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Confidence, financial literacy and investment in risky assets: Evidence from the Survey of Consumer Finances *

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Abstract

We employ recent Survey of Consumer Finances (SCF) microdata from the US to analyze the impacts of confidence in one's own financial knowledge, confidence in the economy, and objective financial literacy on investment in risky financial assets (equity and bonds) on both the extensive and intensive margins. Controlling for a rich set of covariates including risk aversion, we find that objective financial literacy is positively related to investment in risky assets as well as debt securities. Moreover, confidence in own financial skills additionally increases the probability of holding risky assets and bonds. While these relationships are rather robust for the extensive margin, they break down with regard to the conditional share of financial wealth in risky assets of those who actually hold them. The relevance of financial literacy as well as confidence varies considerably with the distribution of wealth as well as across several socio-economic dimensions such as age, education and race.

Keywords: financial literacy, confidence, risky assets, household finance, survey data, US

JEL-Codes: D12, D14, D31, D91, I20, G11

*The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff or members of the Board of Governors of Federal Reserve System, the Oesterreichische Nationalbank, the National Bank of Slovakia, or the Eurosystem. Any omissions and remaining errors in the text are solely ours.

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1. Introduction

The composition of household portfolios differs substantially across households and countries (e.g. Christelis et al., 2013; Badarinza et al., 2016). While economic theory predicts that household portfolios should generally be diversified and include more sophisticated financial instruments like equities, empirical evidence shows that few households actually hold such assets (Haliassos and Bertaut, 1995). Low engagement of households in equity markets could yield significant welfare losses—nonparticipation can generate welfare losses of up to 2% of annual household consumption (Cocco et al., 2005). Similarly, "financial ignorance" can also be costly. For example, one might under-diversify one's financial assets, generating unnecessary portfolio risk, or choose unfavorable mortgages (Campbell, 2006; Calvet et al., 2007).

With emerging high-quality micro-data on household balance sheets, researchers have related stock market participation in particular and investment in financial assets in general to household characteristics including gender, education, income, or risk aversion (e.g. Campbell, 2006). More recently, the role of financial literacy has been highlighted as a key input for sound financial behavior (see Lusardi and Mitchell, 2014, for a comprehensive overview). Few empirical studies have shown that *confidence* in one's own financial knowledge matters for investment decisions (e.g. Xia et al., 2014; Allgood and Walstad, 2016; Bannier and Schwarz, 2018). While the empirical literature on the importance of financial literacy is already well established, evidence on the role of confidence remains rather limited.

In this paper, we investigate the influence of financial literacy, confidence in one's own financial knowledge, and confidence in the future development of the economy on household portfolio allocation using recent data from the Survey of Consumer Finances (SCF). We particularly focus on investment in equity and investment in bonds. First, we analyze the relationship between financial literacy together with the two confidence measures and the probability of holding risky assets (i.e. direct and indirect investment in stocks) and the probability of holding bonds. Second, we analyze the determinants of the intensive margin of investing in equities and bonds. To do so, we employ standard regression techniques as well as unconditional quantile regressions based on the recentered influence function (Firpo et al., 2009) to analyze the effects at different points of the distribution. To the best of our knowledge, our study is the first to utilize the SCF to analyze the role of financial literacy and confidence as determinants of household investment behavior. The SCF is a comprehensive household wealth survey, containing detailed information on risky assets and bonds, together with a rich set of covariates including financial literacy, confidence, and risk aversion providing a rare opportunity.

Our analysis makes an important contribution to the empirical literature on understanding the "equity premium puzzle" from the household perspective. Furthermore, an analysis of US households provides an interesting addition to the previous empirical literature on the role of financial literacy and confidence in household investment behavior and also helps to understand generalizability of the previous research results: for instance, in China (Xia et al., 2014; Chu et al., 2017), Germany (Bannier and Schwarz, 2018), and the Netherlands (Kramer, 2016). Furthermore, individual financial decision-making might be even more important in the US context, where the government Social Security plan is intended to support retirees alongside employer-linked pension plans and personal savings. Finally, in our empirical analysis we are able to control for confidence in the development of the economy. To the best of our knowledge, none of the previous empirical studies have controlled for confidence in the economy when analyzing confidence in one's own financial literacy with respect to household investment behavior.

Our descriptive results show that overall around 52% of households in the US participate in the market for risky assets and around 10% of households hold bonds and other secured financial assets. The conditional share of total financial assets held in equities is above 40%, with nearly 9% in bonds. At the same time, only about 50% of the US households can correctly answer all three (relatively basic) financial literacy questions on the survey. Around 78% of the respondents can correctly answer the questions related to interest rates and inflation. The concept of riskiness of financial instruments is less-understood, with around 63% of respondents correctly answering this question. In addition, US households seem to be fairly confident in their financial knowledge, with an average self-rating of 7.35 on a scale to 0 - 10. We find a weak correlation between confidence and objective financial literacy (0.143), consistent with previous empirical studies. In addition, nearly 40% of households are confident that the US economy will be doing much better in 5 years as compared to the year of the survey, 2016.

Results from regression analyses indicate that, controlling for a rich set of family characteristics, both financial literacy and confidence in own financial knowledge positively affect the extensive-margin decision of participating in equity markets. A marginal increase in financial literacy is associated with a 12 percent increase in stock market participation (coefficient of 0.06, $p < 0.01$, evaluated at the dependent variable mean), and confidence in one's own financial knowledge is associated with a 1 percent increase (coefficient of 0.005, $p < 0.01$) in owning equities. Participation in the market for secured financial assets such as bonds is also influenced by the level of financial literacy (coefficient of 0.014, or 14 percent of the mean, $p < 0.01$). While confidence in own financial knowledge exerts less influence over the intensive-margin decision for holding

risky assets and bonds, the impact of confidence in the economy turns out to be positive and statistically significant in the case of bonds (coefficient = 0.022, or 24 percent of the mean, $p < 0.05$). Despite the fact that households are not professional forecasters, trust in the economy appears to help shape their investment decisions. Furthermore, recentered influence function regressions show considerable heterogeneity in the estimated impacts of the covariates across the distribution of both equity and bonds.

Our results support recent work arguing that structural changes in financial attitudes (including literacy and sophistication) might be behind the growing stock-market participation in the US (Bilias et al., 2017). Yet, the overall engagement of household in markets for risky assets (especially direct participation) is still far from what economic theory predicts. Our findings could be seen as a potential policy tool to further foster stock-market participation and investment behavior in the US.

The paper proceeds as follows. The previous literature is reviewed and testable hypotheses are developed in section 2. The data and variables are described in section 3 and section 4 presents the implemented empirical framework and strategies. Results of the univariate and multivariate analysis, along with several robustness checks, are presented and discussed in section 5. Finally, section 6 concludes and offers policy implications.

2. Related literature and conceptual framework

2.1. Financial literacy

Financial literacy has been highlighted as a key input for sound financial decision-making for both participation in financial assets as well as liabilities. The positive impact of financial literacy and cognitive abilities on the participation in risky asset markets in particular and financial wealth accumulation in general has been documented in several empirical studies.

For example (see Lusardi and Mitchell, 2014, for a comprehensive overview), Christelis et al. (2010) studied the relationship between cognitive abilities and stockholding using survey microdata from 11 European countries for a population aged 50+, and found that cognitive abilities positively relate to direct and indirect stockholding. In another influential study, Van Rooij et al. (2011) found that in a sample of Dutch households, those with lower levels of financial literacy are less likely to invest in stocks, and vice versa. Furthermore, Von Gaudecker (2015) found that households in The Netherlands

that score high on financial literacy or rely on professional financial advice achieve better investment outcomes and more diversified portfolios.[1] Research has also documented the positive impact of financial literacy on pension savings and retirement planning (Van Rooij et al., 2012; Cupák et al., 2019).

Based on the robust empirical evidence of positive impacts of financial literacy on financial wealth accumulation and participation in financial instruments, we hypothesize that *the ability to understand financial concepts of interest rates, inflation, and risk diversification (captured by the financial literacy index) is associated with a higher propensity to hold sophisticated financial instruments such as equity and bonds as well as larger conditional values invested in these financial instruments.*

2.2. CONFIDENCE

In addition to the importance of financial literacy for household and personnel financial outcomes, other research has focused on more psychological aspects of household investment behavior. Barber and Odean (2000, 2001), in their seminal works, stressed the importance of confidence of retail investors for high levels of trading. The authors conclude that overconfidence can explain a large part of the high trading levels, but at the same time can result in poor performance of individual investors. The authors also highlight the gender difference in confidence with respect to investing.

Recent empirical work includes studies using Chinese survey data demonstrating that (over)-confidence (proxied by a difference between subjective and objective financial literacy) is positively related to stock market participation (Xia et al., 2014; Chu et al., 2017). More confident households have been shown to have higher levels of financial wealth in a sample of German households (Bannier and Schwarz, 2018). Kramer (2016) in addition found that, in the sample of Dutch households, people confident in their own financial literacy are less likely to seek financial advice, which in turn has implications for their wealth accumulation. Finally, Allgood and Walstad (2016) examined web-based survey data of US households and found that confidence in one's own financial knowledge matters on top of measured financial literacy, especially for investment decisions. While the impact of financial literacy and cognitive abilities on household financial outcomes is well documented in the empirical literature, there is significantly fewer studies on the importance of confidence in financial assets holding and investment decisions, perhaps due to lack of the available data. Given the available empirical evidence from multiple countries we hypothesize that *confidence in one's own*

[1] Similarly, Shin et al. (2020) find that, controlling for financial literacy and confidence, using financial planners is associated in more diversified portfolios.

financial knowledge is associated with a higher propensity to hold risky financial assets and—conditional on holding them—to a larger share of these assets in overall financial wealth.

Finally, the SCF contains information on the expectations of households about the development of the US economy in 5 years, which we use as proxy for the confidence in the macroeconomic environment. Although households are generally neither professional traders nor forecasters, their beliefs about the future economic development and business cycles likely shape their financial decisions. Indeed, the available literature shows that household expectations play an important role in determining economic behaviors such as life-cycle consumption (e.g. Jappelli and Pistaferri, 2000) or choosing an optimal level of debt (e.g. Brown et al., 2005). Regarding investment in financial assets, Guiso et al. (2008) found that in Italy and The Netherlands, individuals who trust less the stock market hold less stocks, and they also invest less into such assets conditional on participation. Our variable captures the confidence in the overall performance of the economy and not stock markets specifically, so the confidence we measure may be secondary to the decision to participate in financial markets. That said, the empirical evidence suggests that the interdependence between stock markets and economic growth is positive (e.g. Levine and Zervos, 1998). We therefore hypothesize that *households that believe that the economy in 5 years will perform better than today are more likely to invest in risky assets, and also to invest more into these assets conditional on participation.*

3. Data and variables

We use microdata from the 2016 wave of the Survey of Consumer Finances (SCF), covering 6248 US households. The SCF is a US nationally representative survey of households conducted triennially by the Board of Governors of the Federal Reserve System to gather comprehensive data on household wealth, and describes both the ownership and magnitude of particular assets and debt. The survey also includes information on families' pensions, income, and demographic characteristics.[2] The unit of our analysis is the household, which is represented by the original respondent to the SCF survey questions.[3]

[2]For more information about the survey, visit: https://www.federalreserve.gov/econres/scfindex.htm. For a detailed overview of the main results from the 2016 SCF data, see Bricker et al. (2017).

[3]In the original survey household unit is composed of all individuals who are financially interdependent and referred to as the "primary economic unit" (PEU). For all individual-level characteristics, we use the respondent, who is generally the most financially knowledgeable person in the PEU. We do not use in our analysis the notion of head as it is described in the SCF codebook, namely "the head is taken to be the single core individual in a PEU without a core couple; in a PEU with a central couple, the head is taken to be either the male in a mixed-sex couple or the older individual in the case of a same-sex couple".

