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Rational or behavioral investors?
Financial information and portfolio performance

Luigi Guiso
University of Sassari, Ente Luigi Einaudi for Monetary, Banking and Financial Studies, and CEPR

Tullio Jappelli
University of Salerno, CSEF, and CEPR

Abstract

Rational investors perceive correctly the value of information. Investment in information is therefore rewarded with a higher Sharpe ratio. Overconfident investors overstate the quality of information, and attain a lower Sharpe ratio. We contrast the implications of the two models using a survey of customers of an Italian leading bank with portfolio data and measures of financial information. We find that the Sharpe ratio is negatively associated with information investment. The negative correlation is stronger for men than women, for those who believe they know stocks well and for the less well educated, arguably because these groups of investors are more likely to be overconfident. We also show that more information is associated with more trading, less delegation of portfolio decisions and less diversified portfolios. In each case, the effect of information is stronger for investors who, a priori, are suspected to be more overconfident.

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1. Introduction

How much financial information should investors collect? And what is the effect of information on portfolio performance? In models with rational investors the answer to these questions is straightforward: investors should spend time and money collecting financial information up to the point where the marginal benefit of doing so exceeds the marginal cost. Since investors acquire information only if utility increases, information improves portfolio performance. Indeed, Peress (2004) shows that the portfolio Sharpe ratio of a cross-section of rational investors increases with information optimally collected.

Behavioral models challenge the rational agent assumption. Drawing on a large body of evidence from experimental cognitive psychological research, behavioral models argue that many overconfident investors make financial decisions attaching too much weight on information they have, and relying too much on the signals they receive, see Barberis and Thaler (2003) for a survey.

Compared to investors with unbiased perceptions, overconfident investors feature poorer portfolio performance. Indeed, they collect too much information, trade more and take more risk than rational agents. Odean (1998) shows that in a model with endogenous information acquisition, overconfident investors are more likely to be informed and obtain lower utility than rational investors who choose to remain uninformed.

Using a survey of accounts at a discount broker, Odean(1999) and Barber and Odean (1999, 2001) show that investors make unprofitable trades in the sense that the assets they buy tend, on average, to under-perform the assets they sell, resulting in negative profits from trading even before trading costs are accounted for. In addition, men – arguably more overconfident than women according to the experimental psychology literature – trade more often and therefore perform less well than women.

The hypothesis underlying the overconfidence model is that investors systematically overestimate the value of information, and end up spending too much time

and money in acquiring information. A proper test of this strong departure from rationality requires data on financial information and portfolio performance.

In this paper we provide such test. We contrast the rational and behavioral models studying the determinants of information acquisition and the effect of information on portfolio performance. To implement the test, we use a survey of customers of a leading Italian bank, with data on time people spend acquiring financial information, trading, risk attitudes, and socioeconomic variables. Detailed financial data allow to construct a measure of expected return and volatility for each investor.

The paper has several important findings. First of all, investment in financial information increases with wealth and risk tolerance, and is negatively associated with proxies of the cost of information. Second, the portfolio Sharpe ratio is negatively associated with information. The negative relation is robust to additional controls, sample definitions and sample selection. Furthermore, the correlation is stronger for groups that are, a priori, expected to be more overconfident. Third, we find that information is positively associated with trading, and that the positive association is stronger for those who are more likely to be overconfident. Fourth, trading is negatively associated with the Sharpe ratio, particularly for the overconfident groups. The paper also provides evidence on the link between information acquisition, portfolio diversification and investors' willingness to delegate financial decisions. Overall, the evidence conflicts with the rational model, supporting models where investors overstate the quality of information, invest too much in information and take too much financial risk, and invest in financial information.

The rest of the paper proceeds as follows. Section 2 summarizes the implications of the rational model for financial information acquisition and portfolio performance, and contrasts them with the prediction of a model with overconfident investors. Section 3 describes the survey, and explains how we measure investment in information and portfolio performance. Section 4 presents evidence on the determinants of information acquisition. Section 5 has the main results of the paper, relating the Sharpe ratio to investment in information. Section 6 explores the effect of financial information on

trading, and Section 7 the relation between delegation of financial decisions, stock market diversification and financial information. Section 7 summarizes the results.

2. Theoretical predictions

One key prediction of rational models of investors' behavior is that there is a well identified set of variables on which individuals condition their decisions on how much to invest in financial information. Suppose that investors can purchase information on a noisy signal on stock returns. Then risk averse individuals will acquire less information, because they intend to invest less in stocks and therefore information is less valuable (Verrecchia, 1982). This also implies that if absolute risk aversion is decreasing with wealth, information purchase is higher for the affluent and those with lower cost of acquiring information. These empirical predictions, however, don't discriminate between rational and behavioral models. Indeed, overconfident investors behave very much like rational investors with respect to the determinants of information. The main difference is that they invest more in financial information.

Where the two models differ and can thus potentially be distinguished empirically is in the *consequence* of information on portfolio performance. Peress (2004) shows that information improves the allocation of wealth and therefore is associated with higher Sharpe ratio. Thus, the portfolio of informed investors is riskier portfolio, but they obtain higher risk-adjusted return. In contrast, overconfident investors acquire more information and *react* to information more strongly than rational investors. As in the rational model, portfolio risk and return increase with information. However, the Sharpe ratio may decline, because they over invest in stocks. This section presents a framework to distinguish the two models empirically.

2.1. Rational investors

Starting with Grossman and Stiglitz (1980), several authors have proposed models of rational financial decisions where agents can increase, at a cost, information on the random return of a risky asset, see Verrecchia (1982) and Barlevy and Veronesi (1999). For our purpose, Peress' (2004) framework is the most appropriate. Investors are rational, that is, they maximize expected utility *and* perceive correctly the quality of the information purchased. Investors have CRRA preferences and choose how to allocate a given amount of wealth between stocks and the risk free asset, and how much information to purchase.

