Financial Literacy and Portfolio Diversification

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Abstract

In this paper we focus on poor financial literacy as one potential factor explaining lack of portfolio diversification. We use the 2007 Unicredit Customers' Survey, which has indicators of portfolio choice, financial literacy and many demographic characteristics of investors. We first propose test-based indicators of financial literacy and document the extent of portfolio under-diversification. We find that measures of financial literacy are strongly correlated with the degree of portfolio diversification. We also compare the test-based degree of financial literacy with investors' self-assessment of their financial knowledge, and find only a weak relation between the two measures, an issue that has gained importance after the EU Markets in Financial Instruments Directive (MIFID) has required financial institutions to rate investors' financial sophistication through questionnaires.

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1. Introduction

One of the most important deviations of investors' portfolios from the prescriptions of normative financial models is lack of diversification (Campbell, 2006; Curcuru et al., 2007). Indeed, a large literature documents that many individuals invest in a few stocks, rather then diversifying through equity funds, tend to invest in the same stock of the firm their work with, concentrating human capital risk and financial risk, and opt often for their firm's stock when allocating retirement saving (Dorn and Huberman, 2005). Investors also tend to concentrate a large share of their wealth in their own business, bearing an amount of idiosyncratic risk that does not seem to be compensated by higher expected returns, either monetary or non-monetary (Moskovitz and Vissing-Jorgensen, 2002). Besides failing to diversify across firms, investors also fail to diversify geographically, concentrating investments in home or regional assets.

Several explanations have been advanced to explain the diversification puzzle. In this paper we focus on lack of financial literacy as one potentially important factor. Indeed, recent literature shows that financial literacy affects households' behavior. Lusardi and Mitchell (2007) find that those with low financial literacy are less likely to plan for retirement and therefore accumulate less wealth. Christelis, Jappelli and Padula (2006) and Alessie, Lusardi and van Rooji (2007) suggest that lack of financial literacy correlates with individual decisions to participate in the stock market. We contribute to this literature showing that financial literacy affects also portfolio diversification.

We use the 2007 Unicredit Customers' Survey (UCS). The survey is a representative sample of clients of the largest Italian bank, and has detailed information on portfolio choice and several indicators of investors' financial literacy. Portfolio data are not limited to the administrative data, but span the entire portfolio of the household. Our study focuses on two issues. First, we analyze a detailed list of questions intentionally designed to distinguish among different levels of financial literacy, with particular reference to the information required to choose among different assets and understand the meaning of diversification. We then study how portfolio diversification correlates with financial literacy and other investors' characteristics. We find that

measures of financial literacy are strongly correlated with the degree of portfolio diversification, and infer that the evidence is consistent with explanations of under-diversification based on investors' limited literacy. To the extent that investors don't take advantage of diversification opportunities because of poor financial literacy, there is scope for policies to train potential investors and to promote financial education programs particularly if targeted to socioeconomic groups characterized by low levels of literacy.

The paper is organized as follows. In Section 2 we review the relevant literature on household portfolio diversification and financial literacy. Section 3 presents the data, and Sections 4 and 5, respectively, discuss the indicators of portfolio diversification and financial literacy, distinguishing between test-based measures of financial literacy and self-assessed measures of financial knowledge. Section 6 relates portfolio diversification to our measure of literacy, controlling for investors' risk aversion, demographic characteristics, and resources. In Section 7 we compare the test-based degree of financial literacy with the self-assessed measure. We find only a weak relation between the two measures, an issue that has gained importance after the EU Markets in Financial Instruments Directive (MIFID) has required financial institutions to rate investors' financial sophistication through questionnaires. Our evidence suggests that a test-based approach is better at measuring investors' ability to make financial decisions than a self-assessed approach. Accordingly, we argue that a test-based, standardized questionnaire with a pre-designed score system would be a more effective alternative to assess investors' financial abilities. Section 8 summarizes our main findings.

2. The portfolio diversification puzzle

A large empirical literature in finance documents lack of portfolio diversification, and tries to understand the degree to which household asset allocation decisions conform to rational models of investors' behavior. Blume and Friend (1975), using tax filing and survey data, find that household portfolios are grossly under-diversified and that the degree of diversification increases with wealth. Kelly (1995) uses data from the 1983

Survey of Consumer Finances, and documents poor diversification among U.S. households. He finds that the median number of stocks in an investor portfolio is only two, and that less than one third of the households hold more than ten stocks. Gentry and Hubbard (2000) examine the portfolios of entrepreneurial households and find that their wealth is grossly undiversified, as more than 40 percent of their portfolios consist of active business assets only. Barber and Odean (2000) find that investors hold portfolios with few stocks and hence are undiversified, while Moskowitz and Vissing-Jorgensen (2001) provide further empirical evidence of improper diversification among households by examining their investments in private equity. They find that households hold concentrated portfolios of private equity even though private equity does not offer a better risk-return trade-off compared with a diversified portfolio of public equity. Kumar and Goetzman (2002) report results that are consistent with the findings of Kelly (1995) and reinforce the evidence of poor diversification.[1]

At least three types of explanations for this lack of diversification have been put forward in the literature. According to a first strand of literature, limited diversification reflects some frictions in otherwise traditional portfolio models: high transaction and search costs, small portfolio size, and constraints to buy in round lots could prevent investors from diversifying appropriately. This approach stresses that under-diversification is a rational choice, where individuals trade-off the benefits of diversifications against the costs of achieving it. The exact mechanism through which frictions operate vary: they can restrict the ability of investors to hold a large number of assets (Perraudin and Sorensen, 2000), limit their information processing capacity (Van Nieuwerburgh and Veldkamp, 2007), or affect the way they value outside job options (Ruffino, 2007).

A second strand of literature argues that diversification may reflect behavioral biases. For instance, it may stem from a (wrong) belief that any multiple-stock portfolio,

[1] It is important to point out that factors such as entrepreneurial risk or income exposure to particular industry risk factors can and should affect the selection of individual assets within the equity portfolio. In fact, Souleles (2003) shows that consumption risk, labor income risk, past returns as well as households' expectations about future returns are important determinants of households' portfolio composition and their buying decisions of risky assets.

irrespective of its covariance structure, is well diversified. This leads to the application of "satisfactory" rules, such the rule splitting equally the portfolio among various assets - the so-called 1/*N* rule, see Benartzi and Thaler (2001; 2007). Similarly, investors could adopt an "erroneous" diversification strategy where they hold stocks with lower volatility and ignore correlations among them. More generally, the behavioral literature stresses that lack of diversification is due to behavioral bias such as familiarity (Huberman, 2001), narrow framing (Kahneman and Tversky, 1979), or loyalty (Cohen, 2007). Several papers have pursued this approach. Investors could ignore correlations (Kroll, Levy, and Rapoport, 1988), or follow price trends (Odean, 1999; Dhar and Kumar, 2001). People who frame their investment decisions narrowly would ignore the interactions among individual stocks and might be insensitive to correlations among them in forming their portfolios (Kahneman and Lovallo, 1993; Barberis, Huang, and Thaler, 2006).

Alternatively, investors could take correlations into account, but misestimate their strength. For instance, investors who are overconfident about the accuracy of their private information may systematically overstate correlations among stocks and thus choose to hold focused and under-diversified portfolios.[2] Or investors might prefer to invest in stocks they are familiar with (e.g., local stocks or employer stocks) and since unfamiliar stocks are under represented (or not represented at all) portfolio are under-diversified (Grinblatt and Keloharju, 2001; Zhu, 2002). While it is unclear the meaning of a preference for familiarity, one interpretation is that it is a reflection of the presence of ambiguity in unfamiliar assets.

