ($)	206,523
Median ($)	61,000
Education (%)	
Grade school only	0.2
Some high school	1.9
HS grad	13.0
Some college	34.3
College grad	26.6
Higher degree	24.0
Percent owning stocks (including mutual funds)	68.0

Notes: Sample is based on 533 observations. *: Only available for 462 observations.

Source: Authors' calculations; see text.

measures in waves 2 and 3 (MS2 and MS3), and a detailed assessment of financial knowledge in wave 5 (MS5).

As the ALP is ongoing, the design is such that new respondents are recruited to the panel monthly. For this reason, the composition of the sample changes over time.[2] The sample for most of the analysis in this chapter consists of 533 observations, for which we have complete information on financial literacy, asset ownership, and at least one experimental measure of risk aversion (described later in the text). Table 5.1 provides summary statistics, which illustrate that the unweighted sample is clearly not typical of the US population. Mean age is approximately 55 in each sample, with a slight female majority. Respondents are better off and better educated than average, with median incomes of above $60,000 and over 80 percent having some education above high school level. Most strikingly, almost 70 percent own stocks.

A key variable needed to model demand is risk aversion, which we model here as a categorical variable based on the Barsky et al. (1997). This was elicited in MS2 of the ALP using hypothetical lotteries over lifetime income. Others, including van Rooij et al. (2007), have also adopted this measure when respondents are asked to imagine that they are the only income earner in their household but they have to change jobs due to allergies that require that they move. The first job guarantees total family income for life, while the second has uncertain income. Respondents are

not given any information about nonmonetary attributes of each job. Respondents then choose between guaranteed lifetime income 'c' at current levels, and a 50/50 gamble that would double income or cut it by different proportions $(1 - \lambda)$. An individual maximizing the expected value of utility '$U(\cdot)$' will select the safe option if $(1/2)\,U(2c) + (1/2)\,U(\lambda c) < U(c)$.

In the survey, the respondent was first asked to choose between the safe option and a 50/50 chance of doubling income or cutting income by 1/3. If the safe option was chosen, the respondent was presented with a choice of the safe option and a 50/50 chance of doubling income or cutting income by 1/5. If the safe option was again chosen, the respondent was asked to choose between the safe option and a 50/50 chance of doubling income or cutting income by 1/10, and then the set of questions was complete. If the risky option was chosen in the first question, the respondent was presented with a choice of the safe option and a 50/50 chance of doubling income or cutting income by 1/2. If the risky option was again chosen, the respondent was asked to choose between the safe option and a 50/50 chance of doubling income or cutting income by 3/4 and then the set of questions was complete. To measure risk aversion, we categorize individuals into groups based on the threshold value of λ, at which the respondent is willing to switch from the safe to the risky option: the more risk averse he/she is, the less he/she is willing to gamble with lifetime income.[3]

Measuring financial illiteracy: basic and advanced questions

The battery of questions for the evaluation of financial knowledge fielded in MS5 allow the respondent to refuse to answer, which means that he or she chooses to skip the question and move ahead in the survey.[4] In MS5, this occurs at a very low frequency, at most once for any of the questions listed later. In the first *basic* module, respondents are asked five questions listed in Table 5.2, each of which addresses a particular financial concept. These questions cover respondents' ability to perform simple calculations, understand how compound interest works, and understand inflation. Respondents are also asked to answer an *advanced* module, including specific questions that address higher-order knowledge about investing (e.g., van Rooij et al., 2007). These questions assess knowledge of assets, risk diversification, the working of market institutions, and the relationship between bond prices and interest rates. These questions, and the responses, are also listed in Table 5.2.

As one might expect, this sample is very financially knowledgeable, relative to the population. We benchmark this result using the nationally

TABLE 5.2 Financial literacy assessment questions (%)