Each investor can spend money or time to obtain a private signal $S = \tilde{r} + \varepsilon$. The signal increases the precision of the stock return $\tilde{r}$, where $E\tilde{r} = r > 0$, and is noisy, revealing the stock return plus a normally distributed random error, $\varepsilon \approx N(0, \frac{1}{p})$. Investors can purchase information to increase the signal's precision p. The cost of purchasing the signal is $C(p)$, increasing and convex in the signal's precision; thus $C'(p)>0$ and $C''(p)>0$.[1] The portfolio is chosen after information is acquired, conditional on the signal and the stock price observed by all market participants. The model delivers several empirical predictions.

First, information purchased increases with investor's wealth and risk tolerance, and falls with the marginal cost of information. Wealthier and more risk tolerant investors value information more because they invest more wealth in the information intensive asset and, accordingly, the signal is more valuable for them. Corner solutions are possible. Poor or very risk averse investors benefit little from information, because they would

[1] The assumptions $C'(0) > 0$ and $\lim_{x\to\infty} C'(x) = \infty$ guarantee an internal solution. Convexity of the cost function reflects the assumption that the cost of each additional unit of information is larger than the previous unit, for instance because it is positively correlated with (and hence less useful then) the previous unit.

invest little in stocks even if they had a very precise signal. So they may choose to purchase no information.

A second implication of the model is that the expected portfolio return and volatility increase with information. More informed investors face less risk and invest more aggressively in stocks, obtaining higher returns. They react also more strongly to the signals they receive and trade more.

Third, rational agents are willing to pay the cost of information precisely because they obtain a benefit in terms of higher risk-adjusted return. This implies that the expected Sharpe ratio - the ratio between the portfolio expected excess return and its standard deviation - increases with information purchased, even accounting for trading and information costs.

Finally, risk aversion affects the Sharpe ratio only because it affects information purchased. Controlling for information, risk aversion should have no effect on the Sharpe ratio. This is a neat exclusion restriction of the rational model that we are able to confront with the data.

2.2. Overconfident investors

Rational investors maximize expected utility and perceive correctly the signal quality. Overconfident investors still maximize utility, but don't perceive correctly the signal. One way to capture this situation is to posit that the signal is $\varepsilon_0 \approx N\left(0, \frac{1}{kp}\right)$ where $k>1$ is an indicator of overconfidence. As far as information is concerned, the choice of the overconfident investor is similar to that of the rational agent who perceives correctly precision $1/p$', with $p' = kp$. Thus, in the model with overconfident investors the decision to purchase information is still driven by the same variables as in the rational model: wealth, risk tolerance and cost of purchasing information.

However, compared to the rational investor, the overconfident purchases more information. Indeed, the perceived information value is higher than the true value. Proxies for overconfidence – such as gender – should therefore help predicting investment in

information. But apart from this, the decision of overconfident investors about information acquisition are observationally equivalent to the rational agent. This implies that the determinants of investment in information alone do not allow to discriminate between the rational and the behavioral model.

The difference between the two models lies in portfolio performance (Odean, 1998). First, overconfident investors attain lower utility than rational investors and take more risk for given expected return. This implies a negative relation between information acquired and portfolio performance, as measured by the Sharpe ratio. Since it is driven by overconfidence, the negative relation is stronger the larger the degree of overconfidence.

Second, in the model with overconfident investors, information acquisition triggers more trading (as in the rational agent model), but since information is associated with a lower Sharpe ratio, there is negative correlation between trading and the Sharpe ratio, in contrast with the positive association implied by the rational model. Finally, since overconfident investors put more weight on information, investors who acquire more information diversify less and are less willing to delegate financial decisions to others (brokers, financial intermediaries, etc.), the more so the more investors are overconfident. The empirical predictions of the two models are summarized in Table 1, which we use as a guide for the empirical analysis of Section 4.

3. Data description

The UniCredit-Pioneer Economic Research Survey of Investors Behavior (UPS) is a very detailed survey of 1,834 customers of Unicredit, a leading Italian bank. The sample is representative the population of Unicredit customers, and therefore all survey respondents have a bank account (whereas 15% of the Italian population does not). Unicredit has a large market share, and thus relatively more customers, in Northern Italy, where people tend to be wealthier on average. The UPS therefore over-samples relatively rich investors with respect to the general population. The data appendix describes sample design and other characteristics of the survey.

The unit of observation is the customer, defined as a person with a bank account in one of the Unicredit banks. However, the survey collects also detailed information also on the entire household assets and socioeconomic variables. Furthermore, it has data on investment in financial information, knowledge of specific financial assets, attitudes towards financial risk, bank-customer relations, reliance on financial advise, and delegation of financial decisions. The UPS represents therefore a unique opportunity to study the relation between financial information, portfolio allocation and portfolio performance, and to test the implications of the rational and behavioral models outlined in Section 2.

3.1. Investment in financial information

The survey has a question on time spent acquiring financial information: "*Let's talk about financial information. How much time do you usually spend, in a week, to obtain information on how to invest your savings? (think about time reading newspapers, surfing the internet, talking to your advisor, etc.). Answers range from no time (category 1) to more than 7 hours per week (category 7).*"

The first panel of Table 2 displays the sample distribution of the variable. Over one third of the sample spends no time, most respondents spend between "less than 30 minutes" and "Between 30 and 60 minutes" per week. Interestingly, 13% spend more than 2 hours per week, about 5% of the average weekly working time. To provide further insights on the time involved, the last row of the table reports also the equivalent number of working days spent in information each year. The number ranges from zero to 43 working days.

As suggested in Section 2, in both the rational and behavioral models, those who invest more in stocks have a stronger incentive to acquire information. In turn, those who are more informed perceive lower stock volatility, and should invest more in stocks.