A third strand of literature stresses that investors may develop preferences or attractions toward certain types of stocks. For instance, investors may over-weight certain categories of stocks or styles (e.g., small-cap stocks, growth stocks, etc.), certain industries (e.g., technology stocks), or they might prefer stocks with higher variance and

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[2] Consider two stocks *x* and *z* with true standard deviations of returns σ_x and σ_z; overconfident investors with degree of overconfidence *k*>1 perceive instead σ_x / k and σ_z / k. The correlation coefficient $\rho_{xz} = \frac{k^2 \operatorname{cov}(x,z)}{\sigma_x \sigma_z}$ is overstated by a factor of k^2 even if the perceived covariance is not affected.

positive skewness (Simkowitz and Beedles, 1978; Golec and Tamarkin, 1998; Polkovnichenko, 2005; Barberis and Huang, 2007). In all cases, this leads to less then perfect diversification.

In this paper we stress that poor financial literacy is a fourth important factor associated with lack of diversification. In fact, individuals with poor financial sophistication may undervalue the benefits of diversification or ignore them altogether. To combine optimally a portfolio of assets picking the right combination of stocks requires sophisticated knowledge of the variance-covariance matrix of asset returns and good understanding of the benefits of diversification. Diversifying wealth through mutual funds is an easier task, but still requires understanding the benefits of diversification and of the risk properties of the pool of assets in the fund.

There are least two reasons to explore the role of lack of financial literacy as an explanation for poor diversification. First, it is well-documented that in the U.S. and elsewhere there is dramatic lack of financial literacy (OECD, 2005; Lusardi and Mitchell, 2007). Alessie, Lusardi and van Rooji (2007) document severe lack of financial literacy also in a sample of Dutch households and Christelis, Jappelli and Padula (2006) show that a large fraction of households in the leading European countries are deficient in numeracy and other cognitive abilities. As we will show this is also true in our sample.

Second, there is evidence that financial literacy affects households' behavior. Lusardi and Mitchell (2007) find that people with low financial literacy are less likely to plan for retirement and therefore accumulate less wealth. Christelis, Jappelli and Padula (2006) and Alessie, Lusardi and van Rooji (2007) find that lack of financial literacy correlates with investors' decisions to participate in the stock market. These papers have not looked at the impact of literacy on portfolio diversification. From a welfare perspective it is the failure to take advantage of available diversification opportunities that should be of concern. While non-participation in the stock market by the financially illiterate may be the optimal response of people that are aware of their scarce ability to invest in risky assets, lack of diversification leads to excessive risk taking. Furthermore, if investors don't take advantage of diversification opportunities because of lack of financial

literacy, there is scope for policies to inform potential investors and promote financial education programs.

3. The data

The data used in this paper draw on a sample of Italian clients of the Unicredit Group. The Unicredit Clients' Survey (UCS) was conducted between June and September 2007 and elicits detailed financial and demographic information on a sample of 1686 individuals with a checking account in one of the banks of the Unicredit Group. The sample is stratified according to three criteria: geographical area, city size, and financial wealth. The survey over-samples rich investors, because respondents are selected from the pool of clients with at least 10,000 euro of financial wealth at Unicredit in December 2006. As we shall see, finding lack of sophistication and diversification in a sample of relatively rich investors is interesting, because it is likely that these two characteristics will be even more prevalent in the population at large.

An important feature of the survey is that the sample selection is based on individual clients of Unicredit. The UCS, however, contains detailed information on the spouse, if present. Financial variables are elicited for the survey respondents as well as for the entire household. In the paper, demographic variables refer to the household head (even when different from the respondent), and economic variables (real and financial assets) refer to the household, not to the individual investor.

The survey contains detailed information on ownership of real and financial assets, and amounts invested. For real assets, the UCS reports separate data on primary residence, investment real estate, land, business wealth, and debt (distinguished between mortgage and other debt). Real asset amounts are elicited without use of bracketing.

For financial wealth, respondents report ownership of financial assets grouped in the following 17 categories: (1) transaction accounts; (2) certificates of deposit; (3) repurchase agreements; (4) short-term and flexible rates Treasury Bills; (5) long-terms, fixed rates Treasury Bills; (6) corporate bonds; (7) Italian listed stocks; (8) foreign listed

stocks; (9) Italian and foreign unlisted stocks; (10) derivatives; (11) mutual funds; (12) hedge funds; (13) Exchange Traded Funds; (14) managed investment accounts; (15) unit and indexed linked insurance products; (16) life insurance; (17) pension funds.

With the exception of pension funds and life insurance, respondents are then asked to report the share of assets in total assets in one of the following 6 categories: (1) transaction accounts; (2) Treasury Bills; (3) Listed and unlisted stocks, derivatives; (4) Mutual funds and ETF (5) managed investment accounts; (6) unit and index linked insurance. Although the specific composition of mutual funds and managed investment accounts is not given, we know if they are predominantly invested in stocks or bonds. Finally, investors also report the number of stocks they own, although no information on the specific stock is reported.

4. Measuring diversification

The UCS survey has information on the share of financial wealth invested in equities through mutual funds, derivatives and ETF (denoted by α), financial wealth invested directly in stocks (listed or not), denoted by (1-α), and number of stocks of each investor (denoted by *N*).[3] However, the survey does not record the particular stock people own, or the specific mutual fund. If one assumes that the direct portion (1-α) is split equally across *N* stocks, one can write the return of the portfolio as the linear combination of the return of the indirect and direct equity investment:

$$R_p = \alpha R_m + (1-\alpha)\frac{1}{N}\sum_{i=1}^{N} R_i$$

where R_m is the return of indirect investment in stocks, R_i the return of each stock in the direct equity portfolio and $\frac{(1-\alpha)}{N}$ the corresponding portfolio weight. If the indirect

[3] The number of stocks is imputed for 173 investors using age, education, gender, regional dummies and financial wealth dummies.

portfolio contains enough securities (for example it is invested in a market index) its idiosyncratic risk has a marginal impact on the total idiosyncratic risk, so the latter is driven mostly by the direct portion invested in the N stocks. Thus an index of diversification is simply the portfolio weight invested directly in the stock market:

$$D_1 = 1 - \frac{(1-\alpha)}{N} \text{ if } N \geq 1$$
$$= 1 \text{ if } N = 0$$

Notice that the index ranges from 1 (complete diversification) when α=1 (and therefore N=0) or N is large, to 0 when α=0 and N=1.[4] A second index of diversification allows for correlation among the stocks in the portfolio:

$$D_2 = 1 - (1-\alpha)\left[\frac{1}{N} + \frac{(N-1)}{N}\text{corr}\right] \text{ if } N > 1$$
$$= 1 \text{ if } N = 0$$

In the estimation we assume that *corr*, the average correlation between any two stocks, ranges between 0 and 0.2, with a preferred value of 0.05.[5] Empirically, however, the index D_2 is very close to the index that does not take into accounts stock correlations. We also use two other simple indicators of diversification, that is, the number of stocks in the portfolio, which is defined for all investors with stocks, and the total number of assets categories in the investor's portfolio (in this case, we define stocks as one category).

Figure 1 plots the index D_1, which is clearly polarized among those with only few stocks and low α, and those who invest directly only a small share of wealth in stocks

[4] The index is closely related to the measure portfolio diversification proposed by Blume and Friend (1975). Since the weight of each security in the market portfolio is very small, the index is approximated by the sum of squared portfolio weights, $\sum_{i=1}^{N}(w_i - w_m)^2 \approx \sum_{i=1}^{N} w_i^2$, where N is the number of securities, w_i the portfolio weight assigned to stock i in the investor's portfolio and w_m the weight assigned to a stock in the market portfolio.

[5] The 0.05 average correlation is taken from Pelizzon and Parigi (2007).

(high α). Note also that about 60 percent of respondents invest more than 50 percent of total stockholding in equity funds, but only 15 percent own foreign equities, and only 3 percent invest in ETF. Overall, these indicators show that many portfolios are not well diversified. In the next step of our analysis we relate the index of diversification to an index of financial sophistication, controlling for a wide range of demographic and economic characteristics of investors.