	American Life Panel	Health and Retirement Study
Basic questions		
A. Compound interest		
1. 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	92.3	67.1
(ii) Exactly $102	2.3	22.2*
(iii) Less than $102	3.2	
(iv) Do not know	2.3	9.4
2. 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 in this account in total?		
(i) More than $200	77.7	
(ii) Exactly $200	15.6	
(iii) Less than $200	4.1	
(iv) Do not know	2.6	
B. Inflation		
3. 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 or exactly the same as today	0.9	13.4
(ii) Exactly the same	3.0	**
(iii) Less than today	94.2	75.2
(iv) Do not know	1.9	9.4
4. 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	3.2	
(ii) The same	78.8	
(iii) Less than today	16.7	
(iv) Do not know	1.3	
C. Time value of money		
5. 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	77.6	
(ii) His sibling	4.7	
(iii) They are equally rich	10.2	
(iv) Do not know	7.5	
Advanced questions		
Institutions 1		
1. Which of the following statements describes the main function of the stock market?		
(i) The stock market helps to predict stock earnings	10.0	
(ii) The stock market results in an increase in the price of stocks	1.3	
(iii) The stock market brings people who want to buy stocks together with those who want to sell stocks	75.9	
(iv) None of the above	7.5	
(v) Do not know	5.3	

(*continued*)

TABLE 5.2 Continued

	American Life Panel	Health and Retirement Study
Institutions 2		
2. Which of the following statements is correct?		
(i) Once one invests in a mutual fund, one cannot withdraw the money in the first year	1.5	
(ii) Mutual funds can invest in several assets, for example invest in both stocks and bonds	72.9	
(iii) Mutual funds pay a guaranteed rate of return which depends on their past performance	6.8	
(iv) None of the above	4.0	
(v) Do not know	14.9	
Returns 1		
3. Considering a long time period (e.g., 10 or 20 years), which asset normally gives the highest return?		
(i) Savings accounts	1.3	
(ii) Bonds	18.1	
(iii) Stocks	70.9	
(iv) Do not know	9.8	
Volatility 1		
4. Normally, which asset displays the highest fluctuations over time?		
(i) Savings accounts	1.5	
(ii) Bonds	1.7	
(iii) Stocks	90.0	
(iv) Do not know	6.8	
Volatility 2		
5. Stocks are normally riskier than bonds.		
(i) True	82.6	
(ii) False	4.1	
(iii) Do not know	13.1	
Bond prices 1		
6. If the interest rate falls, what should happen to bond prices?		
(i) Rise	37.9	
(ii) Fall	27.6	
(iii) Stay the same	13.2	
(iv) Do not know	21.2	
Diversification 1		
7. Buying a company stock usually provides a safer return than a stock mutual fund.		
(i) True	4.5	13.2
(ii) False	78.8	52.3
(iii) Do not know	16.5	33.7
Diversification 2		
8. When an investor spreads his money among different assets, does the risk of losing money.		
(i) Increase	4.9	
(ii) Decrease	81.9	
(iii) Stay the same	7.0	
(iv) Do not know	6.2	

Notes: Numbers may not add up to exactly 100% due to refusals. *: The HRS study gave as an answer option 'Exactly or less than $102' which is the statistic reported here.
** The HRS study did not give 'Exactly the same' as an answer option for this question.

Source: Authors' calculations; see text.

representative 2004 HRS described by Lusardi and Mitchell (2007), focusing on adults over the age of 50. Table 5.2 displays the answers to a subset of the MS5 questions that are the same as three questions administered by Lusardi and Mitchell in the HRS module; the second column shows the comparable results from the (unweighted) HRS sample. There are two principal explanations for the observed difference: mode effects and sample selection. Mode effects refer to the fact that presentations on a computer screen may affect respondents' ability to answer compared to the HRS, which is conducted on the phone. In addition, ALP respondents may also be able to receive help in answering the survey, which is unobservable. Dominitz and Hung (2006) analyze the gap in financial literacy between the MS and the HRS-derived sample in detail. They find that HRS respondents with Internet access display higher levels of financial literacy than respondents without Internet access. While difference in responses across the two surveys may result from sample selection, this issue remains to be further examined. To construct our financial literacy score, we follow van Rooij et al. (2007),[5] but depart from it in some key respects.

First, we construct an index for basic financial knowledge by performing principal components analysis (PCA) on binary indicators for the correct answers to the five questions in the basic module. We retain the first principal component and treat the score for this component as our index for basic knowledge. Next, instead of performing the same exercise for advanced financial literacy, we reclassify the 'advanced' questions about investment into two mutually exclusive groups, based on their relevance to stock market participation. We group knowledge of the relative risk/return of stocks, the stock market, stock mutual funds, and diversification (Questions 1–5, 7, and 8 in Table 5.3) together as being directly related to the decision to participate in the stock market. The remaining question, knowledge of the inverse relation between bond prices and interest rates, is not directly related (Question 6 in Table 5.2).