The main advantage of our data compared to other wealth micro data is that the SCF includes comprehensive measures of household balance sheets, as well as rich set of covariates. Having the standard measures for financial literacy, confidence measures, and risk aversion combined with a fully-fledged wealth survey is a rare opportunity. Please refer to the Appendices for a detailed description of all variables, including the text of the survey questions and how our measures were constructed.

3.1. Dependent variables

The primary outcome of interest is investment in risky financial assets, measured at the household level. While the level of risk differs substantially across different types of financial instruments, we group them into two broader categories, which we refer to as equities and bonds. These categories include investments in financial instruments, which are directly or indirectly linked to stocks or investment in bonds and other debt securities.[4] Our first set of outcome variables are a dummy variable taking a value of 1 if household holds equities and 0 otherwise, and a dummy variable taking a value of 1 a household holds bonds and 0 otherwise. Our second set of outcome variables are then the share of total financial assets (including retirement accounts) held in equities as well as the share of total financial assets held in bonds, conditional on holding those financial assets.

3.2. The main explanatory variables

We focus on levels of financial literacy and confidence, which were added to the SCF in the most recent wave in 2016. The financial literacy score is created by counting the number of questions answered correctly. The financial literacy questions are the standard three questions proposed by Lusardi and Mitchell (2014) covering inflation, interest rates, and riskiness. The confidence measure is created in two ways. In general, the most direct way to measure subjective confidence is a survey, but it is not trivial to do so.[5] Here we rely on the approach of Bannier and Schwarz (2018) and proxy for the level of confidence in own skills by using the self-assessed level of financial knowledge. In the SCF, the household respondents were asked the following question:

> *"On a scale from zero to ten, where zero is not at all knowledgeable about personal finance and ten is very knowledgeable about personal finance, what number would you (and your husband/wife/partner) be on the scale?"*

[4] A full overview of all the considered assets is listed in Appendix A.

[5] See Dominitz and Manski (2004) for a detailed discussion on measuring consumers' confidence with micro and macro data.

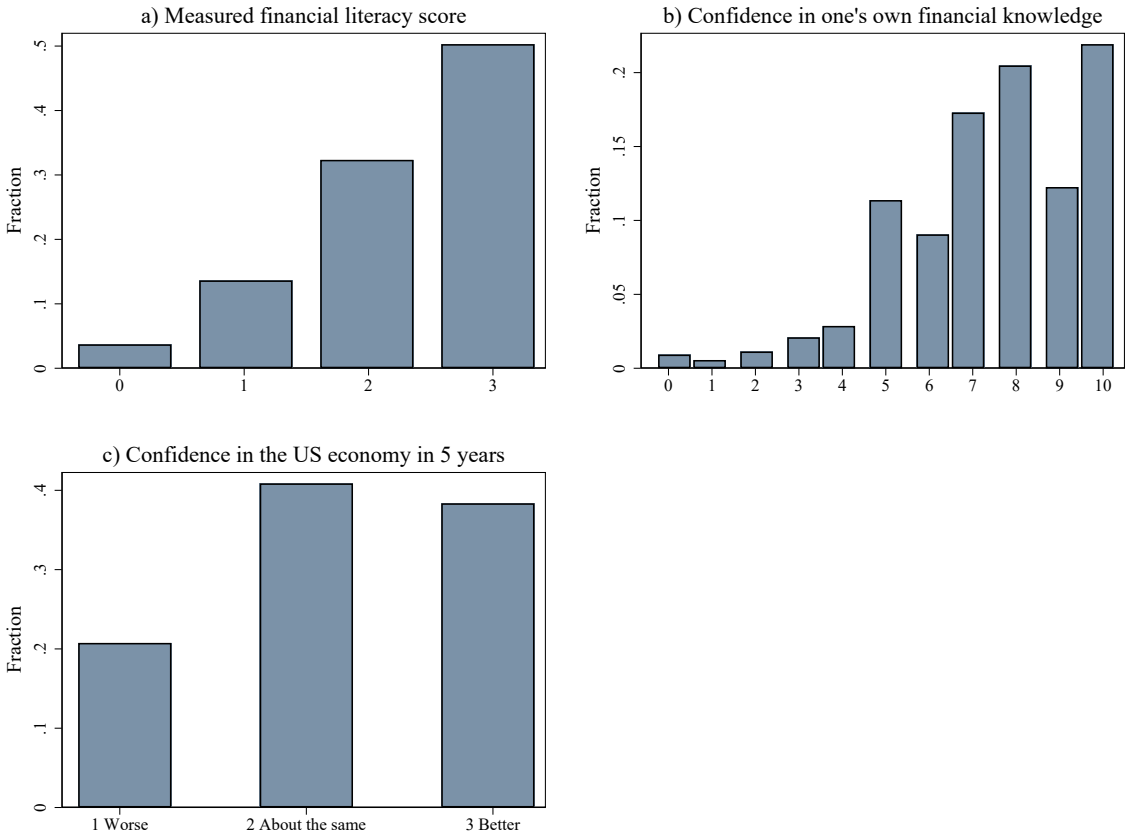
The SCF also includes another variable on expectations about the future macroeconomic development of the US economy in 5 years' horizon, which we apply as a measure of a different kind of confidence. Respondents were asked the following:

> *"I'd like to start this interview by asking you about your expectations for the future. Over the next five years, do you expect the U.S. economy as a whole to perform better, worse, or about the same as it has over the past five years?"*

Dominitz and Manski (2004) describe this kind of variable as confidence in the economy. See, again, Appendix A and B for the creation of financial literacy and confidence scores.

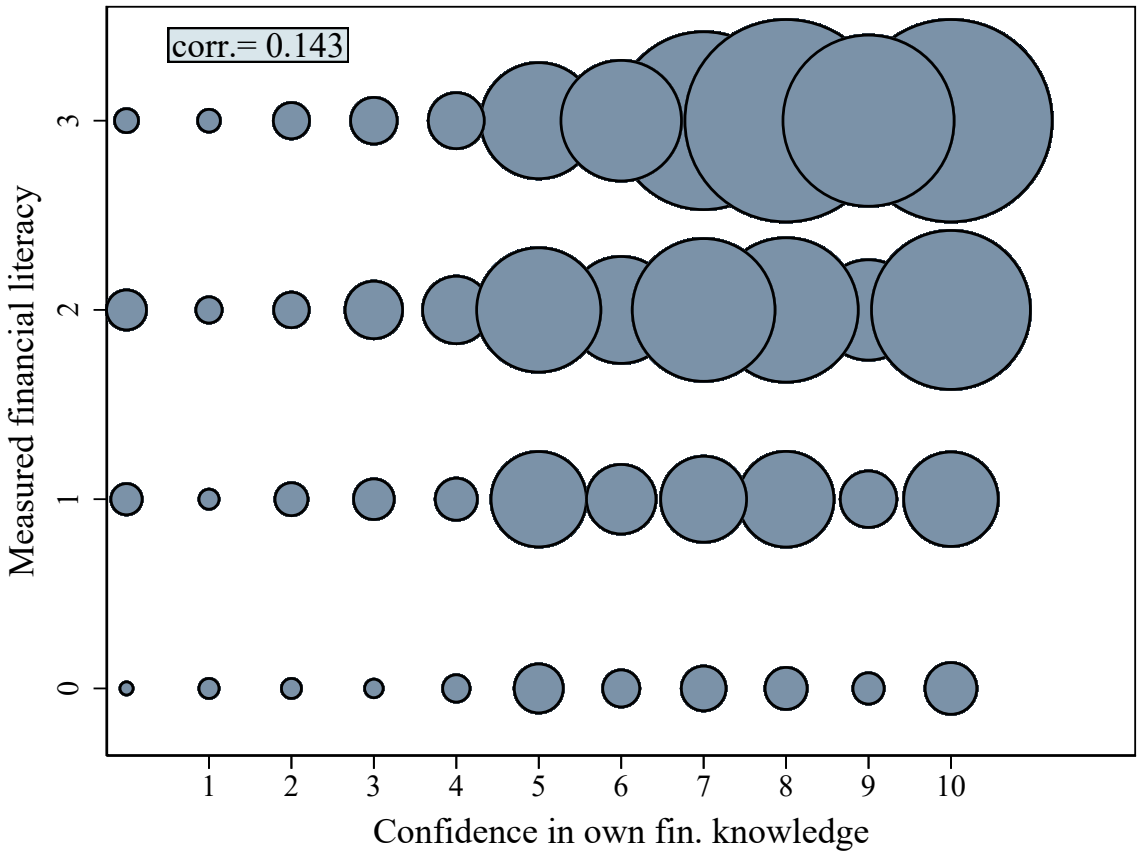
Figure 1 shows the response behavior with regard to these three variables. Figure 2 shows both measured financial literacy as well as self-assessed financial literacy jointly. The size of each bubble is proportional to the number of respondents with such a combination of measured and selfassessed financial literacy. We see a positive, albeit imprecisely measured correlation $(\rho = 0.143)$ between measured and self-assessed financial literacy. A considerable proportion of observations are also observed in the lower right area, namely individuals with rather high self-assessed financial literacy but rather low measured financial literacy. These individuals could be described as "overconfident" with regard to their financial literacy. We will further investigate the impact of (over)confidence and financial literacy on equity and bond holdings in our multivariate analysis.

Figure 1: Distributions of financial literacy score and confidence measures



Data source: Survey of Consumer Finances 2016

Figure 2: Correlation between measured financial literacy score and confidence in one's own financial knowledge



Notes: This graph shows a scatter plot of measured and self-rated financial knowledge, where dots are weighted by frequency of observation.
Data source: Survey of Consumer Finances 2016

3.3. CONTROL VARIABLES

We also control for a rich set of covariates that could also drive the investment choices of households. Following prior literature, we include variables capturing economic resources of the household, both net real estate wealth and income.[6] We also consider whether or not a household owns a closely-held business or received an inheritance. We also control for an extensive set of demographic characteristics (age, gender, education, marital status, ethnicity, and employment status of the respondent) and family com-

[6]As our outcome variable covers financial wealth, our control variable uses non-financial wealth to avoid endogeneity due to simultaneity. Furthermore, we subtract liabilities to generate a measure of net real estate wealth. Since our income and wealth variables have highly skewed distributions, and a significant share of households possesses negative wealth, we employ an Inverse-hyperbolic-sine (IHS) transformation to these two variables. Note that the interpretation of the coefficients of the IHS transformed variables is very similar to that of a natural log.

position, defined as the household size, and presence of children under the age of 18. Furthermore, we include a subjective measure of risk aversion, which has been identified as an important factor determining household risky behavior. Detailed explanation of the construction of all control variables is shown in Appendix A, while the descriptive statistics are presented in Table 1.