Figure 2 plots the number of stocks for those who invest in stocks (59 percent of all stockholders) and the total number of assets. The median number of stocks is 4, and about 30 percent of investors report owning 1 or 2 stocks. The median number of assets is 3, and the variable ranges from 1 to 15, with 55 percent of investors reporting to invest only in three assets (bank deposits, Treasury Bills and stocks are the most common).

5. Financial literacy

In this section we describe how we construct an index of financial literacy based on a set of specifically designed questions posed to UCS respondents. In particular, we stress that we measure financial literacy using "objective" questions, based on the quality of the answers to simple financial literacy questions. To compute the index, we define preliminarily two dummy variables equal to one if respondents answer correctly two questions about the understanding of interest rates and inflation.[6] The interest rate question is answered correctly by 34.2 percent of the sample, the inflation question by 51.9 percent, while only 17 percent answers correctly both questions.[7]

We also define a variable that measures investors' ability to rank asset riskiness correctly. In particular, we consider if the respondents' ranking of asset categories

[6] The interest rate question is: Suppose that in the next 6 months interest rate will increase. Do you think it is a good idea to buy today fixed interest rate bonds? The inflation question is: Suppose that a saving account earns an interest rate of 2 percent per year (net of costs). If the annual inflation rate is 2 percent, after two years (with no withdrawals), do you think that you could buy more than you could buy today / less / the same / don't know?

[7] These two questions are similar to the module of financial literacy proposed by Lusardi and Mitchell (2006) in the 2004 US Health and Retirement Study. Their study shows that financial illiteracy is widespread and particularly acute among women, the elderly, and those with low education.

satisfies each of the following inequalities: (a) bonds are at least as risky as transaction accounts; (b) stocks are at least as risky as bonds; (c) equity mutual funds are at least as risky as bond mutual funds; (d) housing is riskier than transaction accounts. The variable is plotted in Figure 3, showing that less then 10 percent of the sample ranks all assets considered "correctly", while over 70 percent of the sample ranks correctly at most two assets.[8]

Finally, we define two dummy variables based on the responses to specific questions on financial diversification. The first question asks the meaning of financial diversification, and the responses are plotted in Figure 4. It appears that only 39.9 percent of respondents state that financial diversification means "to invest in assets to limit risk exposure". The second question asks respondents to compare and rank how diversified are specific portfolios. As shown in Figure 5, only 13 percent of the sample states that the mot diversified portfolio is one with 70 percent invested in T-bills and 30 percent in a European equity fund (the others responses are: 70 percent in T-bills, 15 percent in a European equity fund, and 15 percent in 2-3 stocks; 70 percent in T-bills and 30 percent in 2-3 stocks; 70 percent in T-bills and 30 percent in a stock I know well).

Table 1 reports the correlation matrix among the indicators of financial literacy. With few exceptions, the correlations are positive, but they are also small in absolute value, indicating that the questions capture different dimensions of financial literacy. Summing the dummy variables, we obtain an overall indicator of financial literacy ranging from 0 to 8. Figure 6 plots the index, and documents considerable heterogeneity among investors as well as lack of financial literacy: less than 10 percent of investors scores more than 5, while almost 30 percent scores less than 3. This is strong evidence that people have limited financial literacy, confirming previous studies (Alessie, Lusardi and van Rooji, 2007) even in a sample of relatively rich investors.

It is interesting to relate financial literacy to demographic variables, income and wealth. In Table 2 we report the means and standard deviations of the main variables used

[8] One may argue that these rankings reflect the variances of the assets categories, rather than their covariance with market returns (betas). This interpretation is not warranted, because the question asks about the riskiness of broad asset categories.

in the estimation. Table 3 reports regression results of some of the components of the index of financial literacy (correct on the inflation question, correct on the interest rate question, correct asset ranking, correct answers to the diversification questions) on age, gender, education, area of residence, a dummy for risk aversion, occupation (retired and self-employed), log disposable income and financial wealth dummies.[9]

Several interesting patterns emerge from the estimates. Education, being male, high income and high financial wealth (in particular, wealth above 500 thousand euro) are associated with greater financial literacy. The association between investors' resources and financial literacy may be due to the fact that wealth raises the incentives to acquire more financial expertise. But we cannot rule out reverse causality because financial literacy might lead to better investment and higher wealth.

We also find that risk averse investors are less financially sophisticated, as measured by the two dummies for the meaning of financial diversification. This is an important finding, because it implies that investors who would value more the benefits of diversification are also less endowed with the knowledge tools to take advantage from it.

The last column reports a regression for the index of financial literacy, and confirms the patterns found in the individual indicators: males, and people with high education, income and wealth are more financially knowledgeable. Table 3 also shows that the main correlation patterns among the various indicators and the explanatory variables are remarkably consistent, and are preserved when aggregating the various responses. Thus, in the remaining of the paper we will rely mainly on the aggregate indicator to measure financial literacy.

[9] The risk aversion dummy is based on the question: In managing your financial investment, you think you are a person that is interested in investments that offer the possibility of: (1) high return, with high risk of loosing the capital; (2) good return, and reasonable safety; (3) moderate return, but at the same time good degree of safety; (4) low return, without any risk of loosing the capital. The risk aversion dummy is equal to one for investors who answer (3) or (4).

6. Portfolio diversification and financial literacy

In this section we relate our indicators of portfolio diversification to financial literacy, controlling also for demographic variables, risk aversion, income, wealth, and other potential determinants of diversification.

We start out with a descriptive analysis. In Figure 7 we plot the index of portfolio diversification D_1 against age (upper left panel), education (upper right), occupation (bottom left), income and wealth deciles (bottom right). We find a negative correlation between age and diversification (younger households are also more diversified), contrary to the positive relation found by Kumar and Goetzman (2002). However, given the cross-sectional nature of our data, we cannot distinguish a life-cycle effect from a cohort effect, i.e. that younger generations are more diversified than older ones. The figure also highlights a positive association of diversification with formal education (particularly for college graduate). Richer households also tend to be more diversified: going from the first income or first financial wealth deciles to the top deciles is associated with an increase in diversification between 5 and 10 percentage points. On the other hand, the diversification index does not vary significantly across occupation groups.

In Figure 8 we plot the relation between diversification and the index of financial literacy, our main variable of interest: going from the lowest to the highest values of literacy is associated with an increase in portfolio diversification of about 15 percentage points. This is a non trivial amount, considering that the diversification index varies between zero and one and has a sample mean of 0.86.

The regression analysis broadly confirms the descriptive evidence. In Table 4 we relate portfolio diversification to demographic variables and the indicator of financial sophistication. Estimation is performed by two-limit Tobit, as the index varies between zero (all wealth is invested in one stock) and one (all wealth is invested in a mutual fund). Overall, we find the diversification index difficult to predict. The sign of the coefficients conform to the descriptive analysis (except for education), but the coefficients are not precisely estimated. Actually, the coefficient of financial literacy is the only one that is statistically different from zero. The impact of the variable is similar to the one shown

graphically in Figure 8: raising the index from 1 to 8, is associated with an increase in diversification of 15.2 percentage points.

We also refine our estimates replacing the diversification index D_1 with the index D_2, positing that the average correlation coefficient between any two stocks in investors' portfolio is 0.05. The regression coefficient of financial literacy is hardly affected, even when we raise the assumed correlation coefficient in the D_2 to 0.10 or 0.20.

In Table 5 we repeat the estimation using as indicator of portfolio diversification the number of stocks. Estimation is performed by ordered probit, and the sample is restricted to investors with at least one stock. The results suggest again that financial sophistication is associated with greater diversification. Furthermore, in these set of estimates we find that age, education, income and financial wealth are associated with greater number of stocks and therefore with diversification. The dummy for risk aversion is negative, suggesting that more risk averse investors hold fewer stocks, other thinks equal.

Finally, in Table 6 we report estimates for the total number of assets as a third indicator of diversification. Estimation is again performed by ordered probit, and the sample includes now all investors. The results are quite similar as for the number of stocks. Financial sophistication is associated with higher number of assets in the portfolio. Also in these estimates we find that age, education, income and financial wealth are associated with greater number of assets, while risk averse investors hold fewer assets.