Thus, not surprisingly, those who collect more information are also more likely to own stocks and to invest a larger share of their wealth in stocks.[2]

Survey participants report also how often they monitor the value of their financial assets; answers are reported in 8 categories, from "every day" to "never". Monitoring the portfolio requires time to read the press, surf internet, call the bank or the financial advisor, study alternative opportunities, and is an alternative measure for information purchased. The lower panel of Table 2 reports the sample distribution of the variable. Most respondents check their investments every month or every quarter, but 4.2% never check or do it very infrequently (5.1.% less than once a year). Others check very often, every week or even every day (19.3%).

In the paper we rely mostly on time spent in information, but check the sensitivity of the results using the alternative indicator. Clearly, those who spend time collecting financial information also monitor their investment more often: the correlation coefficient between the two variables is 0.6. According to the rational and behavioral models, both variables should correlate with wealth, risk tolerance, and the cost of information.

3.2. Portfolio performance

We measure portfolio performance by the expected Share ratio of the investor's portfolio. To construct the ratio we use the same procedure and assumptions as Pelizzon and Weber (2004). We combine survey information on 10 financial assets with time series data on assets returns and impute, for each investor, the portfolio expected return and volatility; see the Appendix for details.

The Sharpe ratio is defined for 1,365 out of 1,834 investors, or 74.4% of the sample. The remaining part of the sample invests only in risk-free assets. Figure 1 reports

[2] Stock market participation is positively correlated with investment in information but the direction of causality is not obvious. If investors choose information *after* the participation decision, those who don't participate should not purchase information (unless they do it for pleasure). If information is purchased *before* the participation decision, some who don't participate may have purchased information, but have chosen to stay out of the market on the basis of the information purchased. In the data, even among those who acquire information, some don't buy stocks, suggesting that information is acquired before the participation decision, at least for this group.

the sample distribution of the Sharpe ratio. The average ratio is estimated at 0.263. In contrast to the uniformity predicted by standard finance theory, that all portfolios have the same Sharpe ratio, the ratio exhibits considerable sample variability (the standard deviation is 0.149 and the ratio ranges from 0.108 to 0.538).

3.3. Risk aversion, trading, and delegation

The UPS measures risk aversion as the willingness to bear financial risk. The question, patterned after the Survey of Consumer Finance, is: *"Which of the following statements comes closest to the amount of financial risk that you are willing to take when you make your financial investment?: (1) a very high return, with a very high risk of loosing the money; (2) high return and high risk; (3) moderate return and moderate risk; (4) low return and no risk.*[3] Only 19% choose "low return and no risk", so most are willing to accept some risk if compensated by corresponding return. A recent literature on eliciting preferences from survey data shows that such direct questions are useful and informative.[4] The question can be used to sort investors according to different degrees of risk tolerance.

The survey has also another indicator of risk aversion: *With which of the following statements do you agree most? (1) Risk is an uncertain event from which one can extract a profit; (2) Risk is an uncertain event from which one should seek protection.* Most respondents (71%) answer (2), considering risk a threat rather than an opportunity. The two indicators of risk aversion, though based on quite different framings, are highly correlated. In the empirical analysis we rely mostly on the first indicator, but check the sensitivity of the results using also the second.

In separate questions, respondents report how often they buy or sell financial assets, how willing they are to delegate decisions to financial advisors, and how much they trust them. Frequency of trading ranges from "every day" (2% of the sample) to "never" or "at maturity" (18%); the median is "every six months." When asked about

[3] The question does not allow to distinguish between relative and absolute risk aversion. But since we can control for wealth, we can allow the risk aversion indicator to reflect differences in preferences for risk that do not arise from differences in the level of endowments.
[4] See, among others, Barsky et al (1997) and Guiso and Paiella (2003).

willingness to delegate financial decisions, 28% of respondents report to take financial decisions alone, 58% take decisions alone but consult a financial advisor, and 12% delegate and let the advisor decide. On the trust side, 66% of respondents report "high" or "very high" trust in his or her financial advisor.

Financial wealth is constructed from questions about 10 different assets categories: (1) bank accounts; (2) repurchase agreements; (3) certificate of deposits; (4) government bonds; (5) corporate bonds; (6) derivatives: (7) shares of listed companies; (8) shares of unlisted companies; (9) mutual funds; (10) managed investment accounts. For each of these categories, the survey provides information on assets kept with Unicredit, as well as with other banks/financial institutions. Total financial wealth is the sum of all financial assets, both in Unicredit accounts and in other banks/financial institutions. Two definitions of financial wealth are available: respondents' wealth (the bank's customer), and household financial wealth, resulting from the sum of respondent' and other household members wealth (see Appendix for details).

In the absence of information on individual stocks in the portfolio, we construct an index of portfolio diversification as the ratio of stocks held indirectly through mutual funds or managed investment accounts and total stocks (direct plus indirect stockholding). On average, the index of diversification is 56%, see Table 3.

Finally, the UPS also has detailed socioeconomic variables for the respondent and household members: education, gender, marital status, residence, occupation, etc. Summary statistics for some of these variables are also reported in Table 3**.**

4. Determinants of investment in financial information

As shown in Section 2 the rational model and the model with overconfident but utility-maximizing investors deliver similar implications about the determinants of investment in information. Thus, one cannot rely on estimates of the demand for financial information to discriminate between the two models. Yet, looking at these determinants is quite useful for many reasons.