Table 1: Summary statistics

Variable	N	Mean	SD	Min	Max
Holds equities*	6248	0.52	0.50	0	1
Share of total fin. assets in equities	6248	0.23	0.30	0	1
Share of total fin. assets in equities (conditional on participation)	3770	0.43	0.29	0	1
Holds bonds*	6248	0.10	0.30	0	1
Share of total fin. assets in bonds	6248	0.01	0.06	0	1
Share of total fin. assets in bonds (conditional on participation)	769	0.09	0.18	0	1
Financial literacy score	6248	2.18	0.86	0	3
Fin. literacy (risk) correct*	6248	0.63	0.48	0	1
Fin. literacy (interest) correct*	6248	0.77	0.42	0	1
Fin. literacy (inflation) correct*	6248	0.78	0.42	0	1
Confidence in own financial knowledge	6248	7.27	2.19	0	10
Confidence in the economy in 5 years	6248	2.16	0.75	1	3
Above-average risk tolerance*	6248	0.21	0.40	0	1
Net real estate wealth (in 1000 US $)	6248	208.10	1240.86	-1440	580000
Business ownership (privately held)*	6248	0.13	0.34	0	1
Disposable household income (in 1000 US $)	6248	66.31	219.40	-1284	176000
Inheritance/gift received*	6248	0.20	0.40	0	1
Number of household members	6248	2.35	1.36	1	10
Presence of children under 18*	6248	0.32	0.47	0	1
Age	6248	51.05	17.30	18	95
Female*	6248	0.53	0.50	0	1
Employed for wage*	6248	0.64	0.48	0	1
Primary or no education*	6248	0.11	0.31	0	1
High school graduate*	6248	0.40	0.49	0	1
College graduate*	6248	0.49	0.50	0	1
White*	6248	0.68	0.47	0	1
Black*	6248	0.16	0.37	0	1
Hispanic*	6248	0.11	0.32	0	1
Other race/ethnicity*	6248	0.05	0.21	0	1
Married*	6248	0.57	0.50	0	1
Single*	6248	0.17	0.38	0	1
Divorced/separated*	6248	0.18	0.38	0	1
Widowed*	6248	0.09	0.28	0	1

Notes: Descriptive statistics estimated using survey weights and multiple-imputation techniques. * denotes dummy variables.

Data Source: Survey of Consumer Finances 2016

4. EMPIRICAL STRATEGY

Our empirical strategy is motivated by standard theories of household portfolios (see Guiso et al., 2002). A household faces a two-step decision: the binary participation decision (probability of holding an asset), and a continuous allocation decision (share of invested amounts in the particular asset relative to total financial wealth). We model these two decisions, with a particular focus on financial literacy and confidence, by several econometric techniques. We employ standard regression models as well as unconditional quantile regressions based on recentered influence function to assess the relative importance of financial literacy and confidence over the distribution of the equity/bond shares.

4.1. PARTICIPATION DECISION

In our baseline model, we estimate the relationship between participation in equities/bonds and financial literacy, and confidence measures (controlling for a large set of covariates) by a Linear Probability Model[7], which takes the following form:

$$Pr\left(D\_equity; D\_bonds = 1|X\right) = \beta_0 + \beta_1 FL + \beta_2 Conf1 + \beta_3 Conf2 + \beta_4 X^{'} + u, \quad (1)$$

where FL is the level of measured financial literacy and, $Conf1$ and $Conf2$ represent the individual's confidence in own financial knowledge and confidence in the US economy, respectively, as described in section 3. Vector X includes a large set of control variables usually used to predict financial literacy and generally financial behavior of households such as education, gender, age, race, employment status, income, wealth, closely-held business ownership, inheritance, risk tolerance, household size and number of children, etc., and u is the error term.

4.2. ALLOCATION DECISION

For those households holding equities $(D\_equity = 1)$ and bonds $(D\_bonds = 1)$, we model the relationship between the share of financial wealth invested in the asset type

[7] As a robustness check, we re-estimated the baseline participation-stage equations (Tables 2a and 2b) by means of Probit models. The estimated marginal effects at the mean of explanatory variables did not differ significantly from the Linear Probability Model estimates. Since we consider interaction terms in some of our estimates (Tables 6a and 6b), and because of its straightforward interpretation, we prefer the Linear Probability Model as the baseline estimates. Results of the Probit estimates are available upon request.

and our explanatory variables of interest by the following linear regression model:

$$W\_equity; W\_bonds = \pi_0 + \pi_1 FL + \pi_2 Conf1 + \pi_3 Conf2 + \pi_4 X^{'} + v, \tag{2}$$

where the notation of right-hand-side variables remains the same as in the participation equation (1), except the new error term v.

Next, we estimate the influence of our regressors X at different parts of the distribution of our outcome variable Y, the share of equity and bonds held in financial assets for those household who hold equity and bonds. We employ unconditional quantile regressions (UQR) developed by Firpo et al. (2009), which are based on recentered influence functions (RIF). This framework has several advantages over the standard conditional quantile regressions and is an attractive tool for researchers studying distributional impacts. The UQR estimator can be written as follows:

$$RIF\left(Y, \tau\right) = X\beta^{UQR} + \varepsilon. \tag{3}$$

We estimate UQRs for τ taking values of 0.10, 0.25, 0.5, 0.75, and 0.9.[8]

Finally, we would like to point out that missing values in some of the SCF variables (mostly related to assets, debts and incomes) were imputed and replaced 5 times.[9] Multiple-imputed data allow us to consider imputation uncertainty related to item nonresponse while obtaining statistical inference. We follow the standard procedure suggested by Rubin (1987) to obtain correct point estimates and variance estimation of the statistics of interest.[10] We describe the applied multipleimputation technique in Appendix D.

5. Results

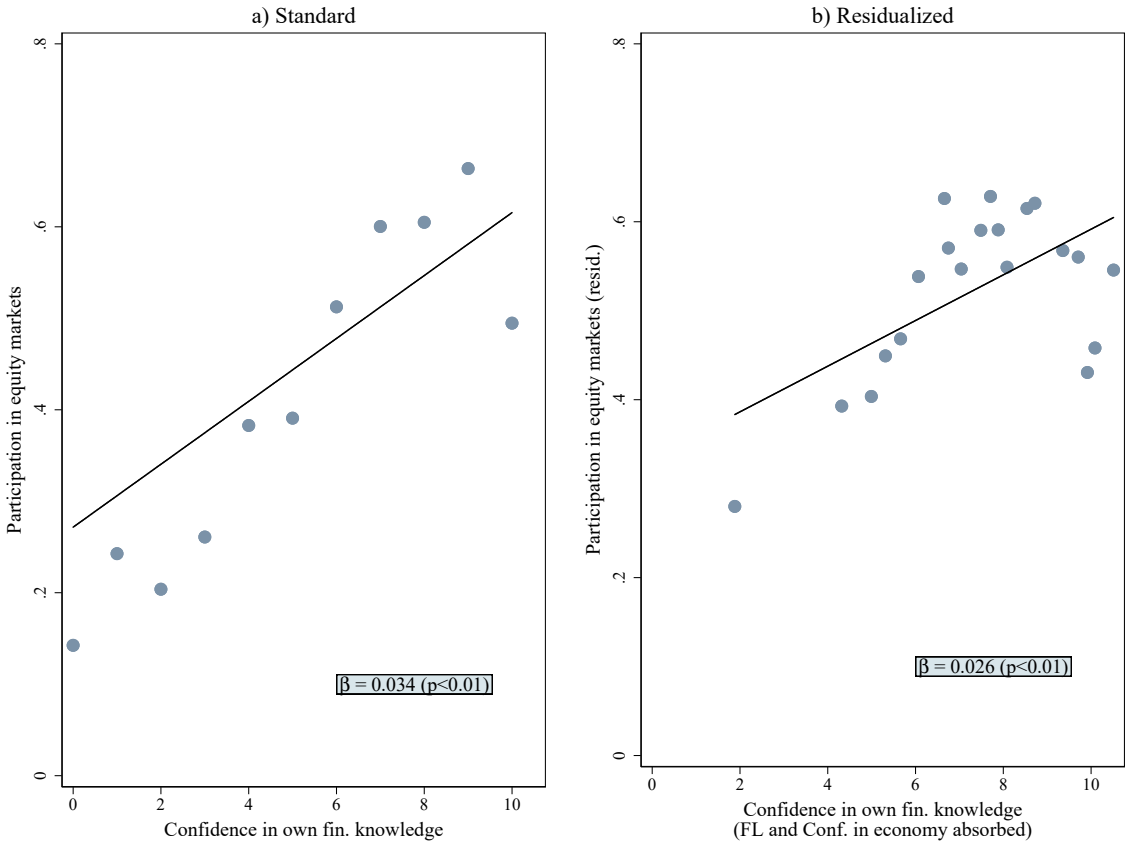
5.1. Descriptive analysis

Figures 3 and 4 show the relationship between confidence (self-assessed financial literacy) and the probability of holding the two types of assets. The figures summarize our main findings: confidence is positively related to the probabilities of holding equities and bonds (left panels of Figures 3 and 4). Given the correlation of 0.034, a 10 percent increase in confidence translates to a 7 percent increase in stock market participation ($p < 0.01$). Likewise, the correlation of 0.006 in the case of bonds means that a 10 percent increase in confidence is associated with a 6 percent increase in bond market

[8] We briefly describe the UQR framework in Appendix C.
[9] The imputation procedure in the SCF data is described in detail by Kennickell (1998).
[10] We use the STATA mi package to do so.

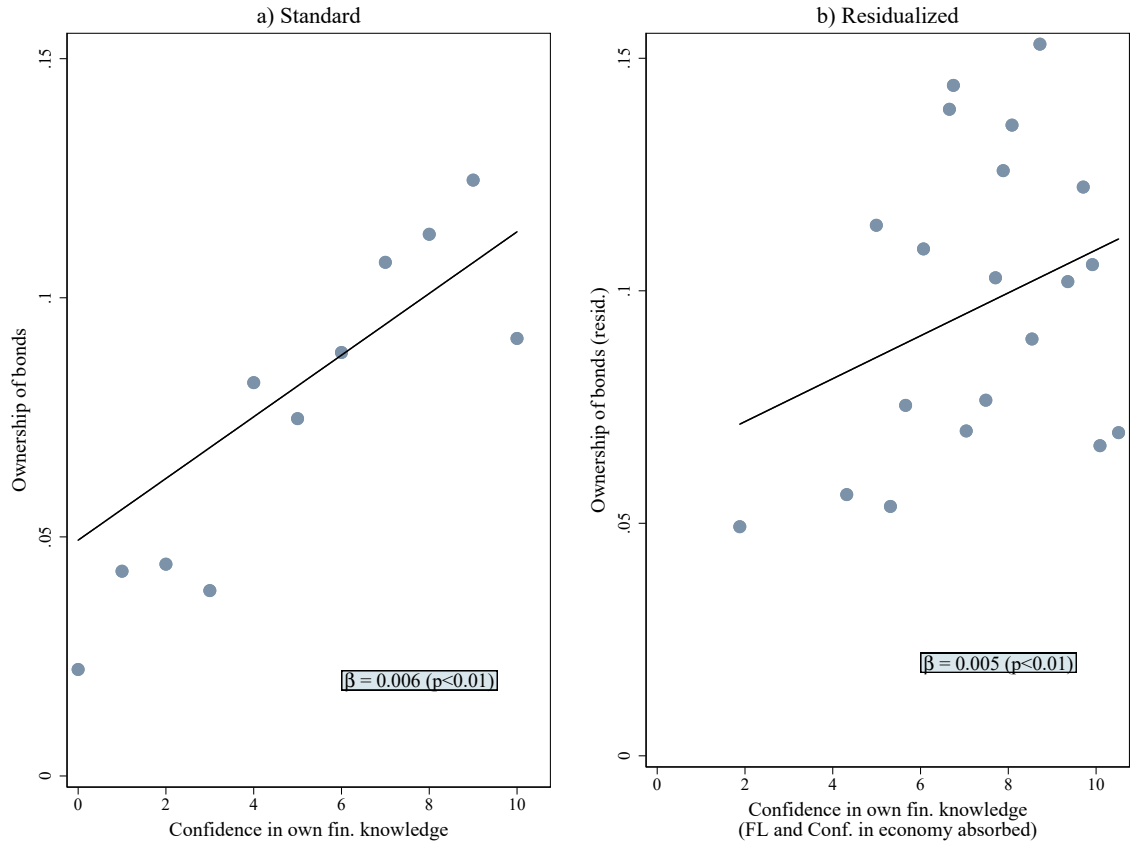
participation ($p < 0.01$). These economically sizable results remain after absorbing variation explainable by measured financial literacy and confidence in the economy (right panel of Figures 3 and 4, 5 and 5 percent of the mean, respectively, both $p < 0.01$). Therefore, confidence in one's own financial knowledge matters for holding equities as well as bonds beyond the effect of objective financial knowledge and the confidence in the country's economy. As we will see in section 5.2, this relationship holds even if we control for a larger set of socio-economic variables relevant for household financial behavior.