It is important to note that financial illiteracy (which we define as not having any knowledge of financial matters) is distinct from having mistaken subjective beliefs, and has different implications for behavior. If individuals are ambiguity-averse, they prefer known risks over unknown risks. In this case, a financially illiterate individual with no financial knowledge will be less likely to participate than someone with some knowledge about stocks and their relative risks/returns (Gollier, 2006). On the other hand, consider someone who erroneously believes that stocks are not risky and have high returns. Such an individual is expected to be more likely to participate in the stock market, compared to the correctly informed person.

We therefore explicitly emphasize the difference between 'Don't know' responses to knowledge questions (which measure illiteracy or lack of knowledge, and therefore should reduce stock market participation, all

Table 5.3 Multivariate OLS estimates: individual financial literacy questions and stock market participation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Own any stock	Own any stock	Own any stock	Own any stock	Own any stock	Own any stock	Own any stock
Don't know: Institutions 1	–0.25**						
	(0.09)						
Don't know: Institutions 2		–0.29***					
		(0.05)					
Don't know: Returns			–0.29***				
			(0.07)				
Don't know: Volatility 1				–0.20*			
				(0.08)			
Don't know: Volatility 2					–0.19***		
					(0.06)		
Don't know: Diversification 1						–0.35***	
						(0.05)	
Don't know: Diversification 2							–0.26**
							(0.08)
N	533	533	533	533	533	533	533
R-squared	0.12	0.15	0.14	0.12	0.13	0.18	0.13

Notes: Mean of dependent variable 'owning any stock' = 0.68. All specifications include constant term and controls for gender, age, marital status, education, retirement status, and risk aversion. Upper threshold for *p*-values: *** 0.01, ** 0.05, and * 0.10.

Source: Authors' calculations; see text.

else equal) and incorrect responses (which may or may not reduce participation, depending on the question). We focus on the former, and control for the latter. To measure illiteracy, we construct an index for ignorance of stock market investment by performing PCA on seven binary indicators for 'Don't know' answers to the seven questions in the advanced module related to stock market investment, retaining one principal component and treating the score for this component as our index for stock market investment illiteracy.

Empirical analysis

In the multivariate analysis, we estimate equations of the following form, with stock ownership as the dependent variable *Y*:

$$Y_i = \beta X_i + \delta Z_i + \epsilon_i$$

where X_i is a vector of measures of interest and Z_i is a vector of individual-level control variables. With a binary dependent variable, when estimated by ordinary least squares (OLS), this specification is directly interpretable as a linear probability model. The vector of controls includes controls for age and education, with the lowest category in both cases omitted; gender; and, importantly, risk aversion. Our main hypothesis of interest is that $\beta < 0$ for our measures of stock-related investment ignorance.

Ordinary least squares/probit estimation

Tables 5.3 and 5.4 present results from estimating the impact of binary indicators for answering 'Don't know' to the individual questions about stock market investments. Individually, each of the regressors has the expected negative and strongly significant sign. We note also that the effects of most demographic controls also have the anticipated signs (not shown). Participation is strongly increasing with general education, and married

TABLE 5.4 Probit estimates: individual financial literacy questions and stock market participation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Own any stock	Own any stock	Own any stock	Own any stock	Own any stock	Own any stock	Own any stock
Don't know: Institutions 1	–0.27** (0.10)						
Don't know: Institutions 2		–0.31*** (0.06)					
Don't know: Returns			–0.30*** (0.08)				
Don't know: Volatility 1				–0.21* (0.09)			
Don't know: Volatility 2					–0.21** (0.07)		
Don't know: Diversification 1						–0.37*** (0.06)	
Don't know: Diversification 2							–0.28** (0.09)
N	533	533	533	533	533	533	533

Notes: Mean of dependent variable 'owning any stock' = 0.68. All specifications include controls for gender, age, marital status, education, retirement status, and risk aversion. Upper threshold for *p*-values: *** 0.01, ** 0.05, and * 0.10.

Source: Authors' calculations; see text.