First, if the variables that theory predicts should explain information play no role, one could legitimately argue that our indicator of information or the explanatory variables are fraught with errors. Second, estimates of the demand for information might provide evidence on overconfidence. Overconfident investors have an upward biased perception of the precision of the information they acquire, so proxies for overconfidence might play a role in explaining information investment. If variables which tend to be associated with overconfidence – such as gender – have no effect on information, one may also doubt that overconfidence affects investors' decisions, particularly if the core variables suggested by the rational model matter. Third, estimates of information investment help identifying variables that can be used as instruments when, later in the paper, we estimate the effect of information on portfolio performance. Finally, the variables that affect information might help understanding the effects that changes in some of the variables – in particular wealth - can have on investors' welfare.

The rational model in Section 2 suggests that three variables should affect investment in information: investor's wealth, risk tolerance and the marginal cost of collecting financial information. We have no direct measure of the latter, but a good proxy is education, as measured by years of schooling. More educated people have a lower cost of acquiring information of any kind, for instance because they know how to find it, and need to spend less time to obtain any extra unit of information. Thus, we expect investors with higher education to invest more in information.

Figures 2, 3 and 4 show two-way plots of investment in financial information and financial wealth, risk aversion and education, respectively. Information is positively correlated with financial wealth and education, and negatively correlated with the indicator of risk aversion, consistent with the predictions of Table 1.

The regression analysis confirms the simple correlations. We use three dummies for risk aversion, excluding the dummy for the most risk-averse. Even when financial wealth, risk aversion and education are introduced simultaneously, each variable has an independent and statistically significant effect on investment in information. The coefficient of education is positive, consistent with more educated individuals have a

lower cost of information. Since education is also positively correlated with the value of time, the coefficient is a lower bound of the cost effect of education.[5]

The economic impact of these variables, however, is quite different. Raising financial wealth from the bottom to the top quartile lowers the probability of making no information investment by only 2 percentage points (5% of the sample mean). Risk tolerance has a much stronger impact: being in the highest risk tolerance group lowers the probability of not acquiring information by 27 points (75% of the sample mean); increasing education by 5 years (about one standard deviation) lowers information by 10 points.

In column 2 we add an indicator of income risk to the set of explanatory variables. This is a dummy for those who are unable to tell if their income will fall significantly, rise significantly or remain unchanged over the next 5 years. In more general models, any variable – such as income risk – that affects the demand for stocks should also affect the demand for information. For instance, those who expect to allocate less wealth in stocks, also benefit less from information. Consistent with this interpretation, income risk has a negative effect on information collection, and the coefficient is statistically different from zero.

Column 3 adds further demographic controls to account for variation in preferences which are possibly correlated with wealth, education or risk aversion: region (a dummy for living in the North), gender, marital status, age and city size. The results are qualitatively unchanged, suggesting that the correlations between financial information and wealth, education and risk aversion are not due to omitted demographic characteristics.

[5] An alternative interpretation is those with higher education have a preference for finance. Some individuals may obtain utility from collecting financial information; for them the marginal benefit of financial information is even larger and thus invest more in financial information. Even if these preferences are unobserved they will be reflected in information acquired. Having raised this issue, note that unobserved taste for finance does not affect the implications of the two models. If investors are rational, those who like finance purchase more information because for them it is less costly to do so. Having more information, they benefit more because they act correctly on that information, so portfolio performance and information are still positively correlated. If investors are overconfident, those who purchase more information for pleasure are also hurt more: information and portfolio performance are negatively correlated, not due to preference for finance but to overconfidence.

Controlling for gender is particularly important in the present context. The results indicate that males invest significantly more than women in information. For males, the probability of spending no time in information is 16 percentage points lower (43% of the sample mean), while the probability of spending more than 7 hours per week is twice as high. The literature presents considerable evidence that males tend to be more overconfident than women, especially in relation to specific duties, such as finance (Lundeberg, Fox and Puncochar, 1994; Barber and Odean, 2001). The positive coefficient of the male dummy is consistent with this literature and the hypothesis that males are more confident then women; of course, we cannot rule out that the male coefficient reflects omitted variables correlated with gender.

The other regressions in Table 4 report various sensitivity checks. In column 4 we replace the dummies for risk aversion with an alternative measure based on the respondents' opinion about risk. Viewing risk as a threat rather than as an opportunity is negatively associated with investment in information, but the other results are unchanged. Column 5 includes only stockholders, since acquiring information is mostly relevant for them and those who don't have stocks may provide inaccurate answers; results are again similar to the whole sample estimates. Finally, column 6 drops investors who spend more than 7 hours per week to make sure that the correlations between information and wealth, risk tolerance and education are not driven by a small group of outliers with above-average taste for financial information. The estimates are again unaffected.

In Table 5 we replace time spent acquiring information with the variable measuring how often investors check the value of their financial assets. The results are very similar to the ordered probit regressions in Table 4: wealth, risk tolerance and education correlate with the alternative indicator in the way suggested by the rational and behavioral models; males check more often than females.

Overall, the estimates are consistent with the hypothesis that those who invest in information do it because they expect, rightly (as in the rational model) or wrongly (as in the behavioral model), to benefit from it. In the nest section we will test whether, in fact, they are right or wrong.

5. Information and portfolio performance

The regressions for the Sharpe ratio in Table 6 are the core estimates of the paper. Since the Sharpe ratio is not defined for individuals who invest only in the risk-free asset, the sample includes only 1,365 investors. To measure financial information we use time spent collecting information. Results are similar with the alternative measure.

Column 1 reports OLS estimates using the indicator of financial information as the only explanatory variable. In a rational model without psychological bias, cross-sectional differences in the Sharpe ratio arise only from differences in information. Contrary to the prediction of the rational model, the coefficient of information is negative and statistically different from zero at the 1 percent level. The effect is also economically large: those who spend between 2 and 4 hours per week in financial information have a Sharpe ratio that is 27% lower than those who spend no time.