Figure 3: Correlation of confidence in own knowledge and participation in equity markets



Notes: Figure (a) shows the share of households holding equity across confidence in own financial knowledge. Figure (b) shows the residualized share of households holding stocks and other equity across confidence in own financial knowledge, where measured financial literacy and confidence in the economy are controlled for.
Data source: Survey of Consumer Finances 2016

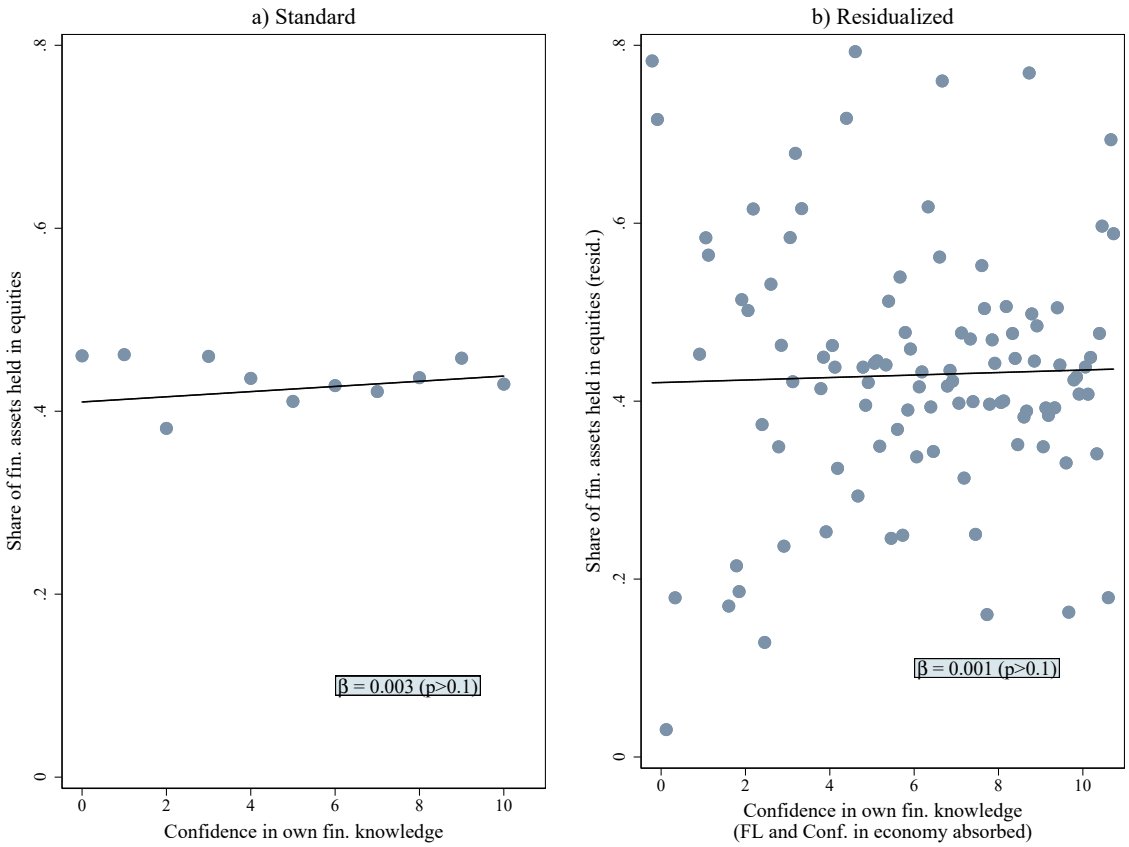
Figure 4: Correlation of confidence in own knowledge and ownership of bonds



Notes: Figure (a) shows the share of households holding bonds and other secured debt assets across confidence in own financial knowledge. Figure (b) shows the residualized share of households holding bonds and other secured debt assets across confidence in own financial knowledge, where measured financial literacy and confidence in the economy are controlled for.
Data source: Survey of Consumer Finances 2016

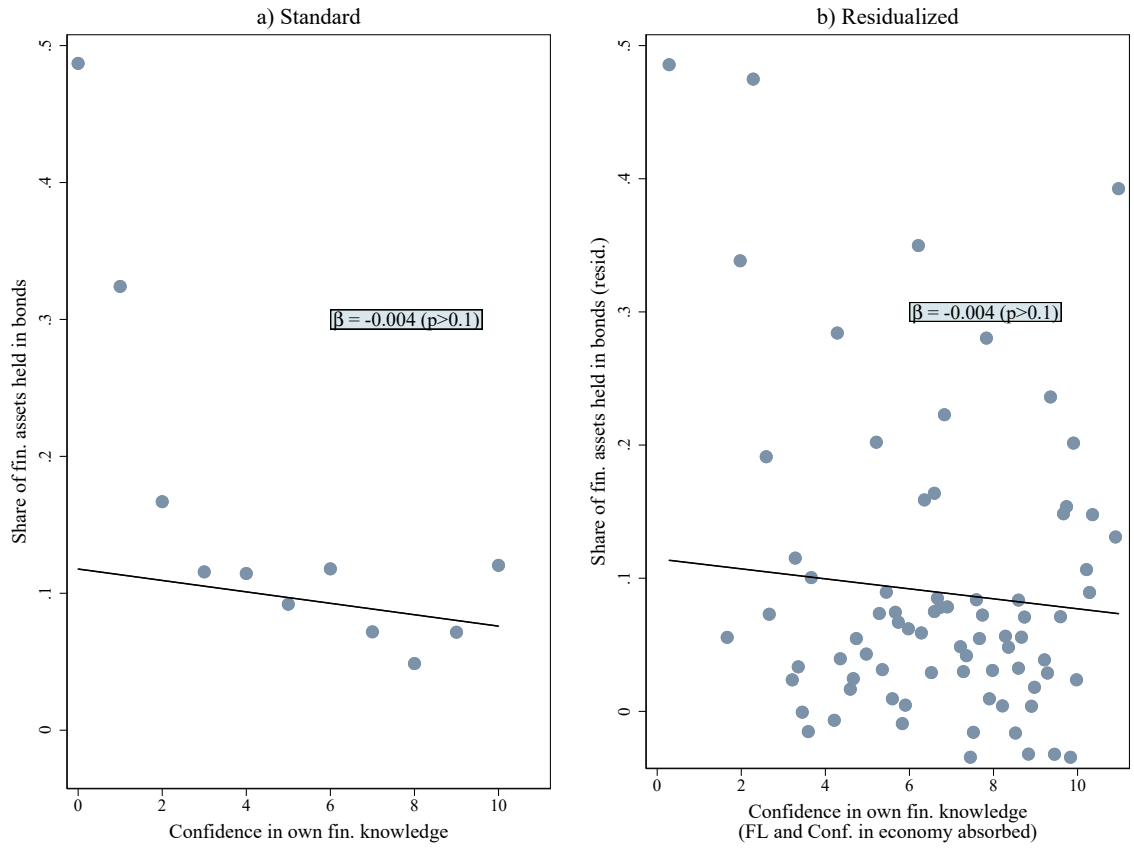
Analogously, Figures 5 and 6 show the relationship between confidence in own financial knowledge and the share of financial assets held in equity and in bonds for those who actually hold those assets. This positive relationship breaks down when we control for measured financial literacy and confidence in the economy. While confidence in own skills seems to be rather relevant for the participation decision in the market of risky assets and bonds, it seems to matter much less with regard to the allocation decision for those who actually participate.

Figure 5: Correlation of confidence in own knowledge and share of total financial assets held in equities



Notes: Figure (a) shows the share of households' financial wealth held in equities across confidence in own financial knowledge. Figure (b) shows the residualized share of households' financial wealth held in equities across confidence in own financial knowledge, where measured financial literacy and confidence in the economy are controlled for.
Data source: Survey of Consumer Finances 2016

Figure 6: Correlation of confidence in own knowledge and share of total financial assets held in bonds



Notes: Figure (a) shows the share of households' financial wealth held in bonds and other secured debt assets across confidence in own financial knowledge. Figure (b) shows the residualized share of households' financial wealth held in bonds and other secured financial assets across confidence in own financial knowledge, where measured financial literacy and confidence in the economy are controlled for.
Data source: Survey of Consumer Finances 2016

5.2. Regression analysis

The baseline results of our multivariate analyses are presented through tables 2a to 4b. Table 2a and Table 2b show the results of the Linear Probability Model estimates for participation in equity and bonds as outlined in section 4 (equation 1). We find that financial literacy, confidence in the economy and confidence in own skills are all positively related to the probability of holding equity (Table 2a). However, only the effects of financial literacy and self-confidence are precisely measured. A one-unit (correct answer) increase in the financial literacy score is associated with a 12 percent (coefficients of around 0.06 combined with mean of 0.52) increase in the probability of holding stocks ($p < 0.01$). A 10 percent increase in confidence in one's own financial knowledge

has a smaller effect on stock market participation. The estimated coefficients between 0.005-0.006 translate to an increase of 1 percent in the probability of holding stocks ($p < 0.01$). Confidence in the economy does not have a measurable effect at the 5 percent level. The effect of financial literacy remains stable over the various specifications, all of which control for a large set of covariates relevant for household financial behavior. Most importantly, in specifications (4) and (7), we see that the effect of self-confidence remains positive and significant even when controlling for objective financial literacy. That means, that the finding that confidence in skills matters above the actual skills (graphically demonstrated in Figure 3) holds even if we control for a large set of covariates. Results from the linear probability model estimates for participation in bonds and other debt securities (Table 2b) reveal that the impact of objective financial literacy is positive and rather large. The coefficient of 0.014 means that a one-unit (correct answer) increase in the financial literacy score is associated a 14 percent higher probability of holding bonds ($p < 0.01$). Confidence in the future economy (coefficient of -0.008) is associated with *reduction* in bond market participation (-8 percent of the mean, $p < 0.05$), while confidence in own skills does not exert any measurable influence. These measured effects are robust across specifications.

The estimated effects of other covariates are in line with the previous literature. The probability of holding equities and bonds significantly rises with economic resources: wealth, income (only for equities), employment, as well as inheritance receipt. It also rises generally with age, decreasing somewhat at oldest ages, and rises with education. Owners of privately-held businesses are less likely to participate in equity markets, which is unsurprising given that equities and privately-held businesses can both be considered risky assets.

Non-Hispanic white respondents are 6 – 13 percentage points more likely to own stocks and 5 – 7 percentage points more likely to own bonds than non-white groups. This result is in line with Thompson and Suarez (2015), who document substantial financial wealth gaps by race in the US. Our results also show that self-rated risk tolerance is positively associated with holding equities, but has no effect with respect to holding bonds, and hence suggests that households are quite consistent in assessing their risk aversion and actual risky behavior.