Table 5.5 OLS/probit estimates: stock market illiteracy and participation

	(1)	(2)	(3)	(4)
	Own any stock	Own any stock	Own any stock	Own any stock
	OLS	Probit	OLS	Probit
Stock market illiteracy index			–0.13*** (0.02)	–0.14*** (0.02)
Don't know: Institutions 1	–0.00 (0.09)	–0.01 (0.11)		
Don't know: Institutions 2	–0.15* (0.06)	–0.17* (0.08)		
Don't know: Returns	–0.18* (0.08)	–0.20* (0.09)		
Don't know 4: Volatility 1	0.04 (0.09)	0.04 (0.09)		
Don't know 5: Volatility 2	–0.05 (0.06)	–0.07 (0.07)		
Don't know: Diversification 1	–0.24*** (0.06)	–0.25*** (0.07)		
Don't know: Diversification 2	0.00 (0.09)	–0.01 (0.10)		
N	533	533	533	533
R-squared	0.20		0.17	
F-stat: all DK variables = 0	8.75			
p-value	0.00			

Notes: All specifications include constant term (for OLS) and controls for gender, age, marital status, education, retirement status, and risk aversion. Upper threshold for *p*-values: *** 0.01, ** 0.05, and * 0.10.

Source: Authors' calculations; see text.

couples are also more likely to hold stocks. It appears at first that participation is increasing in our age dummies, but the overall effect is counterbalanced by the large negative and significant coefficient on retired status. With the presence of controls, risk aversion is not independently significant.

Table 5.5 presents the results of including all the binary indicators together in the OLS and probit regressions. The results show effects that are either negative and significant, or not significantly different from zero, which is consistent, but the high degree of correlation between the literacy variables makes these results hard to interpret meaningfully. We do, however, strongly reject the null hypothesis that all the coefficients on the literacy variables are jointly zero (see Column 1). Finally, Columns 3 and 4 present the results using the stock market illiteracy index alone, which is normalized to a mean of 0 and a standard deviation of 1. The estimates suggest that stock-related

Table 5.6 OLS estimates: stock market illiteracy, beliefs, and participation

	(1)	(2)	(3)	(4)
	Own any stock	Own any stock	Own any stock	Own any stock
Stock market illiteracy index	–0.13*** (0.02)	–0.12*** (0.02)	–0.10*** (0.02)	–0.10*** (0.02)
Basic financial knowledge index		0.05** (0.02)	0.06** (0.02)	0.06** (0.02)
Overestimate risk relative to returns		–0.13** (0.05)	–0.10 (0.06)	
Underestimate risk relative to returns		–0.04 (0.13)	0.06 (0.14)	
Don't know: Bond pricing		–0.02 (0.05)	0.00 (0.06)	
Log of 2002 income			0.05** (0.02)	0.06** (0.02)
Constant	0.25 (0.15)	0.27 (0.15)	–0.14 (0.23)	–0.18 (0.23)
N	533	533	462	462
R-squared	0.17	0.20	0.19	0.18

Notes: All specifications include constant term and controls for gender, age, marital status, education, retirement status, and risk aversion. Upper threshold for *p*-values: *** 0.01, ** 0.05, and * 0.10.

Source: Authors' calculations; see text.

investment illiteracy is significantly negatively related to stock market participation, with an effect of 12–13 percent. The OLS and probit analyses deliver qualitatively similar results in all these specifications, so for ease of exposition, we refer exclusively to OLS from here on.

Table 5.6 introduces additional controls to the initial estimates, which are reproduced in Column 1. In Column 2, we introduce controls for other types of knowledge, primarily the basic financial knowledge index of van Rooij et al. (2007). Adding controls reduces the estimated impact of illiteracy, but the result is generally robust. The impact of basic knowledge is positive and significant, although relatively small. In Columns 2 and 3, we also control for unrelated investment knowledge (bond pricing) and incorrect beliefs. First, we include an indicator for not knowing the relationship between bond prices and interest rates, along with two proxies for having mistaken beliefs about the relative risk/returns of stocks. If an investor believes that stocks are safer than bonds/saving and have a higher return, we regard this as having underestimated risk relative to returns. On the flip side, we treat the belief that stocks are riskier than bonds or saving and have a lower return as having overestimated risk relative to returns. In line with our earlier arguments, knowledge of the mechanics of bond