The Sharpe ratio is only defined for investors with positive amounts of risky assets. To account for possible selection bias, in column 2 we report the second stage estimates of a Heckman two-step estimator. The first stage is a probit regression where the decision to invest in stocks depends on information investment, financial wealth (liner and quadratic terms), risk aversion and demographic variables.[6] Nothing substantial changes: the coefficient of information is still negative and statistically different from zero, and its magnitude is only slightly reduced.

The third column adds demographic variables for region, gender, age, marital status and city size. In the rational model these variables should not affect the Sharpe ratio, unless there are differences in information not captured by our indicator. Except for age, the coefficients of the additional variables are jointly not statistically different from zero.

[6] Those who acquire more information are more likely to invest in stocks. Causality however can run both ways depending on the timing of the participation decision and information acquisition. The coefficient of risk tolerance is positive, as expected. Wealth has strong and positive effect on participation, consistent with the presence of transaction costs.

The negative correlation between information and the Sharpe ratio may reflect unobserved factors (not captured by the demographic variables) correlated with information. For instance, one may argue that ability to manage one's portfolio differs across investors, and that clever investors can achieve a higher Sharpe ratio without investing too much time in information. Time spent information would then be correlated with unobserved ability, resulting in a negative correlation with the Sharpe ratio.

To address this concern we use an instrumental variables approach. The model with rational agents suggests that attitudes towards risk is a good instrument for information: risk aversion is correlated with information but has no direct effect on the Sharpe ratio. However, in the behavioral model risk aversion may effect the ratio directly, because risk aversion might be correlated with overconfidence. For this reason, we rely on alternative instruments: education, stock market experience (current age less age of first stock purchase), and dummies for retirement and income risk. As shown in Table 4, education and income risk are correlated with investment in information and there are no compelling reasons why they should affect portfolio performance in either the rational or behavioral model.

Column 4 of Table 6 reports the IV estimates, adjusted for selectivity. The coefficient of information is negative, precisely estimated, and larger than in the previous estimates. Furthermore, the Sargan test for over-identifying restrictions does not reject the null hypothesis that the instruments are orthogonal to the error term.

Column 5 adds to the second stage IV estimates three dummies for risk tolerance. In the rational model, risk tolerance should not effect the Sharpe ratio, once differences in information are controlled for (Peress, 2004). If our variables control imperfectly for differences in information, the correlation between risk tolerance and the Sharpe ratio should be positive, because risk tolerance and information are positively correlated. This provides a supplementary test of the rational model. In the data we find that risk tolerance is negatively correlated with the Sharpe ratio: the ratio of the most risk tolerant is 8 percentage points lower than that of the least risk tolerant (the excluded category). This result is not consistent with the rational model. To the extent that overconfidence is correlated with risk tolerance, the result is instead consistent with a behavioral model.

The final regression in Table 6 excludes investors who spend more than 7 hours each week collecting information. The estimated effect of information on the Sharpe ratio is unaffected, implying that the results are not driven by a small group of irrational investors.

The negative relation between the Sharpe ratio and investors' information begs the question of why informed investors attain a lower Sharpe ratio. Is it because their returns are "too low" or because risk is "too high"? To distinguish between these two possibilities Table 7 reports regressions relating the expected return and the standard deviation of the portfolio to financial information. Investors who collect more information have higher returns, but also riskier portfolios. This result, together with the evidence in Table 6, is consistent with models where investors are overconfident about the signal precision.

To further assess if overconfidence drives the results we exploit the theoretical implication that the negative effect of information on the Sharpe ratio should be stronger for individuals that, a priori, can be classified as "more overconfident." Indeed, psychological research shows that overconfidence is so widespread to be classified as a pervasive cognitive bias, but that it differs considerably across individuals.[7] West and Stanovich (1997) provide experimental evidence that overconfidence differs considerably across individuals and across tasks. When individuals are subject to multiple experiments over different domains, those who show more overconfidence in one domain – e.g. a classical knowledge based test of overconfidence – tend to exhibit also more confidence in other domains. This suggests that there are traits that are specific to individuals (rather than to specific tasks) that affect the degree of overconfidence.

Experimental research also shows that overconfidence is more likely to manifest itself when individuals face relatively difficult tasks, such as finance (Fischhoff, Slovic and Lichtenstein, 1977; and Yates (1990). Finally, researchers tend to agree that in tasks

[7] Here is one of many examples of overconfidence. In 1991, the US General Social Survey asked the following two questions: (1) "Compared to other people who do the same or similar kind of work that you do, how well would you say you do your job? Would you say much better, somewhat better, about the same, somewhat worse or much worse?" (2) "Compared to other people who do the same or similar kind of work that you do, how much work would you say you do? Would you say that you do much more, somewhat more, about the same, somewhat less or much less?" Over 72% percent answered to the first question they did better or much better than average; only 0.2% rated themselves below average. About 61% said they worked more or much more than other people, and only 3.3% below average.

that are specific to a type, individuals of that type exhibit more overconfidence. In particular, in more masculine tasks males show more overconfidence than women and vice versa (Lundeberg Fax and Puncochar, 1994).

We split the sample using three different criteria. The first split is based on education, and we classify as more overconfident those with 8 years of schooling or less. If overconfidence increases when tasks are difficult, those with lower education might be more overconfident with respect to a difficult task such as managing the portfolio.The first split is education. The second split uses a question that asks survey participants how well they think they to know stocks. We classify as overconfident those who claim they know stocks well or very well (56 percent of the sample).[8] The third split is based on gender, on the assumption that finance is typically a masculine task (Barber and Odean, 2001). In our sample males are responsible for financial matters of the household in 75 percent of the cases (85 percent excluding singles).

Results are reported in Table 8. The Sharpe ratio is always more negatively associated with information for the group that is classified as more overconfident: individuals with lower education, who claim to know stocks well, and males. To provide a sense of the magnitudes involved, the last row of Table 8 reports the percent reduction in the Sharpe ratio when time spent increases from 30-60 minutes to 2-4 hours per weak, evaluated at sample means. The reduction in the ratio in the high confidence group is between 10 and 20 percent, twice as large as in the other corresponding group. The results are consistent with the hypothesis that the propensity to take financial risk increases with overconfidence.