Table 2a: OLS estimates of determinants of participation in equity markets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.060**			0.059**		0.060**	0.059**
	(0.006)			(0.006)		(0.006)	(0.006)
Confidence in own financial knowledge		0.006**		0.005*	0.006**		0.005*
		(0.002)		(0.002)	(0.002)		(0.002)
Confidence in the economy in 5 years			0.009		0.009	0.009	0.009
			(0.005)		(0.005)	(0.005)	(0.005)
Above-average risk tolerance	0.099**	0.106**	0.106**	0.098**	0.105**	0.098**	0.097**
	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)
Net real estate wealth (IHS)	0.015**	0.016**	0.016**	0.015**	0.016**	0.015**	0.015**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	-0.031*	-0.030*	-0.028	-0.032*	-0.030*	-0.031*	-0.032*
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Disposable household income (IHS)	0.024**	0.025**	0.025**	0.024**	0.025**	0.024**	0.024**
	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)
Inheritance/gift received	0.042**	0.045**	0.046**	0.041**	0.045**	0.042**	0.041**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Number of household members	-0.020**	-0.020**	-0.020**	-0.020**	-0.020**	-0.019**	-0.020**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Presence of children under 18	0.048**	0.045**	0.044**	0.048**	0.044**	0.047**	0.047**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.015)
Age	0.010**	0.011**	0.011**	0.010**	0.011**	0.010**	0.010**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age squared	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.005	-0.008	-0.007	0.005	-0.008	0.005	0.005
	(0.009)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)	(0.009)
Employed for wage	0.189**	0.192**	0.191**	0.190**	0.191**	0.189**	0.189**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
High school graduate	0.130**	0.136**	0.140**	0.127**	0.136**	0.130**	0.126**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
College graduate	0.290**	0.314**	0.320**	0.286**	0.314**	0.290**	0.286**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Black	-0.128**	-0.140**	-0.140**	-0.129**	-0.141**	-0.129**	-0.129**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Hispanic	-0.132**	-0.142**	-0.144**	-0.131**	-0.143**	-0.133**	-0.132**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Other race/ethnicity	-0.058**	-0.063**	-0.066**	-0.056**	-0.064**	-0.058**	-0.057**
	(0.020)	(0.021)	(0.021)	(0.020)	(0.021)	(0.020)	(0.020)
Married	0.082**	0.082**	0.084**	0.080**	0.082**	0.082**	0.080**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Divorced/separated	-0.063**	-0.071**	-0.069**	-0.064**	-0.070**	-0.062**	-0.064**
	(0.017)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)	(0.017)
Widowed	-0.013	-0.018	-0.018	-0.013	-0.018	-0.013	-0.013
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Constant	-0.611**	-0.572**	-0.559**	-0.635**	-0.591**	-0.630**	-0.654**
	(0.070)	(0.073)	(0.074)	(0.069)	(0.073)	(0.071)	(0.069)
R squared	0.368	0.358	0.358	0.368	0.358	0.368	0.368
N	6248	6248	6248	6248	6248	6248	6248

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non- Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Table 2b: OLS estimates of determinants of ownership of bonds

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.014**			0.014**		0.014**	0.014**
	(0.004)			(0.004)		(0.004)	(0.004)
Confidence in own financial knowledge		-0.000		-0.001	-0.000		-0.000
		(0.001)		(0.001)	(0.001)		(0.001)
Confidence in the economy in 5 years			-0.008*		-0.008*	-0.008*	-0.008*
			(0.004)		(0.004)	(0.004)	(0.004)
Above-average risk tolerance	0.006	0.008	0.008	0.006	0.008	0.006	0.006
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Net real estate wealth (IHS)	0.003**	0.003**	0.003**	0.003**	0.003**	0.003**	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	-0.007	-0.006	-0.006	-0.007	-0.006	-0.007	-0.006
	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Disposable household income (IHS)	-0.004	-0.003	-0.003	-0.004	-0.003	-0.004	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Inheritance/gift received	0.027**	0.027**	0.027**	0.027**	0.027**	0.027**	0.027**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Number of household members	0.006	0.006	0.006	0.006	0.006	0.006	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Presence of children under 18	0.032**	0.031**	0.032**	0.032**	0.032**	0.032**	0.032**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Age	0.000	0.001	0.001	0.000	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.006	0.003	0.002	0.006	0.002	0.005	0.005
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Employed for wage	0.017*	0.017*	0.018*	0.017*	0.018*	0.017*	0.017*
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
High school graduate	0.026**	0.029**	0.029**	0.026**	0.029**	0.026**	0.027**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
College graduate	0.070**	0.078**	0.078**	0.071**	0.078**	0.070**	0.071**
	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)	(0.009)
Black	-0.050**	-0.053**	-0.052**	-0.050**	-0.052**	-0.050**	-0.050**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Hispanic	-0.075**	-0.077**	-0.076**	-0.075**	-0.076**	-0.074**	-0.074**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Other race/ethnicity	-0.063**	-0.065**	-0.064**	-0.063**	-0.064**	-0.062**	-0.063**
	(0.013)	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)
Married	0.016	0.016	0.016	0.016	0.016	0.016	0.016
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Divorced/separated	-0.023*	-0.024*	-0.025*	-0.023*	-0.025*	-0.023*	-0.023*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Widowed	0.020	0.018	0.018	0.019	0.018	0.019	0.019
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Constant	-0.029	-0.011	0.006	-0.026	0.007	-0.011	-0.008
	(0.051)	(0.052)	(0.051)	(0.051)	(0.051)	(0.050)	(0.051)
R squared	0.065	0.064	0.064	0.065	0.064	0.065	0.065
N	6248	6248	6248	6248	6248	6248	6248

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non- Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Tables 3a and 3b display estimates of regressions of the determinants of the share of total financial assets held in equities and bonds, respectively, conditional on participating in those markets. The results confirm the descriptive analysis from Figures 5 and Figure 6. Estimated results reveal little to no relationship between the portfolio allocation measures and financial literacy or confidence. One interesting exception is that confidence in the economy has positive and precisely measured relationship with the share of financial wealth invested in bonds: The coefficient of 0.022 implies that a one-unit increase in confidence is associated with a 24 percent higher share of the financial portfolio held in bonds ($p < 0.01$). Also, owners of privately-held businesses invest a greater share of their financial wealth in bonds (share increases by 38 percent, $p < 0.01$) but less in stocks (-6 percent of the mean, $p < 0.01$), which improves the diversification of their overall portfolios. The overall precision of other coefficient estimates decreases relative to the participation regressions.

However, further investigation using UQRs reveals that the lack of a measurable relationship for the conditional mean masks substantial heterogeneity across the distribution of the share of equity and bonds in total financial assets. For example, in the case of the share of financial wealth held in equity (Table 4a): while the 25th percentile of equity holdings exhibits a positive relationship with measured financial literacy (5 percent increase in the share of financial wealth held in stocks, $p < 0.01$) and no measurable relationship with either confidence measures, we find a significant and negative impact of financial literacy at the 90th percentile of equity holdings (6 percent decrease of the share of financial wealth held in stocks, $p < 0.05$). That means, that for households generally holding riskier assets—given their set of covariates—those with higher literacy and higher confidence actually hold a little less of their financial wealth in stocks. That is, for those with comparably risky portfolios, higher financial literacy and confidence is associated with mean-reverting allocation behavior. Note that this differential behavior at top of the distribution holds in spite of the fact that we control for business ownership, so it is not specifically driven by business owners with substantial other risky assets.

On the other hand, measured financial literacy and self-confidence have imprecisely estimated effects across the distribution of the share of financial wealth held in bonds (Table 4b). The impact of confidence in the performance of the US economy is positive and precisely measured between the 50th and 75th percentile of the distribution (6 and 34 percent increase in the share of financial wealth in bonds, respectively, both $p < 0.01$). Our results show that confidence in the economy—including the performance of the financial markets—shapes household investment decisions, especially in the case of bonds.

Table 3a: OLS estimates of determinants of share of total financial assets held in equities (conditional on participation)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.007			0.007		0.007	0.007
	(0.007)			(0.008)		(0.007)	(0.008)
Confidence in own financial knowledge		-0.001		-0.001	-0.001		-0.001
		(0.003)		(0.003)	(0.003)		(0.003)
Confidence in the economy in 5 years			0.007		0.007	0.007	0.007
			(0.007)		(0.007)	(0.007)	(0.007)
Above-average risk tolerance	0.069***	0.070***	0.070***	0.069***	0.070***	0.069***	0.069***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Net real estate wealth (IHS)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	-0.025*	-0.024*	-0.025*	-0.024*	-0.024*	-0.025*	-0.025*
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Disposable household income (IHS)	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inheritance/gift received	0.017*	0.017*	0.017*	0.017*	0.017*	0.017*	0.017*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Number of household members	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Presence of children under 18	0.018	0.018	0.017	0.018	0.017	0.017	0.017
	(0.020)	(0.020)	(0.021)	(0.020)	(0.021)	(0.021)	(0.021)
Age	0.006**	0.006**	0.006**	0.006**	0.006**	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.050***	-0.051***	-0.051***	-0.050***	-0.051***	-0.050***	-0.050***
	(0.011)	(0.010)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)
Employed for wage	-0.010	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
High school graduate	-0.062*	-0.060	-0.061	-0.062*	-0.061	-0.063*	-0.062*
	(0.037)	(0.036)	(0.037)	(0.036)	(0.036)	(0.037)	(0.036)
College graduate	-0.043	-0.038	-0.039	-0.042	-0.039	-0.043	-0.043
	(0.034)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Black	-0.025	-0.027	-0.027	-0.025	-0.027	-0.025	-0.025
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Hispanic	-0.034*	-0.036*	-0.036*	-0.033*	-0.036*	-0.034*	-0.034*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Other race/ethnicity	0.007	0.006	0.006	0.007	0.006	0.007	0.007
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Married	-0.000	0.000	-0.000	0.000	0.000	-0.001	-0.000
	(0.021)	(0.020)	(0.021)	(0.020)	(0.020)	(0.021)	(0.020)
Divorced/separated	-0.014	-0.014	-0.014	-0.014	-0.014	-0.014	-0.014
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Widowed	-0.012	-0.012	-0.012	-0.011	-0.012	-0.011	-0.011
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Constant	0.219***	0.235***	0.214***	0.224***	0.218***	0.203***	0.208***
	(0.070)	(0.073)	(0.072)	(0.072)	(0.074)	(0.072)	(0.074)
R squared	0.050	0.050	0.050	0.051	0.050	0.051	0.051
N	3770	3770	3770	3770	3770	3770	3770

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non- Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. $^{*}\ p < 0.05$, $^{**}\ p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Table 3b: OLS estimates of determinants of share of total financial assets held in bonds (conditional on participation)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial literacy score	0.011			0.010		0.012	0.011
	(0.010)			(0.010)		(0.010)	(0.010)
Confidence in own financial knowledge		0.003		0.002	0.003		0.002
		(0.004)		(0.004)	(0.004)		(0.004)
Confidence in the economy in 5 years			0.022**		0.022**	0.023***	0.022***
			(0.009)		(0.009)	(0.009)	(0.009)
Above-average risk tolerance	0.003	0.003	-0.000	0.003	-0.001	-0.001	-0.002
	(0.014)	(0.014)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)
Net real estate wealth (IHS)	-0.004*	-0.004*	-0.004*	-0.004**	-0.004*	-0.004*	-0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Privately-held businesses	0.036**	0.037**	0.036**	0.036**	0.035**	0.034**	0.034**
	(0.017)	(0.016)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)
Disposable household income (IHS)	0.002**	0.002**	0.002**	0.002**	0.002*	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Inheritance/gift received	0.004	0.003	0.002	0.003	0.001	0.002	0.002
	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)
Number of household members	-0.000	-0.002	0.000	-0.001	-0.000	0.001	0.001
	(0.008)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Presence of children under 18	-0.021	-0.020	-0.023	-0.021	-0.023	-0.024	-0.024
	(0.022)	(0.022)	(0.021)	(0.022)	(0.021)	(0.021)	(0.021)
Age	-0.008***	-0.008***	-0.007***	-0.008***	-0.007***	-0.008***	-0.008***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.008	-0.010	-0.010	-0.008	-0.009	-0.007	-0.007
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Employed for wage	-0.039*	-0.038*	-0.037*	-0.038*	-0.037*	-0.037*	-0.037*
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
High school graduate	0.046	0.046	0.046	0.046	0.047	0.047	0.048
	(0.042)	(0.041)	(0.040)	(0.041)	(0.039)	(0.040)	(0.039)
College graduate	0.005	0.009	0.008	0.006	0.009	0.006	0.007
	(0.038)	(0.037)	(0.036)	(0.036)	(0.035)	(0.036)	(0.035)
Black	0.025	0.018	0.024	0.024	0.023	0.031	0.030
	(0.035)	(0.035)	(0.034)	(0.036)	(0.035)	(0.035)	(0.036)
Hispanic	-0.073***	-0.070***	-0.071***	-0.072***	-0.071***	-0.073***	-0.073***
	(0.020)	(0.019)	(0.017)	(0.020)	(0.018)	(0.019)	(0.019)
Other race/ethnicity	-0.028	-0.030	-0.029	-0.028	-0.029	-0.026	-0.026
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Married	-0.076**	-0.077**	-0.077**	-0.078**	-0.079**	-0.079**	-0.080**
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Divorced/separated	-0.052	-0.055*	-0.054*	-0.053	-0.055*	-0.053	-0.054
	(0.033)	(0.032)	(0.032)	(0.033)	(0.032)	(0.033)	(0.033)
Widowed	-0.031	-0.033	-0.036	-0.032	-0.036	-0.034	-0.035
	(0.039)	(0.040)	(0.038)	(0.040)	(0.039)	(0.038)	(0.039)
Constant	0.379***	0.384***	0.345***	0.370***	0.333***	0.323***	0.317***
	(0.087)	(0.087)	(0.081)	(0.088)	(0.083)	(0.083)	(0.084)
R squared	0.094	0.098	0.096	0.098	0.099	0.096	0.100
N	769	769	769	769	769	769	769