pricing or the lack thereof has no economically or statistically significant relation to stock market participation. Finally, the model suggests that wealth is excludable, but this arises solely as a consequence of our choice of utility function. For completeness, therefore, we also wish to introduce wealth as a control. Unfortunately, the ALP does not contain a comprehensive measure of wealth. In Columns 3 and 4, we include reported log 2002 income instead. The coefficients on our proxies for mistaken beliefs show that investors who overestimate the risk/return tradeoff are less likely to participate (although this effect is not robust to controlling for wealth), while there is no consistent or significant effect for investors who underestimate the risk/return tradeoff. Our wealth proxy positively affects participation. However, we note that the estimated coefficient on the illiteracy index is robust to this inclusion. Our preferred specification is thus Column 4, which suggests that an increase of one standard deviation above the mean level of illiteracy results in a 10 percent fall in stock market participation.

Instrumental variables analysis

Because linear regression may not lead us to correct inferences about the causal link between financial literacy and stock market participation, in this section, we turn to an instrumental-variables strategy as a check on our results. We test the validity of a set of candidate instruments, by checking for relevance and exogeneity of the instrument set, and select our preferred instruments. We then test for the endogeneity of our stock market illiteracy index.

It should be noted that endogenity can lead to biased coefficients, but the presence as well as direction of overall bias is not clear *a priori*. Endogenity could lead to bias in two directions. First, intrinsic unobservable characteristics may cause some people to seek information because they want to improve their financial results. The relationship between literacy and stock market participation will be underestimated if individuals who are strongly ambiguity-averse may respond more strongly to ignorance about the stock market by not participating. Also, if people are automatically enrolled in stock-holding retirement funds, we would expect that people with little or no knowledge of the stock market may be made to invest in stocks. On the other hand, learning-by-doing would instead lead to overestimation (van Rooij et al., 2007). Selection may also play a role: financially literate investors may be better at investing, and unsuccessful, less literate investors may be more likely to leave the market. There is also room for measurement error, as measures of illiteracy may have a significant amount of noise.

Table 5.7 Testing for valid instrumental variables (IV)

	(1)	(2)	(3)	(4)
	Own any stock	Own any stock	Own any stock	Own any stock
	2SLS	2SLS	2SLS	GMM
	IV(2)	IV(3)	IV(4)	IV(4)
Stock-related investment illiteracy index	–0.80* (0.39)	–0.75 (0.60)	–0.11 (0.07)	–0.11 (0.07)
Basic financial knowledge index	–0.07 (0.08)	–0.06 (0.12)	0.06* (0.03)	0.06* (0.03)
Anderson LR stat (under-identification)	4.87	1.81	56.89	56.89
Anderson LR stat: *p*-value	0.09	0.40	0.00	0.00
Cragg-Douglas *F*-statistic (weak instruments)	2.37	0.88	29.29	29.29
Sargan test statistic (over-identification)	0.00	0.00	0.22	
Sargan test statistic: *p*-value	1.00	0.99	0.64	
Pagan-Hall test statistic (homoskedasticity)	2.53	1.64	18.07	18.15
Pagan-Hall test statistic: *p*-value	1.00	1.00	0.20	0.20
N	462	462	462	462

Notes: All specifications include constant term and controls for gender, age, marital status, education, retirement status, and risk aversion. Upper threshold for *p*-values: *** 0.01, ** 0.05, and * 0.10. Also included are: IV(1), availability of financial education in high school; IV(2), availability of financial education in workplace; IV(3), self-assessed degree of economics education; IV(4), no knowledge of bond pricing.

Source: Authors' calculations; see text.

As the degree and sign on the bias are theoretically ambiguous, we take an empirical approach to accounting for this potential issue, using IV. In the ALP, there are four potential candidate instruments. We have two supply-related education variables: the availability of financial education in high school and in the workplace. Drawing on Bernheim et al. (2001), high school education may be determined largely by curricular mandates and so may be considered exogenous. Workplace education is more salient to the individual, but less plausibly exogenous. In particular, Bayer et al. (1996) suggest that employers tend to offer training on a remedial basis; that is, when participation by lower-wage employees in the 401(k) plan is low enough to fail discrimination testing.