6. Trading and portfolio performance

Those who invest in information receive more signals, and can therefore be expected to trade more frequently, in both rational and behavioral models. But rational

[8] Several studies suggest that the overconfident tend to overestimate their knowledge, see Svenson (1981), Taylor and Brown (1988), and Weinstein (1980).

investors benefit from trading, achieving higher returns per unit of risk (a higher Sharpe ratio), while overconfident investors are potentially harmed. Furthermore, in behavioral models trading should increase with the degree of overconfidence. Our data allow us to test these further implications of the models.

Table 9 reports order probit estimates of "Frequency of trading," a categorical variable ranging from "never trades" to "trades every day". In column 1 the coefficient of time spent in information is positive and precisely estimated. Estimates with demographic controls in column 2, and adding dummies for risk aversion in column 3 deliver similar results. The positive correlation between information and trading is consistent with rational and overconfident investors, and therefore cannot distinguish between the two.

In Table 10 we split the sample using the same indicators of overconfidence described in Section 5: education, knowledge of stocks, gender. The results show that the more overconfident react to information more strongly than those classified as less overconfident. Compared to the relevant group, the effect of information on trading is about twice as large among the low educated, almost three times as large for men, and more than 5 times for those who claim to know stocks well. These results support the behavioral model, because in the rational model the effect of information on trading should not vary across population groups.

In Table 11 we estimate the correlation between trading and the Sharpe ratio. The correlation is first estimated by OLS, and then adjusted for selectivity some who report trading financial assets don't own stocks, either directly or indirectly through mutual funds and investment accounts. The results show that more frequent trading is associated with lower Sharpe ratio, contrary to the implications of the rational model and consistent with the presence of overconfident investors.

7. Additional implications: delegation and diversification

The survey allows us to delve deeper into the analysis of the effects of financial information on portfolio choice. Here we examine three additional implications of models with overconfident investors. First, overconfident investors tend to rely more on information collected directly, and are less willing to delegate financial decisions to advisors, banks or brokers. Therefore time spent in information should be negatively correlated with investors' willingness to delegate financial decisions, and the effect should be stronger for more overconfident investors. Second, to the extent that overconfident investors rely on information collected directly, they might have less diversified portfolios. This implies that those who acquire more information might engage more in stock-picking, ending up with a less diversified portfolios; again, this effect should be stronger for the overconfident. Finally, in a model with overconfident investors the Sharpe ratio should be higher for those who delegate more and with more diversified portfolios. In this section we provide empirical evidence on each of these implications.

7.1. Delegation

Table 12 reports regressions for investors' willingness to delegate financial decisions. The dependent variable is a categorical variable ranging from 1 (never delegates) to 4 (delegates completely to a financial advisor/bank/broker). Delegation opens up economies of scale in portfolio management and information acquisition.[9] But delegation is expensive, in terms of commissions and fees, and might give rise to agency problems. We add to the standard controls (wealth, education, demographic variables) two dummies for high and medium trust in financial advisor (the reference group is those

[9] Financial advisors can spread the cost of information among many investors, reducing the cost to each. Professional advisors also know how and where to gather information. Thus, by delegating financial decisions, individual investors might obtain better portfolio performance than when deciding on their own.

who don't trust). Clearly, the more investors trust financial advisors, the more they are willing to delegate.

The first two regressions in Table 12 report results for the total sample. The coefficient of information is negative and statistically different from zero. As expected, trust is positively associated with delegation, while males are less willing to delegate. The other regressions report the results splitting the sample by our overconfidence indicators. The effect of information on delegation is stronger for man than women, and for those who claim to know stocks very well.

7.2. Diversification

As a proxy for portfolio diversification, we compute the ratio of equity mutual funds and equity investment accounts to total stockholding, which includes these two items and directly held stocks, listed or unlisted. The ratio is computed for the subset of investors with stocks (directly or indirectly owned), and ranges from 0 (all stocks are directly held) to 1 (all stocks are held through mutual funds and other institutional investors).[10] On average, 44% of equities are directly held, highlighting substantial lack of stock market diversification by all investors.

Table 13 reports regressions for the determinants of portfolio diversification. Risk aversion and trust in financial advisors are associated with more diversification. The coefficient of investment in information is negative and statistically different from zero. The portfolio of those who spend between 2 and 4 hours per week in financial information is 15.2 percentage points less diversified (27 percent of the sample mean) than those who spend no time.

The evidence in Tables 12 and 13 is consistent with the presence of overconfident investors. To complete the picture, one should show that those who delegate less and have less diversified portfolios take too much risk, attaining lower Sharpe ratio. Overconfident investors might delegate less because they believe that information is of high quality. Delegation should therefore be positively correlated with the Sharpe ratio. Similarly,

[10] Unfortunately, the survey does not provide information on the individual stocks held.

overconfident investors might diversify less their portfolio than rational investors, purchasing too little in mutual funds and too much in single stocks, implying that portfolio diversification is negatively correlated with the Sharpe ratio.

Table 14 reports regressions of the Sharpe ratio on delegation (columns 1 and 2) and diversification (columns 3 and 4). Both implications of the model with overconfident investors are supported by the data. The Sharpe ratio increases with delegation. Those who are more willing to delegate have a Sharpe ratio that is 15.8 percent higher than those who don't. The Sharpe ratio is also positively associated with diversification. Raising the index from zero to one, that is, investing in equities only through institutional investors, is associated with an increase of the Sharpe ratio of almost 40 percent.