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non- Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Table 4a: Unconditional quantile regression estimates of determinants of share of total financial assets held in equities (conditional on participation)

	(1)	(2)	(3)	(4)	(5)
	p10	p25	p50	p75	p90
Financial literacy score	0.004	0.023**	0.037**	0.013	-0.027*
	(0.005)	(0.006)	(0.009)	(0.010)	(0.011)
Confidence in own financial knowledge	-0.006**	-0.002	-0.003	-0.002	-0.000
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
Confidence in the economy in 5 years	0.001	0.011	0.011	0.007	0.008
	(0.005)	(0.007)	(0.010)	(0.011)	(0.009)
Above-average risk tolerance	0.033**	0.058**	0.085**	0.124**	0.046**
	(0.007)	(0.010)	(0.016)	(0.016)	(0.016)
Net real estate wealth (IHS)	0.001	0.003**	0.002	0.002	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Privately-held businesses	-0.021*	-0.021	-0.040*	-0.021	-0.065**
	(0.009)	(0.013)	(0.017)	(0.020)	(0.017)
Disposable household income (IHS)	0.008*	0.011**	0.013**	0.006	0.003
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)
Inheritance/gift received	0.019**	0.021	0.002	0.009	0.012
	(0.007)	(0.012)	(0.017)	(0.018)	(0.015)
Number of household members	-0.002	0.002	-0.019	0.007	-0.007
	(0.007)	(0.008)	(0.011)	(0.009)	(0.008)
Presence of children under 18	0.018	-0.007	0.042	0.004	0.005
	(0.017)	(0.020)	(0.028)	(0.023)	(0.022)
Age	0.007**	0.006*	0.006	0.001	0.006*
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	-0.000**	-0.000*	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.003	-0.022	-0.070**	-0.070**	-0.072**
	(0.008)	(0.012)	(0.014)	(0.015)	(0.014)
Employed for wage	-0.020	-0.019	-0.013	-0.017	-0.046*
	(0.011)	(0.016)	(0.017)	(0.021)	(0.021)
High school graduate	-0.016	0.004	-0.016	-0.086*	-0.163**
	(0.022)	(0.037)	(0.036)	(0.037)	(0.049)
College graduate	0.002	0.029	0.001	-0.083*	-0.177**
	(0.022)	(0.036)	(0.035)	(0.037)	(0.051)
Black	-0.028*	-0.044*	-0.062**	-0.001	0.001
	(0.013)	(0.022)	(0.022)	(0.026)	(0.027)
Hispanic	-0.011	-0.029	-0.056*	-0.064*	-0.026
	(0.015)	(0.019)	(0.028)	(0.029)	(0.025)
Other race/ethnicity	0.009	-0.003	-0.037	-0.028	0.068
	(0.014)	(0.022)	(0.037)	(0.040)	(0.046)
Married	0.017	-0.003	0.033	-0.045	-0.006
	(0.015)	(0.021)	(0.029)	(0.033)	(0.025)
Divorced/separated	-0.001	-0.034	0.006	-0.012	0.024
	(0.017)	(0.021)	(0.028)	(0.034)	(0.027)
Widowed	0.024	-0.018	0.021	-0.039	-0.037
	(0.025)	(0.032)	(0.045)	(0.044)	(0.033)
Constant	-0.186**	-0.190*	0.053	0.595**	0.966**
	(0.063)	(0.091)	(0.103)	(0.108)	(0.102)
R squared	0.021	0.039	0.043	0.037	0.019
N	3770	3770	3770	3770	3770

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non- Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Table 4b: Unconditional quantile regression estimates of determinants of share of total financial assets held in bonds (conditional on participation)

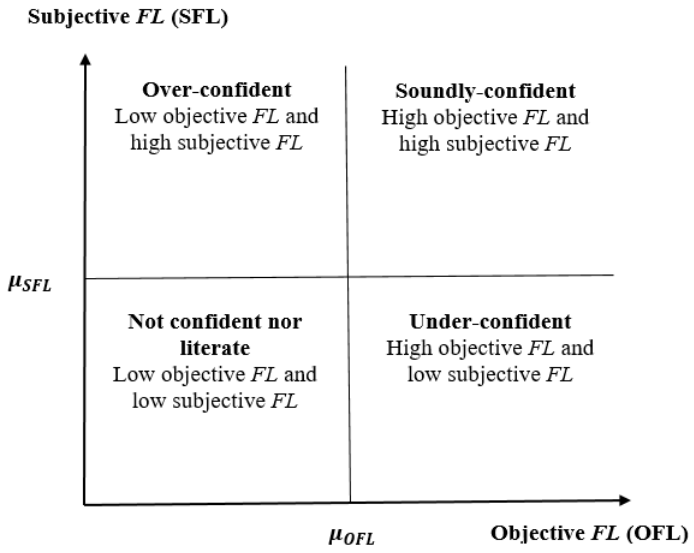
	(1)	(2)	(3)	(4)	(5)
	p10	p25	p50	p75	p90
Financial literacy score	-0.001	0.002	0.002	0.007	0.022
	(0.001)	(0.001)	(0.002)	(0.010)	(0.042)
Confidence in own financial knowledge	-0.000	-0.000	0.000	0.003	-0.002
	(0.000)	(0.001)	(0.001)	(0.004)	(0.024)
Confidence in the economy in 5 years	0.003*	0.002	0.005**	0.031**	0.057
	(0.001)	(0.001)	(0.002)	(0.011)	(0.044)
Above-average risk tolerance	-0.001	-0.004	-0.005	-0.023	0.085
	(0.002)	(0.002)	(0.003)	(0.016)	(0.077)
Net real estate wealth (IHS)	-0.000	0.000	-0.001**	-0.003	-0.008
	(0.000)	(0.000)	(0.000)	(0.002)	(0.007)
Privately-held businesses	0.003	0.001	0.008*	0.033	0.099
	(0.002)	(0.003)	(0.003)	(0.020)	(0.070)
Disposable household income (IHS)	0.001	0.001	0.000	0.001	0.010
	(0.001)	(0.001)	(0.001)	(0.002)	(0.006)
Inheritance/gift received	-0.001	0.000	0.006*	0.017	0.005
	(0.002)	(0.002)	(0.003)	(0.016)	(0.069)
Number of household members	-0.001	-0.001	-0.000	-0.006	0.000
	(0.002)	(0.001)	(0.002)	(0.010)	(0.034)
Presence of children under 18	0.000	-0.000	-0.004	-0.027	-0.121
	(0.003)	(0.003)	(0.004)	(0.027)	(0.102)
Age	-0.001**	-0.002**	-0.002**	-0.009**	-0.035*
	(0.000)	(0.000)	(0.000)	(0.003)	(0.015)
Age squared	0.000**	0.000**	0.000**	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.001	0.000	-0.003	-0.033	0.055
	(0.001)	(0.002)	(0.002)	(0.017)	(0.074)
Employed for wage	-0.003	-0.005*	-0.010**	-0.021	-0.080
	(0.002)	(0.002)	(0.003)	(0.021)	(0.099)
High school graduate	0.005	0.001	0.003	0.103*	-0.023
	(0.008)	(0.008)	(0.011)	(0.050)	(0.263)
College graduate	0.003	-0.007	-0.003	0.048	-0.160
	(0.008)	(0.008)	(0.010)	(0.048)	(0.249)
Black	0.003	0.012**	0.005	0.008	0.086
	(0.003)	(0.003)	(0.005)	(0.035)	(0.134)
Hispanic	0.002	0.000	-0.005	-0.091**	-0.323**
	(0.003)	(0.006)	(0.006)	(0.034)	(0.079)
Other race/ethnicity	0.001	0.007	0.008	-0.023	-0.111
	(0.005)	(0.005)	(0.005)	(0.035)	(0.135)
Married	0.002	0.003	-0.000	-0.056	-0.214
	(0.004)	(0.004)	(0.005)	(0.033)	(0.153)
Divorced/separated	0.007*	0.007	0.010*	-0.023	-0.044
	(0.003)	(0.004)	(0.005)	(0.033)	(0.181)
Widowed	0.006	-0.001	0.007	0.036	-0.020
	(0.004)	(0.006)	(0.006)	(0.042)	(0.202)
Constant	0.007	0.057**	0.075**	0.263**	1.360**
	(0.011)	(0.013)	(0.016)	(0.089)	(0.471)
R squared	0.049	0.077	0.105	0.101	0.062
N	769	769	769	769	769

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for less than high school education, non- Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

5.3. Robustness Checks and Extensions

We estimate several additional models serving as robustness checks and extensions. First, we estimate our models using a more explicit measure of overconfidence. Following Xia et al. (2014) and Allgood and Walstad (2016), we combined the objective (measured) financial literacy score with the subjective 0-10 self-confidence score to create a four-category measure of overconfidence. We create dummy variables for different degrees of confidence with respect to the measured financial literacy: above-average self-rated literacy and below-average measured literacy (over-confident), above-average self-rated literacy and above-average measured literacy (soundly-confident), below-average self-rated literacy and above-average measured literacy (under-confident), and below-average self-rated literacy and below-average measured-literacy, visualized in the following diagram:



As shown in Table 5a and Table 5b, the results from this robustness check suggest that discretized measures of confidence matter on top of the actual measured literacy, especially for participation in risky assets. Relative to being in the lower left quadrant, being sound-confident is associated with 14 percent increase of the probability of holding equities (coefficient of 0.071, $p < 0.01$) and being under-confident is associated with a 12 percent increase in participation probabilities (coefficient of 0.062, $p < 0.01$). Results for bond market participation are similar in column (1), with sound-confident associated 19 percent increase in the probability of holding bonds (coefficient of 0.019, $p < 0.05$) and being under-confident is associated with a 20 percent increase in bond market participation (coefficient of 0.020, $p < 0.05$), though these effects are no longer

precisely measured when also controlling for financial literacy (column 2).