7. Perceived financial sophistication

Having established that portfolio diversification is associated with indicators of financial literacy, in this section we ask to what extent people have a correct perception of their financial ability and are conscious of their lack of financial knowledge. To compare what investors claim to know and what they actually know, we focus on two indexes of self-assessed (or "subjective") financial sophistication. The first index is based on the responses to a series of questions about self-assessed knowledge of 10 categories of financial instruments: Treasury bills, repurchase agreements, corporate bonds, mutual

funds, unit linked life insurance, ETF, managed investment accounts, derivatives, and stocks. The questions are: "How well you think you know the characteristics of this financial instrument?", and are coded as 1 (not at all), 2 (little), 3 (medium), 4 (fairly well), and 5 (quite well).

Some of the responses are tabulated in Figure 9. While most respondents claim to know well or fairly well Treasury Bills, mutual funds, corporate bonds and stocks, perceived knowledge of ETF and derivatives is much lower. Figure 10 aggregates the answers summing the points assigned to the various questions; to rescale the index in the 0-1 interval, the sum is then divided by 50, the maximum number of points. On average, the index is 58 percent, but there is considerable dispersion between respondents who claim to know very little (17 percent scores 40 percent or less), and respondents who are highly confidence about financial matters (10 percent scores 80 percent or higher).

The survey also contains a self-reported indicator of financial ability ranging from 1 to 5 (ability to deal with financial matters is reported to be much above average, above average, about average, slightly below average, much below average).[10] Figure 11 plots the coding of this variable, showing that about 60 percent of investors report being "about average"; the remaining part of the sample splits equally between below and above average ability.

Comparison of self-assessed financial ability with test-based financial literacy is quite relevant in light of the recent implementation of an EU Directive aimed at increasing financial markets transparency and competition (MIFID - Markets in Financial Instruments Directive). The Directive, which in Italy has been implemented on July 1, 2008, requires financial institutions to elicit and rate investors' financial abilities through simple questionnaires. In these questionnaires, investors are not asked test-based financial questions directly; rather, they are asked to report knowledge of specific assets (such as stocks or mutual funds) or, in general, whether they consider themselves financially sophisticated. Since the wording of the questions we ask is quite similar to that posed to

[10] The question is: Think about your ability at managing your portfolio. Compared to the average investor, do you think you have: Much superior ability / Slightly superior ability / About average / Slightly below average / Much below average.

investors by banks and financial advisors as part of MIFID, our comparison between test-based and self-assessed measures can prove useful to get a better understanding of the appropriate way for intermediaries and regulators to measure investors' financial ability.

Figure 12 plots the two indicators of perceived sophistication against the indicator of financial literacy described in Section 5. Only in the case of the index of perceived sophistication the correlation is positive, while for the index of perceived financial ability the relation is completely flat. Furthermore, averages hide substantial heterogeneity as the R^2 of the regressions plotted in Figure 12 don't exceed 5 percent in the case of the index of perceived sophistication, and 1 percent for the self-reported ability index.[11]

The weak correlation between perceived sophistication and financial literacy is confirmed by the regressions in Table 6, where we single out the drivers of perceived sophistication. Other things equal, being male, education, income and financial wealth are associated with higher confidence on financial matters. Financial literacy predicts perceived sophistication only in the first of the two regressions of Table 6, and even in this case the gradient between perceived sophistication and literacy is rather flat: raising the literacy index from 1 to 8 is associated with an increase in perceived sophistication of only 13.2 percentage points.[12]

The evidence thus suggests that eliciting financial literacy by simply asking people if they know finance is bound to lead to serious mistakes: many self-confident investors will report that they know finance, while in fact their financial literacy is likely to be quite poor; pessimistic investors, on the other hand, might report knowing very little while in fact they have above average financial literacy. To put it simply, using self-assessment to rank investors on the basis of their financial knowledge for regulatory purposes is confounded by investors' over- or underconfidence. The two types of errors are

[11] Alessie, Lusardi and Rooij (2007), using a sample of Dutch households, find a positive correlation between objective indicators of financial literacy and self-reported financial sophistication.

[12] Interestingly, if we add the indicators of perceived sophistication to the regressors of Tables 4 and 5 for portfolio diversification we find that the coefficients are small in absolute value and not statistically different from zero. This implies that diversification is related to what people know, rather than to what people think to know about financial markets. In contrast, Alessie, Lusardi and Rooij (2007) find that stock market participation is associated with both objective financial literacy and self-reported financial sophistication.

asymmetric, with overconfidence tending to be more prevalent than underconfidence. This is exemplified in Table 7, which tabulates perceived sophistication against financial literacy: about 50 percent of those with low financial literacy (the index is less than 3) report above average confidence on financial matters (the index of perceived sophistication is greater than 0.6). Similarly, 47 percent of those who score only 3 on financial literacy report above average financial sophistication. On the other hand, about 15 percent of investors who score above 6 on literacy report knowing little about finance.

Designing a standard test-based questionnaire and assigning appropriate scores to the correct answers will produce a better indicator of financial literacy then relying on self-reported sophistication. Given the prevalence of overcofindent investors among the financially illiterate, this will also help to prevent excessive risk taking behavior.

8. Summary

In this paper we focus on lack of financial literacy as one potential factor for lack of portfolio diversification. We use the 2007 Unicredit Customers' Survey, which has indicators of portfolio diversification, several questions on financial literacy and detailed socioeconomic data. We document the extent of portfolio diversification and construct indicators of financial literacy based on survey responses. We then study how portfolio diversification correlates with investors' characteristics, with particular reference to the role of financial literacy. We find that lack of financial literacy is the main variable explaining lack of portfolio diversification. We also find that risk averse investors, older households, low-income and low-education people tend to be less financially sophisticated.

We detect only a weak correlation between financial literacy and perceived knowledge of financial matters, and that a large number of investors claim to know much more about finance than it is actually the case. This finding is relevant to assess the impact of the recent regulation requiring financial intermediaries to elicit the degree of investors' financial sophistication. Since this is usually done through survey instruments

that contain exactly the type of questions that we analyze in our survey, our conclusion is that the response to these questions is more related to the degree of investors' optimism, selfconfidence or overconfidence, than to actual financial literacy. Thus, our analysis calls for long-term education programs to improve investors' financial literacy and ultimately their ability to manage and diversify their portfolio.

Appendix. Definition of variables constructed from survey responses

Portfolio diversification. See section 3.

Financial literacy. The index is constructed on the basis of eight indicators.

- The first indicator is based on the question: Suppose that in the next 6 months interest rate will increase. Do you think it is a good idea to buy today fixed interest rate bonds?
- The second indicator is based on the question: Suppose that a saving account earns an interest rate of 2 percent per year (net of costs). If the annual inflation rate is 2 percent, after two years (with no withdrawals), you think you could buy more than you could buy today / less / the same / don't know.
- The third is based on the meaning of financial diversification: Do you think that financial diversification is: Hold stocks and bonds / Don't hold too long the same asset / To invest in as many assets as possible / To Invest in assets to limit risk exposure / To Avoid high-risk assets.
- The fourth question asks to evaluate how diversified are specific portfolios: 70 percent invested in T-bills and 30 percent in a European equity fund / 70 percent in T-bills, 15 percent in a European equity fund, and 15 percent in 2-3 stocks / 70 percent in T-bills and 30 percent in 2-3 stocks / 70 percent in T-bills and 30 percent in a stock I know well.
- The other four indicators assess the ability to rank asset categories correctly. In particular, we add one point if the respondents' ranking of asset categories satisfies each of the following inequalities: (1) bonds are at least as risky as transaction accounts, (2) stocks are at least as risky as bonds, (3) equity mutual funds are at least as risky as bond mutual funds, (4) housing is riskier than transaction accounts.