8. Summary

Financial information differs considerably across investors. There is also wide cross-sectional heterogeneity in portfolio allocations, portfolio returns and volatility. These differences raise the issue of the relation between financial information and portfolio performance. Models with rational investors recognize that information is valuable and that investors have different endowments or preferences. Accordingly, investors will purchase different amounts of information, and those who purchase more information achieve better portfolio allocations, as summarized by the Sharpe ratio. Therefore in models with rational agents information and the Sharpe ratio are positively correlated.

This implication is not borne out in a survey of investors of an Italian leading bank. Instead, we find that investors that acquire more information attain lower returns per unit of risk (a lower Sharpe ratio). This is not due to omitted variables, because the correlation is still negative and even stronger when we instrument our proxy for financial investment. The rational model is rejected also on other grounds; for instance, a measure of risk tolerance has a negative effect on the Sharpe ratio, in contrast to the model's predictions.

We argue that the empirical correlation are more easily understood if one recognizes that investors are overconfident, and overstate the quality of information. Overconfident investors collect too much information, rely too much on it, take too much risk, and achieve a lower Sharpe ratio. Furthermore, the negative correlation between the Sharpe ratio and information is stronger among investors that are more likely to be overconfident. We also find that information is positively correlated with trading activity and portfolio diversification, and that trading and diversification are associated with a lower Sharpe ratio, again supporting models with overconfident investors.

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Appendix

A. The Unicredit-Pioneer Survey

The UniCredit-Pioneer Economic Research Survey of Investors' Behavior (UPS) draws on the population of clients of one of the three largest Italian banks, with over 4 million accounts. The sample includes 1,834 individuals with a checking account in one of the banks that are part of the Unicredit Group. The sample is representative of the eligible population of customers, excluding customers less than 20 years old or older than 80, and those who hold accounts of less than 1,000 euro or more than 2.5 million euro.

UPS' goal is to study customers' behavior and expectations. The survey has detailed information on households' demographic structure, wealth (both within and outside the bank), and income. It has data on multi-banking, attitudes towards saving and financial investment, propensity to take financial risk, retirement saving and life insurance. Interviews have been administered between September 2003 and January 2004 by an Italian leading poll agency, which also serves the Bank of Italy for the Survey on Household Income and Wealth (SHIW). Most interviewers had substantial experience in administering the Bank of Italy SHIW, which is likely to increase the quality of the data. The Computer Assisted Personal Interview (CAPI) methodology was employed for all interviews. Before the interview, each customer was contacted by phone.

The sampling scheme is similar to that of the Bank of Italy SHIW. The population of account holders is stratified along geographical area of residence (North-East, North-West, Central and Southern Italy), city size (less that 30,000 inhabitants and more), and wealth held with Unicredit (as of 31/1/2003). The questionnaire was constructed with the help of field experts and academic researchers. It has 8 sections, dealing with household demographic structure, occupation, propensity to save, to invest and to risk, individual and household financial wealth, real estate, entrepreneurial activities, income and expectations, life insurance and retirement income. The wealth questions match those in the Bank of Italy SHIW, and allow interesting comparison between the wealth distributions in the two surveys.

An important feature of the UPS is that sample selection is based on individual clients of Unicredit. The survey, however, contains detailed information also on the household head – defined as the person responsible for the financial matters of the family – and spouse, if present. Financial variables are elicited for both respondents and household.

B. Construction and definition of wealth

UPS contains detailed information on ownership of real and financial assets, and amount invested. Real assets refer to the household. Financial assets refer to both the account holder and the household. For real assets, UPS reports separate data on primary residence, investment real estate, land, business wealth, and debt (mortgage and other debt). Real asset amounts are elicited without use of bracketing.

Two definitions of financial wealth are available. One refers to the individual account holder, and the other to the entire household. The two can differ because some customers keep financial wealth also in different banks or financial institutions (multi-banking) and/or because different household members have different accounts.

Calculation of financial assets amounts requires some imputation. First of all, respondents report ownership of financial assets grouped in 10 categories. Respondents are then asked to report financial assets amounts; otherwise, they are asked to report amounts in 16 predetermined brackets and if the stated amount is closer to the upper or lower interval within each bracket. The questions are the same used in the Bank of Italy SHIW.

Asset category in UPS	Fraction with positive amount of the asset	Reclassified asset category
Bank accounts	94.1	Risk-free
Repurchase agreements	4.9	Risk-free
Certificate of deposits	7.9	MTGB
Government bonds	28.8	Risk-free, MTGB, LTGB
Corporate bonds	27.7	MTGB
Derivatives	2.9	Stocks
Shares of listed companies	39.4	Stocks
Shares of unlisted companies	3.1	Stocks
Mutual funds	41.4	MTGB, stocks, risk-free
Managed investment accounts	23.3	MTGB, stocks, risk-free

Source: Pelizzon and Weber (2004).

C. Portfolio expected return, variance and Sharpe ratio

To construct the portfolio Sharpe ratio we rely on Pelizzon and Weber (2004), who further classify the 10 UPS asset categories in short-term government bonds (considered to be the risk-free asset), medium-term government bonds (MTGB), long-term government bonds (LTGB), and stocks. The questionnaire does not contain exact information on the maturity of government bonds, and the composition of mutual funds and managed investment accounts. Even if the precise split is not known, the survey asks if mutual funds are predominantly stocks or bonds, and we can combine this information with aggregate data to reclassify mutual funds and managed investment accounts.

We estimate the proportion invested in stocks using the average portfolio allocation of Italian managed funds in the Assogestioni Technical Report (January 2004 edition). For those who state that mutual funds or managed investment accounts are mostly stocks we assume that 88.61% is invested in stocks, 1.47% in bonds, 9.92% in the risk-free rate asset. For those who state that they are equally distributed between stocks and bonds, we assume that 43.07 percent is invested in stocks, 49.56% in bonds, 7.37% in the risk-free rate asset. For those who state that they are mostly invested in bonds, we assume that 1.55% is invested in stocks, 93.3% in bonds, 5.2% in stocks. Government bonds are allocated according to the composition of Italian public debt: 55% short-term bonds, 1% medium-term bonds, 54% long-term bonds.