Table 5a: OLS estimates of determinants of participation in equity markets and share of total financial assets held in equities (alternative confidence measures)

	Participation		Share	
	(1)	(2)	(3)	(4)
Financial literacy score		0.031**		-0.006
		(0.009)		(0.015)
Over-confident	0.008	0.007	-0.007	-0.006
	(0.012)	(0.012)	(0.015)	(0.015)
Sound-confident	0.114**	0.071**	0.018	0.026
	(0.013)	(0.020)	(0.014)	(0.025)
Under-confident	0.106**	0.062**	0.008	0.017
	(0.012)	(0.017)	(0.017)	(0.022)
Confidence in the economy in 5 years		0.009		0.007
		(0.005)		(0.007)
Above-average risk tolerance	0.097**	0.096**	0.068**	0.067**
	(0.012)	(0.012)	(0.010)	(0.010)
Net real estate wealth (IHS)	0.015**	0.015**	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Privately-held businesses	-0.033*	-0.033*	-0.025	-0.026
	(0.014)	(0.014)	(0.014)	(0.014)
Disposable household income (IHS)	0.024**	0.024**	0.008**	0.008**
	(0.006)	(0.006)	(0.003)	(0.003)
Inheritance/gift received	0.041**	0.041**	0.017	0.016
	(0.010)	(0.010)	(0.010)	(0.010)
Number of household members	-0.019**	-0.019**	-0.004	-0.004
	(0.005)	(0.005)	(0.008)	(0.008)
Presence of children under 18	0.043**	0.045**	0.018	0.016
	(0.016)	(0.016)	(0.020)	(0.021)
Age	0.010**	0.010**	0.006*	0.006*
	(0.002)	(0.002)	(0.003)	(0.003)
Age squared	-0.000**	-0.000**	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.005	0.007	-0.049**	-0.049**
	(0.009)	(0.009)	(0.011)	(0.011)
Employed for wage	0.190**	0.189**	-0.010	-0.010
	(0.011)	(0.011)	(0.014)	(0.014)
High school graduate	0.134**	0.131**	-0.062	-0.062
	(0.015)	(0.015)	(0.036)	(0.036)
College graduate	0.292**	0.288**	-0.044	-0.043
	(0.016)	(0.016)	(0.033)	(0.033)
Black	-0.129**	-0.128**	-0.025	-0.026
	(0.015)	(0.015)	(0.018)	(0.018)
Hispanic	-0.133**	-0.132**	-0.033	-0.034
	(0.015)	(0.015)	(0.019)	(0.019)
Other race/ethnicity	-0.058**	-0.058**	0.007	0.007
	(0.020)	(0.020)	(0.029)	(0.029)
Married	0.081**	0.081**	-0.002	-0.002
	(0.016)	(0.016)	(0.020)	(0.020)
Divorced/separated	-0.062**	-0.062**	-0.014	-0.014
	(0.017)	(0.017)	(0.025)	(0.025)
Widowed	-0.010	-0.011	-0.011	-0.011
	(0.027)	(0.027)	(0.028)	(0.028)
Constant	-0.532**	-0.590**	0.232**	0.225**
	(0.071)	(0.071)	(0.070)	(0.076)
R squared	0.368	0.369	0.051	0.052
N	6248	6248	3770	3770

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for not confident nor literate, less than high school education, non-Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Table 5b: OLS estimates of determinants of ownership of bonds and share of total financial assets held in bonds (alternative confidence measures)

	Participation		Share	
	(1)	(2)	(3)	(4)
Financial literacy score		0.012*		0.036
		(0.006)		(0.029)
Over-confident	-0.003	-0.004	0.008	0.000
	(0.007)	(0.007)	(0.029)	(0.031)
Sound-confident	0.019*	0.003	0.052	0.004
	(0.009)	(0.013)	(0.031)	(0.056)
Under-confident	0.020*	0.004	0.087**	0.038
	(0.008)	(0.011)	(0.031)	(0.053)
Confidence in the economy in 5 years		-0.008*		0.020
		(0.004)		(0.012)
Above-average risk tolerance	0.006	0.006	0.087**	0.083**
	(0.008)	(0.008)	(0.024)	(0.024)
Net real estate wealth (IHS)	0.003**	0.003**	0.003	0.002
	(0.001)	(0.001)	(0.002)	(0.002)
Privately-held businesses	-0.007	-0.006	0.002	0.001
	(0.012)	(0.012)	(0.033)	(0.033)
Disposable household income (IHS)	-0.004	-0.004	0.006	0.006
	(0.004)	(0.004)	(0.006)	(0.006)
Inheritance/gift received	0.027**	0.026**	0.027	0.029
	(0.008)	(0.008)	(0.023)	(0.023)
Number of household members	0.007	0.006	0.003	0.004
	(0.004)	(0.004)	(0.014)	(0.015)
Presence of children under 18	0.031**	0.032**	0.023	0.023
	(0.010)	(0.010)	(0.038)	(0.038)
Age	0.000	0.000	0.007*	0.007*
	(0.001)	(0.001)	(0.003)	(0.003)
Age squared	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.005	0.005	-0.027	-0.024
	(0.007)	(0.007)	(0.021)	(0.022)
Employed for wage	0.017*	0.017*	0.039	0.043
	(0.007)	(0.007)	(0.025)	(0.025)
High school graduate	0.028**	0.027**	0.053	0.052
	(0.007)	(0.007)	(0.068)	(0.070)
College graduate	0.072**	0.071**	0.134*	0.130
	(0.008)	(0.009)	(0.066)	(0.069)
Black	-0.050**	-0.049**	-0.075	-0.061
	(0.007)	(0.007)	(0.044)	(0.045)
Hispanic	-0.075**	-0.074**	-0.064	-0.064
	(0.006)	(0.006)	(0.101)	(0.102)
Other race/ethnicity	-0.064**	-0.063**	-0.021	-0.018
	(0.013)	(0.013)	(0.066)	(0.065)
Married	0.016	0.016	0.030	0.028
	(0.010)	(0.010)	(0.043)	(0.043)
Divorced/separated	-0.023*	-0.023*	-0.080	-0.078
	(0.011)	(0.011)	(0.044)	(0.044)
Widowed	0.020	0.020	-0.064	-0.067
	(0.016)	(0.016)	(0.055)	(0.054)
Constant	-0.010	-0.007	-0.213	-0.316*
	(0.051)	(0.050)	(0.132)	(0.145)
R squared	0.065	0.065	0.098	0.102
N	6248	6248	769	769

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Dummy variables for not confident nor literate, less than high school education, non-Hispanic white ethnicity, and being single are reference categories of the respective dummy variables sets. * $p < 0.05$, ** $p < 0.01$.

Data Source: Survey of Consumer Finances 2016

Next, we analyze the role of gender in financial literacy and confidence for ownership of equities and bonds. This extension is motivated by a body of literature finding gender differences in financial literacy and attitudes towards finance, including differences in confidence and risk aversion (see Cupák et al., 2018; Bannier and Schwarz, 2018). Here, we estimate several models interacting financial literacy and gender, as well as confidence measures and gender, in addition to the standard set of covariates considered in baseline models. The interaction terms allow for gender-specific impacts of financial literacy or confidence on financial behavior. Results from this exercise are presented in Table 6a and Table 6b. Consistent with Bannier and Schwarz (2018), we find that financial literacy has a similar effect on risky asset behavior for both men and women—the difference between the effect for men and women is imprecisely measured. We find that the relationship between self-confidence and participation in the stock market is somewhat weaker for women, though this is also imprecisely measured at the 0.05 level (Table 6a, columns 3 and 5). The influence of self-confidence on the intensive margin does not appear to be different for men and women (Table 6a, columns 8 and 10). We find no differential effect by gender of financial literacy or either confidence measure on the extensive margin for bonds (Table 6b, columns 1-5). We also find that the effect of being confident into the economy on the share of financial wealth in bonds is weaker for women (columns 9 and 10 in Table 6b), although not precisely measured. Note that Bannier and Schwarz (2018) find much stronger gender-related effects of confidence on financial wealth accumulation in the sample of German households.

Table 6a: OLS estimates of determinants of participation in equity markets and share of total financial assets held in equities (gender-related effects of financial literacy and confidence)

	Participation					Share				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Financial literacy score	0.059**	0.065**	0.059**	0.059**	0.063**	0.007	0.009	0.007	0.008	0.009
	(0.006)	(0.009)	(0.006)	(0.006)	(0.010)	(0.008)	(0.010)	(0.008)	(0.008)	(0.010)
Confidence in own financial knowledge	0.005*	0.005*	0.009**	0.005*	0.009**	-0.001	-0.001	-0.000	-0.001	-0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
Confidence in the economy in 5 years	0.009	0.009	0.009	0.010	0.010	0.007	0.007	0.007	0.003	0.003
	(0.005)	(0.005)	(0.005)	(0.010)	(0.009)	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
Financial literacy x female		-0.010			-0.007		-0.002			-0.002
		(0.011)			(0.011)		(0.012)			(0.012)
Confidence1 x female			-0.008		-0.007			-0.001		-0.001
			(0.004)		(0.004)			(0.007)		(0.007)
Confidence2 x female				-0.002	-0.002				0.008	0.008
				(0.013)	(0.013)				(0.014)	(0.014)
Constant	-0.654**	-0.666**	-0.685**	-0.657**	-0.695**	0.208**	0.205**	0.204*	0.217**	0.210*
	(0.069)	(0.070)	(0.074)	(0.074)	(0.078)	(0.074)	(0.078)	(0.079)	(0.075)	(0.082)
R squared	0.368	0.368	0.368	0.368	0.368	0.051	0.051	0.051	0.051	0.051
N	6248	6248	6248	6248	6248	3770	3770	3770	3770	3770

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Other socio-economic variables included as described in the text. * $p < 0.05$, ** $p < 0.01$.
Data Source: Survey of Consumer Finances 2016

Table 6b: OLS estimates of determinants of ownership of bonds and share of total financial assets held in bonds (gender-related effects of financial literacy and confidence)

	Participation					Share				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Financial literacy score	0.014**	0.014*	0.014**	0.014**	0.013*	0.011	-0.005	0.011	0.011	-0.003
	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.010)	(0.014)	(0.010)	(0.010)	(0.014)
Confidence in own financial knowledge	-0.000	-0.000	0.001	-0.000	0.001	0.002	0.002	-0.004	0.002	-0.003
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.004)	(0.004)	(0.005)	(0.004)	(0.006)
Confidence in the economy in 5 years	-0.008*	-0.008*	-0.008*	-0.011	-0.011	0.022**	0.022**	0.022*	0.035**	0.036**
	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.009)	(0.009)	(0.009)	(0.011)	(0.011)
Financial literacy x female		0.001			0.002		0.025			0.020
		(0.007)			(0.007)		(0.017)			(0.017)
Confidence1 x female			-0.002		-0.002			0.011		0.010
			(0.003)		(0.003)			(0.009)		(0.009)
Confidence2 x female				0.005	0.005				-0.024	-0.025
				(0.010)	(0.010)				(0.016)	(0.016)
Constant	-0.008	-0.007	-0.017	-0.002	-0.009	0.317**	0.351**	0.357**	0.282**	0.343**
	(0.051)	(0.053)	(0.054)	(0.052)	(0.056)	(0.084)	(0.088)	(0.088)	(0.078)	(0.084)
R squared	0.065	0.065	0.065	0.065	0.065	0.100	0.102	0.100	0.100	0.100
N	6248	6248	6248	6248	6248	769	769	769	769	769

Notes: Raw coefficients displayed (not standardized). Estimations carried out using multiple-imputation techniques. Bootstrapped standard errors presented in parentheses are based on 999 replicate weights. Other socio-economic variables included as described in the text. * $p < 0.05$, ** $p < 0.01$.
Data Source: Survey of Consumer Finances 2016

5.4. Limitations

Given that we were unable to address the possible endogeneity of financial literacy and confidence, we caution against a strict causal interpretation of our results. Financial literacy and confidence have been identified in some previous empirical studies as endogenous determinants with respect to investment in financial wealth. The SCF data contain some variables, which could be potentially employed as relevant instruments for financial literacy, yet they would not fulfill the exclusion restriction condition of valid instruments.[11]

Confidence is also possibly an endogenous variable. We are not aware of any relevant instruments in the SCF data for the possibly endogenous confidence variable. Given the previous research (see, e.g. Lusardi and Mitchell, 2014), it is very likely that the effect of measured financial literacy would strengthen after addressing its endogeneity. We are not so confident in saying what would happen to the effect of confidence, as the previous empirical literature addressing endogenous confidence is very limited. Even in the presence of valid instruments, models with multiple endogenous variables at the same time (measured literacy and confidence in our case) are extremely hard to identify and to interpret (Angrist and Pischke, 2008). The measured effects hence should be interpreted as conditional correlations or predictive effects rather than causal effects. Despite of this limitation, we believe that our rich empirical results offer interesting insights into the financial behavior of the US households.