Perceived financial sophistication. Investors report knowledge of 11 categories of financial instruments. The question: "How well you think you know the characteristics of this financial asset?", and are coded as 0 (don't know what they are), 1 (not at all), 2 (little), 3 (medium), 4 (fairly well), 5 (quite well). Perceived financial sophistication is the sum of knowledge scores across the different assets, divided by 50, the maximum possible score. The index therefore ranges from 0 to 1.

Self-reported financial ability. Based on the question: Think about you ability in managing your portfolio. Compared to the average investor, do you think that you have: Much superior ability / Slight superior ability / About average / Slightly below average / Much below average.

Risk aversion. Response to the question: "In managing your financial investment, you think you are a person that is interested in investments that offer the possibility of: (1) a high return, with a high risk of loosing the capital; (2) a good return, and reasonable safety; (3) a moderate return, but at the same time a good degree of safety; (4) a low return, without any risk of loosing the capital." The risk aversion dummy is defined as (3) or (4).

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Figure 1. Portfolio diversification index

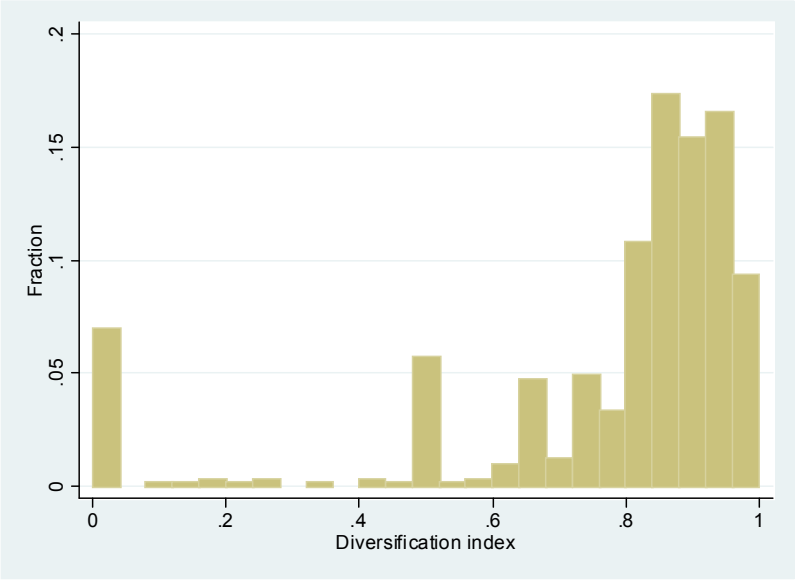