We have also available a measure of self-reported economics education constructed by asking respondents how much of their education was

devoted to economics. Responses are categorized on a scale of 0 (none) to 3 (all). van Rooij et al. (2007) argue that self-reported economics education is a valid instrument in the Netherlands because economics education is available in high school and confined to formal schooling. There are no retirement seminars, as the vast majority of Dutch employees participate in mandatory, collective defined benefit (DB) pensions.

Novel to the analysis is our additional instrument, namely bond pricing knowledge. Here, the identification assumption is based on the notion that bond pricing knowledge, in theory, should not determine the stock market participation decision, but knowledge of bond pricing is likely to be highly correlated with aspects of financial literacy that are. The exclusion restriction is supported by estimates shown previously which demonstrated that the lack of knowledge of bond pricing has no direct impact on stock market participation. This is our preferred IV candidate.

Table 5.7 offers estimates of the specification using two-stage least squares, with the availability of high school financial education in combination with each of our three remaining candidates as instruments included in the first-stage regression. Basic financial knowledge and log annual income are also regressors, in addition to the demographic controls. In each specification, we check for exogenity by reporting the Sargan–Hansen test of overidentifying restrictions. The joint null hypothesis is that the additional instrument is uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Under the null, the test statistic is distributed as chi-squared in the number of overidentifying restrictions. To check for relevance, we also report the Anderson (1984) canonical correlations test, a likelihood-ratio test of whether the equation is identified (i.e., that the excluded instruments are correlated with the endogenous regressors).[6]

The results in Table 5.7 are striking. Column 1 shows that using financial education in the workplace marginally passes the test for relevance and fails the weak-instrument criterion. In Column 2, we also find that the instrument suggested by van Rooij et al. (2007) is not useful, as it does not pass the test of relevancy, nor does it satisfy the weak instruments criterion.[7] By contrast, in Column 3, our preferred candidate performs well with respect to all three tests. The bias introduced by the other two candidate instruments is clearly reflected in the relative size of the estimates.[8]

Specification testing using valid instruments

We note that in the two-stage least squares (2SLS) specification of our choice, the coefficient on stock market illiteracy is negative, but that it is now significant only at a 10 percent level ($p = 0.07$). Given that we have now established a set of valid IV,

it is possible to address our previous concern about the potential endogeneity of literacy, which otherwise cannot be verified. We therefore test for endogeneity using both the Wu-Hausman and Durbin–Wu-Hausman tests. The results show that we do not reject the hypothesis of exogenity under either test.[9] This suggests that the difference between the OLS and IV estimates is, in practice, small enough to allow us to treat literacy as exogenous. That is, endogeneity is not sufficiently serious as to warrant the less efficient method of IV estimation (which in our small sample, again, may represent a significant compromise). We can therefore legitimately treat the more precise OLS results as our preferred estimates.[10]

Further analysis

Planners

One major shortcoming of the analysis is our inability to account for respondents' use of investment professionals and planners. The use of planners complicates the analysis, as planners generally suggest investment in stocks and may themselves impart literacy. In the ALP, we have information on the reported incidence of consultation with financial planners for retirement planning, but the question was asked only to people who indicated they had started thinking about retirement and only about retirement planners, rather than to people who used financial planners for all investment decisions. Moreover, the questions were not asked of the self- or otherwise employed. Nevertheless, one-third of our sample did report using a planner. For this group, we find that individuals who had consulted a planner were much more likely to invest in stocks. But conditional on having a planner, the effect of financial illiteracy was not significant. Individuals who have not consulted a planner, conversely, were less likely to invest. More importantly, the impact of own illiteracy was twice as large and strongly significant. In other words, the evidence is consistent with the use of planners offsetting the effects of poor financial literacy, and for those without planners, the basic results are strengthened (Table 5.8).

Varying risk aversion measures

As an alternative to the Barsky et al. (1997) measure of risk aversion used thus far, a separate measure of risk aversion is available for a subset of respondents using the multiple price list method proposed by Holt and Laury (2002). Comparing the effects of using the two different experimentally based risk aversion measures, we find our basic results qualitatively unchanged.[11]

Table 5.8 Split-sample analysis with and without a planner

	(1)	(2)
	Own any stock	Own any stock
	With planner	Without planner
Stock market illiteracy index	–0.05 (0.06)	–0.08** (0.03)
Basic financial knowledge index	0.02 (0.04)	0.06* (0.03)
N	157	305
R-squared	0.16	0.18

Notes: All specifications include constant term and controls for log 2002 income, gender, age, marital status, education, retirement status, and risk aversion. Upper threshold for *p*-values: *** 0.01, ** 0.05, and * 0.10.