6. Conclusion

In this paper we analyzed unique data on financial literacy, confidence in one's own financial knowledge as well as confidence in the economy and investment into risky assets (equity and bonds) using the recent 2016 SCF wealth microdata. The 2016 survey included, for the first time, the three standard financial literacy questions (Lusardi and Mitchell, 2014). Therefore, it allows to jointly analyze financial literacy of the respondent as well as the according household balance sheets the respondent lives in. The 2016 survey also asked respondents to provide a self-assessment with regard to their own financial knowledge, and a question asking households about their future economic expectations which we employ as proxies for confidence.

We contribute to the literature on portfolio allocation by linking a novel set of behavioral variables on financial literacy and confidence with detailed, dis-aggregated information

[11] For example, mother's and father's education variables are indeed positively correlated with financial literacy; however, it is unlikely they would influence the outcome only via endogenous financial literacy and not by any other channel.

on financial assets held in stocks or bonds. We show that measures of objective financial literacy, confidence in one's own financial knowledge, and confidence in economic conditions are all positively related to the probability of investing in equities, whether analyzed separately or included together. Confidence in one's own financial skills is relevant, even holding those skills constant. However, while this relationship holds even when controlling for a large set of socio-economic characteristics highly predictive for financial literacy and participation in markets for risky assets, it breaks down in the analysis of the intensive margins. Conditional on actually holding risky assets, the share of total financial assets held in risky assets still rises with financial literacy but no longer with confidence.

Using unconditional quantile regressions, we find evidence that financial literacy has a positive and significant effect on the 25th percentile of equity shares, but a negative effect on the 75th. Among households typically holding higher shares of risky assets the financially literate hold relatively lower shares. Financial literacy therefore dampens risk appetite within the comparably risk-tolerant households. The impact of confidence in the economy mostly matters for the allocation decision of financial wealth into bonds, especially at the median and the 75th percentile of the bonds' distribution.

Our results are consistent with past findings on the effect of race and other socioeconomic characteristics on the holdings of financial assets. Most interestingly we reproduce the finding that white families tend to have larger shares of risky assets. We also confirm that lower risk aversion is associated with a higher probability of stock market participation, but no measurable effect for participation in bond markets. Results from robustness checks and extensions suggest that the effects are likely decreasing somewhat over the distribution of net wealth.

In sum, measured financial literacy together with confidence in own skills as well as confidence in the economy seem to be yet another powerful determinants explaining participation and allocation decisions of households in markets for risky assets and bonds. This result confirms the recent findings of Bilias et al. (2017) who argue that structural changes in financial attitudes (including literacy and sophistication) of US households might be behind the growing stock-market participation. Yet, the overall engagement of household in market for risky assets is still far from what the economic theory predicts. Our results could be seen to inform potential policy tools, perhaps through initiatives to increase financial knowledge and up to a certain degree financial confidence, to foster stock-market participation in the US.

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Appendix

A. Description of variables used in empirical analysis

Variable	Description
Dependent variables	
D_equity	Dummy variable taking a value of 1 if household holds any equity of the following type: publicly traded stocks, stock mutual funds, combination funds, IRAs/Keoghs invested in stocks, other managed assets w/equity interest (e.g. annuities, trusts, MIAs), thrift-type retirement accounts invested in stocks, savings accounts classified as 529 (educational savings accounts)
W_equity	Share of the equity value in total financial assets (including pensions)
D_bonds	Dummy variable taking a value of 1 if household holds any instruments of the following type: government saving bonds, corporate bonds, commercial paper, state or municipal non-saving bonds, foreign bonds and other non-saving bonds, debentures, mortgage-backed securities, negotiable certificates of deposit, treasury bills (T-bills), treasury certificates (T-certificates), treasury bonds (T-bonds), zero-coupon bonds, and similar instruments normally traded in financial markets
W_bonds	Share of bonds and other debt securities in total financial assets (including pensions)
Explanatory variables	
FL_score	Number of correct answers to the three financial literacy questions; ranging from 0 to 3
FL1	Dummy variable taking a value of 1 if the knowledge question on "risk" is answered correctly
FL2	Dummy variable taking a value of 1 if the knowledge question on "interest rates" is answered correctly
FL3	Dummy variable taking a value of 1 if the knowledge question on "inflation" is answered correctly
Confidence1	Self-assessed level of knowledge about financial matters; ranging from 0 "very low" to 10 "very high"
Confidence2	Respondent's confidence in overall performance of the US economy in 5 years' horizon as compared to today; ranging from 1 "worse" to 3 "better"
Risk	Dummy variable taking a value of 1 if the respondent reports positive risk attitude
Wealth	Net real estate wealth defined as a total value of properties minus the corresponding liabilities
Business ownership	Dummy variable taking a value of 1 if household owns or shares ownership in any privately-held businesses
Income	Total monetary and non-monetary household current income net of income taxes and social security contributions
Inheritance	Dummy variable taking a value of 1 if household had received an inheritance
HH_size	Number of household members
Children	Dummy variable taking a value of 1 if there are child(ren) under age of 18
Age	Age of the respondent in years
Female	Dummy variable taking a value of 1 if the respondent is female
Working	Dummy variable taking a value of 1 if the respondent is employed for wage or self-employed
Edu_low	Dummy variable taking a value of 1 if the respondent has less than high school education
Edu_middle	Dummy variable taking a value of 1 if the respondent has secondary education
Edu_high	Dummy variable taking a value of 1 if the respondent has university education (bachelor, graduate, postgraduate)
White	Dummy variable taking a value of 1 if the respondent declares Caucasian ethnicity (including Middle-eastern / Arab whites)
Black	Dummy variable taking a value of 1 if the respondent declares African-American ethnicity
Hispanic	Dummy variable taking a value of 1 if the respondent declares Hispanic / Latin-American ethnicity
Other_race	Dummy variable taking a value of 1 if the respondent declares other ethnicity (e.g. Chinese, Indian)
Married	Dummy variable taking a value of 1 if the respondent is married or having partner
Single	Dummy variable taking a value of 1 if the respondent is living in a single-member household
Divorced	Dummy variable taking a value of 1 if the respondent is divorced or separated
Widowed	Dummy variable taking a value of 1 if the respondent is widowed

Source: own processing

B. Framing of the financial literacy questions

Q1) Please tell me whether this statement is true or false. "Buying a single company's stock usually provides a safer return than a stock mutual fund."

a) True

b) False (correct answer)

c) Do not know

d) No answer

Q2) 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?

a) More than $102 (correct answer)

b) Exactly $102

c) Less than $102

d) Do not know

e) No answer

Q3) 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?

a) More than today

b) Exactly the same

c) Less than today (correct answer)

d) Do not know

e) No answer

C. Unconditional quantile regression

To analyze the relationship between covariates and the share of risky assets in total financial assets beyond the mean (baseline model outlined in equation 2), we employ unconditional quantile regression (UQR) method. To do so, we use a concept of the recentered influence function similar to the standard regression technique, besides that the dependent variable is replaced by the recentered influence function of the statistics of interest (Firpo et al., 2009). For a reader's convenience we summarize the Firpo et al.'s (2009) UQR framework.

Let Y be the observed outcome variable of interest in the presence of a set of available covariates X. Y and X have a joint distribution $F_{Y,X}(.;.)$. The unconditional distribution of X can be defined as follows:

$$F_Y(y) = \int_{(Y|X)}^{F} (y|X = x) \times dF_X(x).$$

The UQR framework is developed by defining a recentered influence function (RIF), which is an extension to the concept of influence function (IF). Influence functions are used in statistics to extract the effect/influence of adding or removing a particular observation on the value of statistics $v(F_Y)$. The standard IF can be written as:

$$IF(y; v(F)) = \lim_{\varepsilon \to 0} \frac{[v\{(1-\varepsilon) \cdot F + \varepsilon \cdot \delta_y\} - v(F)]}{\varepsilon}, 0 \leq \varepsilon \leq 1,$$

where F is the cumulative distribution function for Y, and δ_y represents the probability measure putting mass 1 at the value y. We obtain the RIF by adding the IF to the statistics of interest $v(F)$:

$$RIF(y; v; F_Y) = v(F) + IF(y; v; F_Y).$$

After substituting in the particular statistic of interest, regression quantile q_τ, it yields:

$$RIF(y; q_\tau) = q_\tau + IF(y; v; F_Y).$$

In the case of quantiles, we can write the influence function as follows:

$$IF(y; q_\tau) = \frac{\tau - I[Y \leq q_\tau]}{f_Y(q_\tau)},$$

where $f_Y(q_\tau)$ represents the probability density function of Y evaluated at quantile q_τ. $I[Y \leq q_\tau]$ is an indicator variable taking a value of 1 if the outcome variable Y is smaller than q_τ and 0 otherwise.

Finally, the UQR estimator is defined as coefficient vector obtained from the following linear regression of the RIF on a set of explanatory variables:

$$RIF(Y, \tau) = X\beta^U QR + \varepsilon.$$

UQR produces coefficients corresponding to the impact on the τ-th quantile of the outcome variable Y, irrespective of the included set of explanatory variables, which makes the method an attractive tool, especially in the policy context analysis.

D. ANALYZING MULTIPLE IMPUTED DATA

A specific feature of wealth surveys (including the SCF) is that missing values in some of the variables due to responses of "Don't know" and "Refused" have been imputed and replaced m times (five in the case of SCF). This feature should be considered in an empirical analysis when obtaining statistical inferences. Estimations ignoring item-nonresponse can lead to substantial biases as well as efficiency loss due to the large number of covariates included in regressions (see Christelis et al., 2010). Therefore, we follow the rules suggested by Rubin (1987) and Little and Rubin (2002), and we use multiple-imputation techniques to obtain correct estimated coefficients along with the variance.

Let β be our point estimate of an interest – that is mean and regression parameter. For each of the imputed datasets m, we obtain an empirical estimate of β, denoted by $\hat{\beta}_m$. The final average point estimate of β, given by $\bar{\beta}$, is computed as follows:

$$\bar{\beta} = \frac{1}{5}\sum_{m=1}^{5}\hat{\beta}_m.$$

The final estimated $\bar{\beta}$ is associated with a variance having two components: $W = \frac{1}{5}\sum_{m=1}^{5}\hat{V}_m$, which is a within imputation sampling variance, and the between imputations variance given by $B = \frac{1}{4}\sum_{m=1}^{5}\left(\hat{\beta}_m - \bar{\beta}\right)^2$. The total variance-covariance matrix, $\hat{V}$, associated with $\bar{\beta}$ is given by:

$$\hat{V} = W + (6/5)\,B.$$

Finally, to estimate W accounting for the complexity of the SCF sampling design, we implement a bootstrap procedure taking into account 999 replicate weights provided in the SCF.