Figure 2. Number of stocks and number of assets

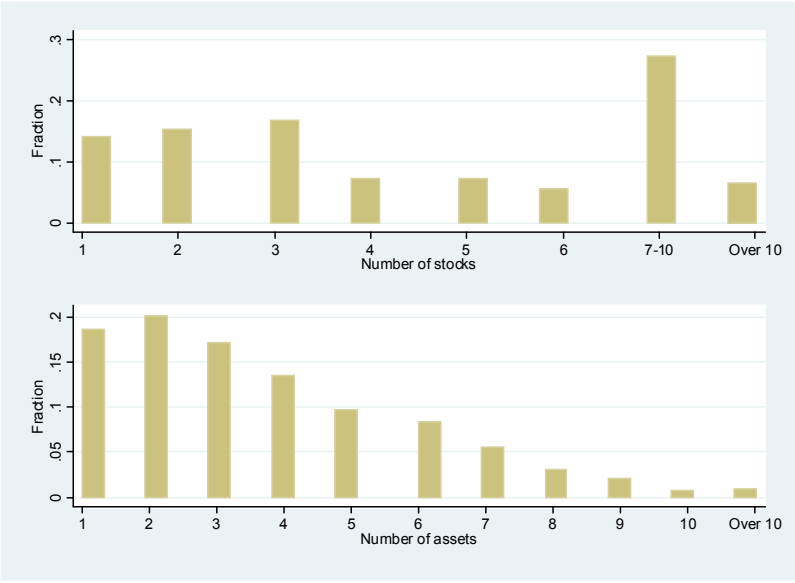

Figure 3. Ability to rank financial assets

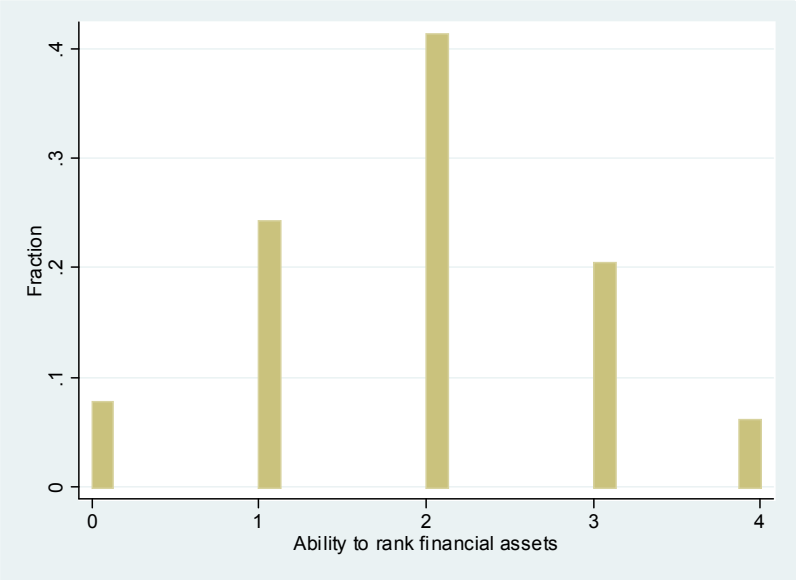

Figure 4. Meaning of portfolio diversification

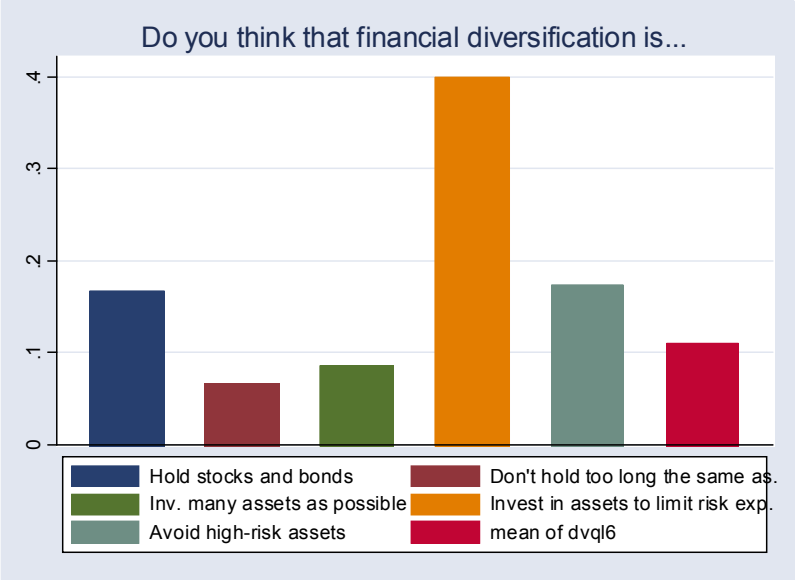

Figure 5. Understanding portfolio diversification

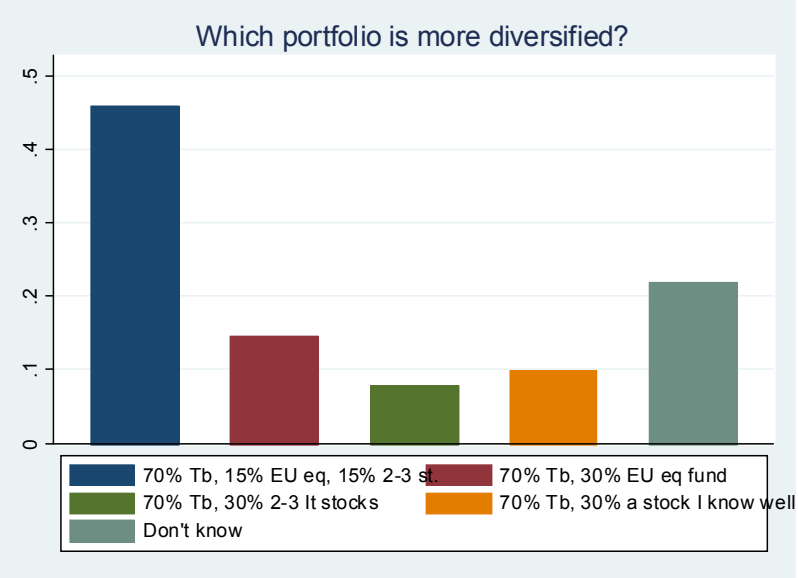

Figure 6. Index of financial literacy

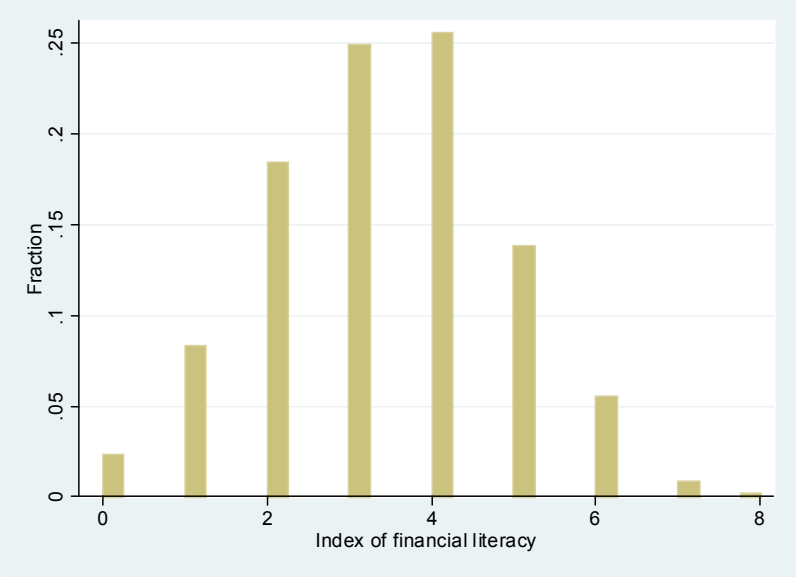

Figure 7. Diversification, demographics, income and wealth

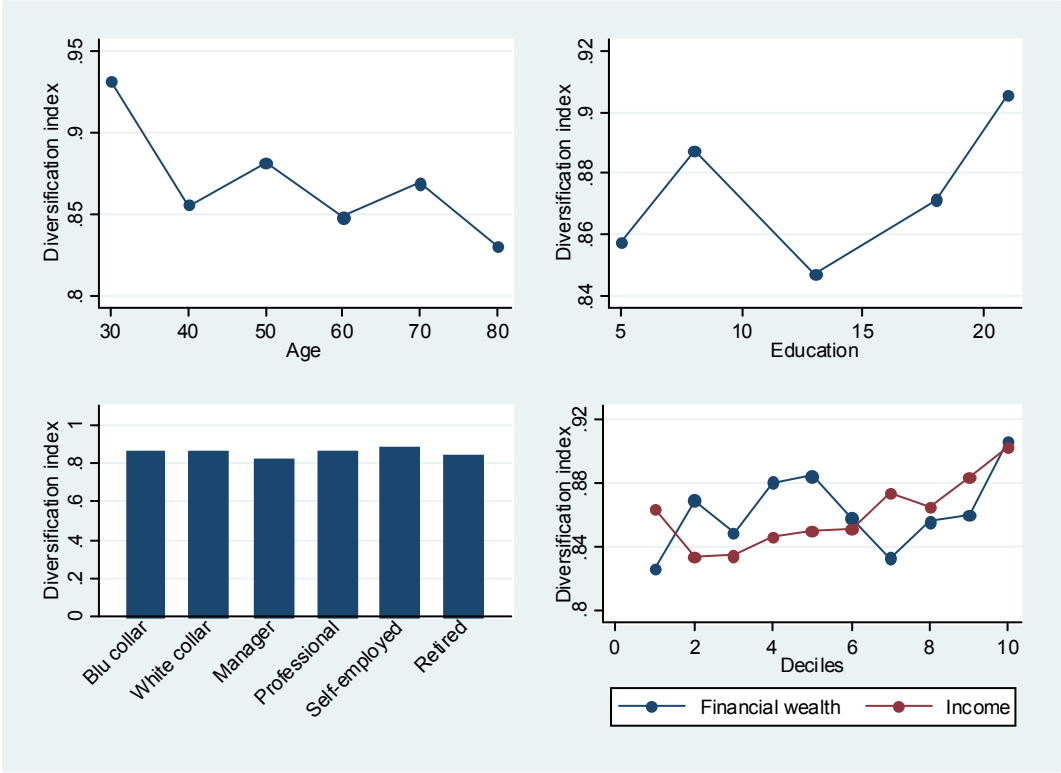

Figure 8. Financial literacy and portfolio diversification

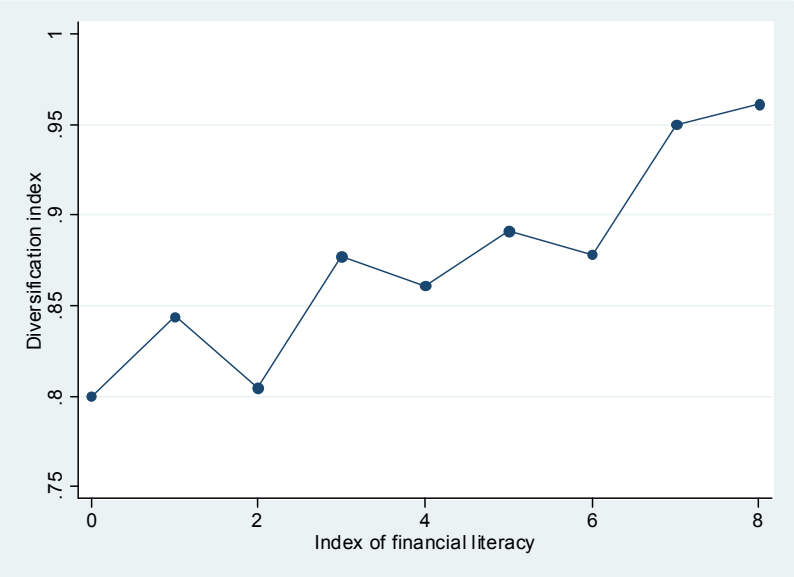

Figure 9. Self-reported knowledge of financial assets

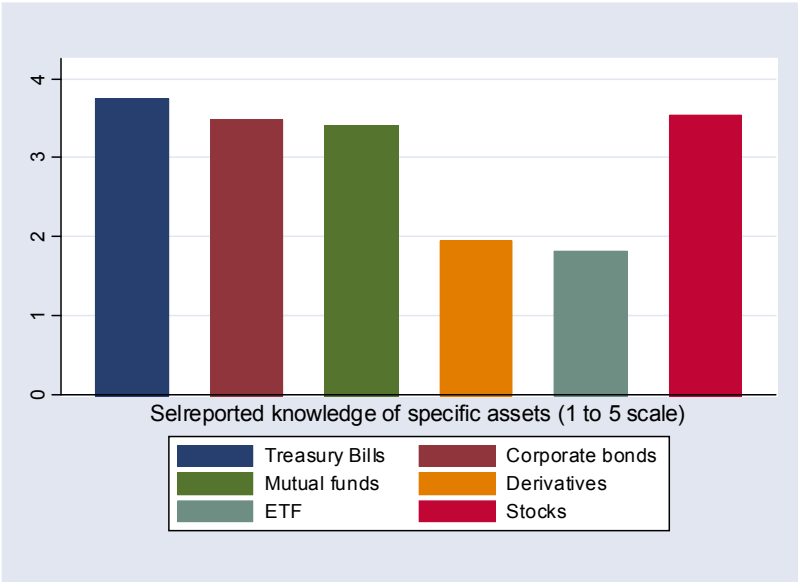

Figure 10. Index of perceived financial sophistication

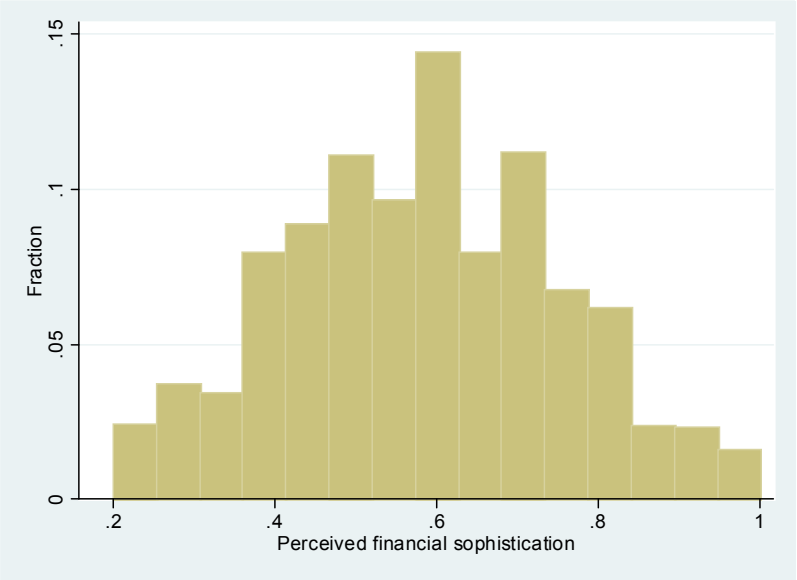

Figure 11. Self-reported financial ability

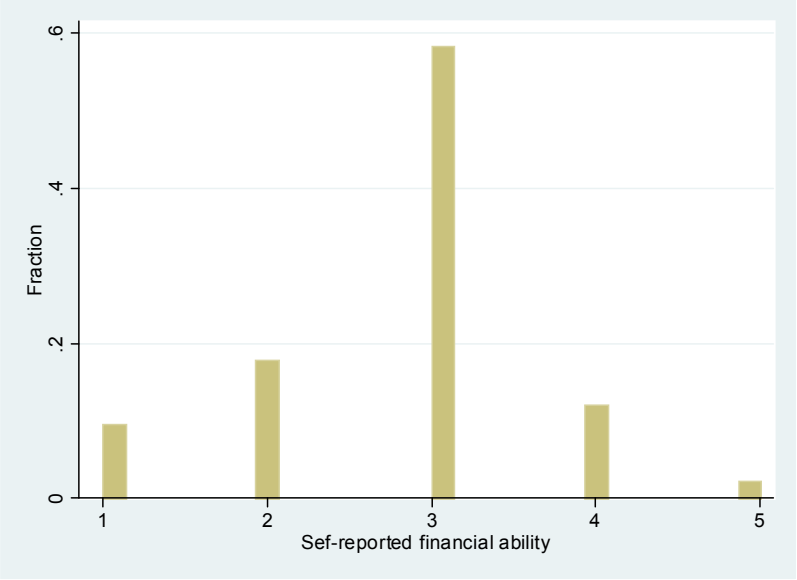

Figure 12
Relation between perceived financial sophistication and financial literacy

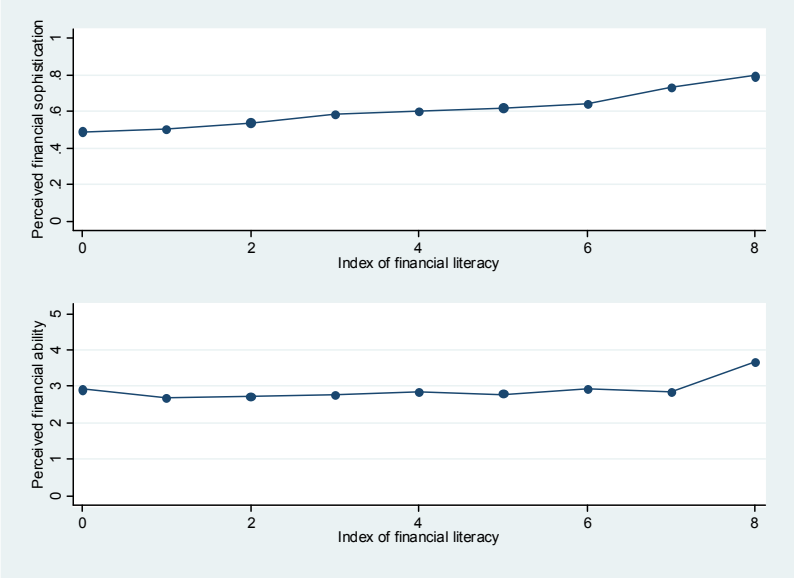

Table 1
Correlation matrix among indicators of financial literacy

	Inflation question	*Interest rate question*	*Asset ranking*	*First diversification question*	*Second diversification question*
Inflation question	1.0000				
Interest rate question	-0.0170	1.0000			
Asset ranking	0.0605	0.0116	1.0000		