Source: Authors' calculations; see text.

Other social/behavioral factors: trust and social interaction

Another reason people may not invest in the stock market may be that they lack trust in financial institutions. Guiso et al. (2005) report that 'trusting' individuals were significantly more likely to buy stocks and risky assets and, conditional on investing in stock, they invested a larger share of their wealth. Their proxy for trust was a binary indicator for the level of generalized trust, based on a question asked in the World Values Survey: 'Generally speaking, would you say that most people can be trusted or that you have to be very careful in dealing with people?' The effect of this indicator was sizable: trusting others increased the probability of buying stock by 50 percent of the average and raised the share invested.

The ALP lacks questions that address 'generalized trust', but we can construct an alternative measure of trust based on a module designed to gather subjective expectations of particular events. Guiso et al. (2005) argue that trust increases investment, based on investor perceptions of the risk of expropriation. By the same logic, we include as the relevant measure the subjective probability of having property stolen in the next year.

In related literature, Hong et al. (2004) found that social interaction positively influences stock market participation, with those who reported interaction with neighbors or church attendance participating more in the stock market. Again, we lack a perfect proxy for these variables in the ALP. Instead, we use two other subjective measures, including whether or not the person felt alone often, and whether the person participated in a team or individual sport.

In other results not reported in detail here, we find our results are robust to the inclusion of these factors. Notably, we find no effect from subjective

property expropriation risk, or from the subjective assessment of being alone. We do, however, find that individuals who participated in sports (including team sports) were more likely to hold stocks, consistent with the findings of Hong et al. (2004).

Conclusion

This study has suggested that ignorance of financial matters, or financial illiteracy, negatively affects stock market participation, even for people whose wealth, education, and financial literacy are high relative to the general population. This finding is robust to the use of different risk metrics and background controls including income, social factors, and behavioral proxies for other explanations suggested in the literature. The external validity of the survey findings must, of course, be regarded with an eye to the selection inherent in the sample.[12] However, the findings do suggest that lack of familiarity with finance can be a meaningful impediment to financial participation, and for individuals who are highly averse to the unknown, building a basic awareness of investing may affect the long-term ability to accumulate wealth.

Several potential avenues are available for future research. First, the model does not account for how time-discounting and compounding enter the asset allocation problem, nor do we model life-cycle-related considerations, which may be relevant given the older age profile of our sample. Second, the empirical analysis is restricted to the binary stock participation decision; a natural next step is to move in the direction of structural estimation of the model's parameters. Third, the construction of literacy indexes is in itself a topic for extensive further research. Work currently underway with the ALP explores other, more sophisticated approaches, including a literacy assessment that directly addresses more functionally diverse areas. Fourth, other types of behavior (financial and otherwise) and their relationship to financial literacy remain to be explored. Finally, one interesting future topic for complementary research is the experimental elicitation of ambiguity preferences, allowing us to further explore the link between illiteracy and behavior.

These results shed additional light on the debates over financial literacy, and provide policymakers and practitioners with new evidence linking financial literacy to financial behavior.

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Endnotes

[1] For a more theoretical treatment of this relationship based on an extension of the standard portfolio choice model, the reader is referred to Yoong (2007), which explores in more depth the rationale for why only some types of financial literacy affect participation.

[2] For a description of the panel, its methodology, and to access the data subject to registration, see http://www.rand.org/labor/roybalfd/american_life.html

[3] As discussed by Barsky et al. (1997), under the assumption of relative risk aversion (CRRA), increasing values of this categorical measure can be used to compute (increasing) numerical bounds for the coefficient of risk aversion.

[4] The questions designed by Annamaria Lusardi and Olivia Mitchell correspond to the two modules in the DNB Household Survey designed by van Rooij et al. (2007). Almost all the same questions are asked, with identical wording.