First diversification question	0.0230	0.0602	0.1247	1.0000	
Second diversification question	-0.0556	0.0502	0.0635	| 0.0674	1.0000

Note. Statistics are computed on the total sample (1686 observations).

Table 2
Sample means of selected variables

	Mean	*Standard deviation*	*Minimum*	*Maximum*
Age	54.81	12.27	25.00	89.00
Male	0.70	0.46	0.00	1.00
Education	12.73	4.25	0.00	21.00
Resident in the South	0.24	0.43	0.00	1.00
High risk aversion	0.19	0.39	0.00	1.00
Self-employed	0.28	0.45	0.00	1.00
Retired	0.31	0.46	0.00	1.00
Disposable income (thousand euro)	71.32	86.02	3.69	1085.00
Financial wealth 10-50	0.19	0.39	0.00	1.00
Financial wealth 50-100	0.23	0.42	0.00	1.00
Financial wealth 100-150	0.20	0.40	0.00	1.00
Financial wealth 150-250	0.18	0.38	0.00	1.00
Financial wealth 250-500	0.16	0.37	0.00	1.00
Financial wealth >500	0.05	0.22	0.00	1.00
Index of portfolio diversification	0.86	0.23	0.00	1.00
Number of stocks	4.62	2.92	1.00	12.00
Index of financial literacy	3.32	1.45	0.00	8.00
Index of perceived financial sophistication	0.58	0.17	0.20	1.00

Note. Statistics are computed on the total sample (1686 observations). Statistics for the index of portfolio diversification are computed on the sample of direct and indirect stockholders (1050 observations). Statistics on number of stocks are computed on the sample of direct stockholders (636 observations).

Table 3
Determinants of financial literacy

	Inflation question Probit	*Interest rate question Probit*	*Asset ranking Probit*	*First diver. question Probit*	*Second diver. question Probit*	*Index of financial literacy OLS*
Age	-0.002	0.002	-0.003	-0.001	0.000	-0.003
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.004)
Male	0.013	0.075	0.025	0.074	0.025	0.205
	(0.027)	(0.028)**	(0.059)	(0.027)**	(0.018)	(0.080)*
Education	-0.002	0.008	0.011	0.015	-0.001	0.029
	(0.003)	(0.003)*	(0.007)	(0.003)**	(0.002)	(0.009)**
Resident in the South	0.012	0.040	-0.141	-0.045	-0.029	-0.150
	(0.028)	(0.029)	(0.061)*	(0.028)	(0.018)	(0.082)
High risk aversion	0.039	0.008	-0.088	-0.135	-0.041	-0.199
	(0.031)	(0.033)	(0.068)	(0.031)**	(0.020)*	(0.093)*
Self-employed	-0.046	0.026	-0.010	-0.037	-0.021	-0.088
	(0.029)	(0.031)	(0.065)	(0.030)	(0.020)	(0.088)
Retired	-0.031	0.002	-0.024	-0.029	-0.004	-0.085
	(0.034)	(0.036)	(0.076)	(0.036)	(0.024)	(0.103)
Log disposable income	0.042	0.013	0.034	0.046	0.005	0.137
	(0.017)*	(0.018)	(0.038)	(0.018)*	(0.012)	(0.052)**
Financial wealth 50-100	-0.045	-0.016	0.032	0.050	0.001	0.019
	(0.036)	(0.039)	(0.081)	(0.039)	(0.027)	(0.111)
Financial wealth 100-150	-0.020	0.007	0.096	0.045	0.028	0.148
	(0.037)	(0.040)	(0.085)	(0.041)	(0.030)	(0.115)
Financial wealth 150-250	-0.025	-0.020	0.118	0.041	0.051	0.153
	(0.039)	(0.042)	(0.088)	(0.042)	(0.032)	(0.119)
Financial wealth 250-500	-0.046	0.014	0.134	0.080	0.011	0.184
	(0.040)	(0.044)	(0.092)	(0.044)	(0.031)	(0.125)
Financial wealth >500	-0.070	0.127	0.150	0.135	0.162	0.482
	(0.056)	(0.062)*	(0.134)	(0.065)*	(0.060)**	(0.182)**
Observations	1686	1686	1686	1686	1686	1686

Note. The variable "Inflation question" is a dummy variable for investors who reply correctly to the inflation question. "Interest rate question" is a dummy variable for investors who reply correctly to the interest rate question. "Asset ranking" is categorical variable (ranging from 0 to 4) summing the responses to the asset ranking questions. "First diversification question" is a dummy variable for investors who reply correctly to the question on the meaning of diversification. "Second diversification question" is a dummy variable for investors who reply correctly to the question on understanding diversification. "Index of financial literacy" is a categorical variable summing the eight variables related to financial literacy. Standard errors are reported in parenthesis. One star indicates significance at the 5 percent level, two stars at the 1 percent level.

Table 4
Tobit for portfolio diversification

	(1)	*(2)*	*(3)*
Index of financial literacy	0.016	0.017	0.017
	(0.008)*	(0.008)*	(0.008)*
Age	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
Male	-0.055	-0.059	-0.061
	(0.028)	(0.029)*	(0.029)*
Education	-0.005	-0.005	-0.005
	(0.003)	(0.003)	(0.003)
Resident in the South	0.025	0.024	0.023
	(0.029)	(0.029)	(0.029)
High risk aversion	-0.015	-0.014	-0.018
	(0.040)	(0.040)	(0.040)
Log disposable income	0.020	0.019	0.021
	(0.017)	(0.017)	(0.018)
Self-employed		0.027	0.026
		(0.029)	(0.029)
Retired		0.016	0.013
		(0.035)	(0.035)
Financial wealth 50-100			0.059
			(0.042)
Financial wealth 100-150			0.039
			(0.042)
Financial wealth 150-250			0.046
			(0.042)
Financial wealth 250-500			0.025
			(0.043)
Financial wealth >500			0.013
			(0.054)
Constant	0.896	0.905	0.846
	(0.187)**	(0.187)**	(0.194)**
Observations	1050	1050	1050

Note. The dependent variable is the index of portfolio diversification described in Section 3. Estimation is performed by two-limit Tobit. Standard errors are reported in parenthesis. One star indicates significance at the 5 percent level, two stars at the 1 percent level.

Table 5
Ordered probit for number of stocks

	(1)	(2)	(3)
Index of financial literacy	0.080	0.080	0.075
	(0.031)**	(0.031)**	(0.031)*
Age	0.010	0.009	0.004
	(0.004)**	(0.005)*	(0.005)
Male	0.305	0.292	0.326
	(0.105)**	(0.106)**	(0.107)**
Education	0.025	0.026	0.018
	(0.011)*	(0.011)*	(0.012)
Resident in the South	-0.053	-0.058	-0.070
	(0.105)	(0.105)	(0.106)
High risk aversion	-0.615	-0.615	-0.611
	(0.159)**	(0.159)**	(0.161)**
Log disposable income	0.225	0.222	0.144
	(0.064)**	(0.065)**	(0.066)*
Self-employed		0.074	0.015
		(0.101)	(0.102)
Retired		0.072	0.011
		(0.125)	(0.126)
Financial wealth 50-100			0.450
			(0.161)**
Financial wealth 100-150			0.654
			(0.156)**
Financial wealth 150-250			0.419
			(0.159)**
Financial wealth 250-500			0.756
			(0.157)**
Financial wealth >500			1.096
			(0.188)**
Observations	636	636	636

Note. The dependent variable is the number of stocks. Estimation is performed by ordered probit in the sample of direct stockholders. Standard errors are reported in parenthesis. One star indicates significance at the 5 percent level, two stars at the 1 percent level.

Table 6
Ordered probit for number of assets

	(1)	*(2)*	*(3)*
Index of financial sophistication	0.193	0.193	0.185
	(0.018)**	(0.018)**	(0.018)**
Age	0.012	0.016	0.009
	(0.002)**	(0.003)**	(0.003)**
Male	0.087	0.081	0.100
	(0.057)	(0.058)	(0.059)
Education	0.036	0.034	0.025
	(0.007)**	(0.007)**	(0.007)**
Resident in the South	-0.493	-0.492	-0.486
	(0.061)**	(0.061)**	(0.061)**
High risk aversion	-0.745	-0.744	-0.684
	(0.070)**	(0.070)**	(0.070)**
Log disposable income	0.290	0.278	0.225
	(0.037)**	(0.038)**	(0.038)**
Self-employed		0.107	0.022
		(0.063)	(0.064)
Retired		-0.157	-0.181
		(0.075)*	(0.075)*
Financial wealth 50-100			0.255
			(0.082)**
Financial wealth 100-150			0.400
			(0.085)**
Financial wealth 150-250			0.604
			(0.088)**
Financial wealth 250-500			0.812
			(0.092)**
Financial wealth >500			1.358
			(0.133)**
Observations	1686	1686	1686

Note. The dependent variable is the number of assets. Estimation is performed by ordered probit. Standard errors are reported in parenthesis. One star indicates significance at the 5 percent level, two stars at the 1 percent level.

Table 7
Relation between perceived financial sophistication and financial literacy

	Index of perceived sophistication OLS	*Self-reported ability Ordered probit*
Index of financial literacy	0.018	0.016
	(0.003)**	(0.023)
Age	0.000	-0.004
	(0.000)	(0.003)
Male	0.047	0.336
	(0.008)**	(0.075)**
Education	0.007	0.020
	(0.001)**	(0.008)*
Resident in the South	-0.017	-0.052
	(0.009)	(0.080)
High risk aversion	-0.063	-0.452
	(0.010)**	(0.099)**
Log disposable income	0.030	0.121
	(0.005)**	(0.048)*
Self-employed	0.030	-0.020
	(0.009)**	(0.079)
Retired	-0.014	-0.139
	(0.011)	(0.095)
Financial wealth 50-100	0.007	-0.041
	(0.011)	(0.111)
Financial wealth 100-150	0.024	0.209
	(0.012)*	(0.112)
Financial wealth 150-250	0.056	0.189
	(0.012)**	(0.114)
Financial wealth 250-500	0.059	0.344
	(0.013)**	(0.117)**
Financial wealth >500	0.115	0.641
	(0.019)**	(0.157)**
Observations	1686	1205

Note. The variable "Claims to know stocks" is a dummy variable for investors who claim to know stocks well or very well. "Claims to know mutual funds" is a dummy variable for investors who claim to know mutual funds well or very well. "Index of perceived financial sophistication" is a variable summing all the responses to the 10 questions on asset knowledge, and dividing the sum by 50. "Self-reported financial ability" is a categorical variable measuring how well people claim about their financial ability. Standard errors are reported in parenthesis. One star indicates significance at the 5 percent level, two stars at the 1 percent level.