[5] In very brief, the authors first conduct a factor analysis which indicates that there are two main factors with different loadings on the two separate groups of questions. Based on this initial finding, the authors generate two indices by performing separate factor analyses using all the questions in each of the two modules separately, retaining one latent factor in each case which is interpreted as 'basic' and 'advanced literacy'. In the case of basic literacy, they use a binary indicator for the correct answer to each question, as the proportion of respondents indicating ignorance is low. In the case of advanced literacy, the authors account for ignorance versus mistakes by including both binary indicators for correct answers as well as 'Don't know' answers. For a more detailed technical description that does better justice to the methodology underlying the advanced literacy index, please see Appendix A of van Rooij et al. (2007).

[6] The null hypothesis of the test is that the matrix of reduced form coefficients has rank = $K - 1$, where K is number of regressors, that is, the equation is underidentified. We also test for weakness by reporting the Cragg–Donald F-statistic from the first stage regression, which must be sufficiently large relative to the Stock–Yogo critical values (which we will take to be the rule-of-thumb value of 10).

To pass both the exogenity and relevance criteria, we must not fail to reject the null under the Sargan–Hansen test for exogenity, but reject the Anderson canonical correlations test for relevance. We also look for an F-statistic larger than 10 to avoid weak-instruments bias.

[7] In a separate analysis, available from the author, we replicate the analysis of van Rooij et al. (2007) using the ALP sample, and obtain qualitatively similar results for basic literacy. We find, however, that even under their specification, the instrument is not valid for the ALP.

[8] We also report the Pagan-Hall test for heteroskedasticity in an IV regression. If heteroskedasticity is in fact present, the generalized-methods-of-moments (GMM) estimator is more efficient. However, the GMM estimator has poor small-sample properties, and in particular tends to over-reject the null. Given the small sample size in this analysis, this is a significant issue and it is not desirable to use GMM unless necessary. In Column 3, we would very marginally accept the null of no heteroskedasticity at an 80 percent level of significance. In Column 4, we therefore replicate the analysis using a GMM estimator. Comparison of Columns 3 and 4 reveals that the results are not significantly altered. Given also that we do not strongly reject the null, we choose to proceed without implementing GMM.

[9] The test statistics are Wu-Hausman F test [0.044]; $F(1,447)$ p-value [0.84]; Durbin–Wu-Hausman chi-squared test [0.045]; and Chi-sq(1) p-value [0.82].

[10] An important caveat to the straightforward application of PCA in the construction of the indices is that this technique, strictly speaking, is developed for continuous variables, rather than discrete data. Most of the theoretical results, including the implicitly used consistency of the estimates of the factor loadings, are derived under the normality assumption. More sophisticated techniques based on polychoric correlations may be adapted to further refine the index.

Alternative methods of data aggregation were also attempted, including the latent factor analysis in van Rooij et al. (2007). It should be noted that this analysis is also subject to the critique earlier, and that the factor analysis model should instead be estimated from the tetrachoric correlation matrix. When a latent factor model was estimated using maximum-likelihood methods, however, we arrived at a Heywood solution for the basic knowledge index, meaning that the variance estimates are negative. The source of this problem may lie in the current small sample size. As the ALP sample becomes larger, this analysis will be revisited.

[11] The Holt and Laury (2002) method requires respondents to participate in a series of lotteries with small hypothetical cash prizes. Respondents are asked to choose between two lotteries, A or B. If the person indicates that he/she is indifferent, the choice of A or B will be made randomly. After each decision, the chosen lottery is played and payoffs realized. The respondent faces ten such decisions. The payoffs are specified such that a risk/neutral individual will pick option A, the safer lotteries, four times before switching to option B. Note that in the last lottery, all respondents should pick B, the higher payoff, as this is now a certainty. We use the number of times the safe lottery is chosen as a measure of increasing risk aversion.

As the Holt and Laury (2002) questions are fielded in a relatively recent wave of the survey for which data is currently being gathered, we have a significantly smaller number of observations where both measures have been elicited. Column 1 of Table 5.7 shows our original preferred estimates using the Barsky et al. measure

(1997) and the larger sample size. Retaining only the smaller sample of 228, we compare the results using the Barsky et al. measure (1997) (Column 2) and Holt and Laury (2002) (Column 3). The results are (surprisingly) robust to the use of both measures, and to the sharp decline in sample size.

[12] We might speculate that, in a population that is less wealthy and less educated, literacy might be more of a barrier to investment, but this remains to be investigated, potentially in future waves of the Health and Retirement Survey.

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