Pelizzon and Weber then estimate the first and second moments of asset returns. Holding period returns for short term government bonds are computed from the 6-month Treasury Bill rate, assumed to be the risk free rate. For MTGB the holding period returns is a weighted average of holding period returns of medium term government bonds (80%) and corporate bonds (20%). The holding period return of medium term government bonds is derived from the RENDISTAT index assuming a duration of two years. For corporate bonds we use the RENDIOBB index (the index of Italian corporate bonds yields) and a duration of three years. For long term bonds we use the estimated term structure of interest rates and a duration of five years. All returns are net of

withholding tax, on the assumption that for most investors other tax distortions are relatively minor (financial asset income in Italy is currently subject to a 12.5% withholding tax). Stocks returns are computed from the MSCI Italy Stock Index total return.

First and second moments of excess returns, 1989-2003	BOT	LTB	MTB	Stocks
Average excess return (%)	0.9275*	1.7402	0.9449	2.1789
Standard deviation (%)		4.2711	2.1547	20.2309

Source: Pelizzon and Weber (2004).

Correlation matrix	LTB	MTB	Stocks
LTB	1	0.9476	-0.1940
MTB		1	-0.1266
Stocks			1

Source: Pelizzon and Weber (2004)

The sample period is 1989-2003, because some assets did not exist prior to 1989. Pelizzon and Weber exploit the convergence process of Italian interest rates to German rates that accelerated dramatically before the introduction of the Euro in January 1999. Using Weighted Least Squares, the early return series are down-weighted more the farther away they are from November 1998, and weight one after November 1998. The weights are a geometrically declining function of the lag operator multiplied by α, with α equal to 0.8. The weighted series is used to compute sample first and second moments.

D. Definition of variables constructed from survey responses

Delegation Based on question: "Which of the following statements describes better your behavior when you make financial decisions?" (1) I take financial decisions alone, on the basis of information that I collect directly; (2) I use the advise of my bank/financial advisor, but the final decision is mine; (3) I let my bank/financial advisor decide, but I ask to be informed of the decision; (4) I delegate to my bank/financial advisor without asking too much details. The variable *delegation* is a dummy which equals to 1 if the variable code is 4.

Financial diversification. The variable is the ratio of stocks held in mutual funds and other investment accounts to total stocks (direct plus indirect). The index ranges from 0 to 1.

Financial sophistication. The survey has two hypothetical questions to elicit financial sophistication. The first is: "In case you need cash, do you (1) sell assets on which you are currently loosing, (2) assets on which you are currently gaining, or (3) assets on which you expect to gain less or loose more?" *Answers correctly asset liquidation question* is a dummy variable equal to 1 if the variable code is (3). The second question is: "Suppose that in the next 6 months the interest rate will increase. Do you think it is a good idea to buy today fixed interest rate bonds?" *Answers correctly investment the interest rate question* is a dummy equal to 1 if the respondent answers no to the question.

How often checks financial investment. Response to question: "Let's now talk about your financial investments (bonds, stocks, mutual funds, investment accounts, etc.). How often do you check the value of your investment?". Coded as: (1) every day; (2) at least once a week; (3) about every two weeks; (4) about every month; (5) about every three months; (6) about every six months; (7) about every year; (8) less than once a year; (9) never.

Income risk. Based on question: over the next 5 years, do you expect your income to (1) fall significantly; (2) rise significantly; (3) remain unchanged; (4) unable to tell. The dummy equals one for those unable to tell.

Knowledge of financial assets. Investors report knowledge of 10 categories of financial assets by answering the following set of questions: "How well do you think you know the characteristics of [this financial asset]?" Answers are coded as: (1) not at all; (2) little; (3) medium; (4) well; (5) very well. *Financial awareness* is the sum, for each individual, of the assets known (score greater than 1), divided by 10, the maximum number of assets known. *Financial knowledge* is the sum of knowledge scores across the different assets, divided by 50, the maximum possible score. Each index therefore ranges from 0 to 1.

Risk aversion. Response to the question: "Which of the following statements comes closest to the amount of financial risk that you are willing to take when you make your financial investment?: (1) a very high return, with a very high risk of loosing the money; (2) high return and high risk; (3) moderate return and moderate risk; (4) low return and no risk." As an alternative indicator we use: "With which of the following statements do you agree most? (1) Risk is an uncertain event from which one can extract a profit; (2) Risk is an uncertain event from which one should seek protection."

Stock market experience. Response to question: "At which age did you first invest in stocks / equity mutual funds / equity investment accounts?" We define stock market experience as current age less age of first investment; if never invested in stocks, the variable equals zero.

Time spent in financial information. Response to question: "How much time do you usually spend, in a week, to acquire information on how to invest your savings? (think about time reading newspapers, internet, talk to your financial advisor, etc.). Coded as: (1) no time; (2) less than 30 minutes; (3) between 30 minutes and 1 hour; (4) 1-2 hours; (5) 2-4 hours; (6) 4-7 hours; (7) more than 7 hours.

Trading. Response to question: "How often do you trade financial assets (sell or buy financial assets)?" Coded as: (1) every day; (2) at least once a week; (3) about every two weeks; (4) about every month; (5) about every three months; (6) about every six months; (7) about every year; (8) less than once a year; (9) at maturity; (10) never.

Trust in financial advisor. Response to question: "How much do you trust your financial advisor for your investments?" Coded as: (1) very high, (2) high, (3) medium, (4) low, (5) very low. The variable "Trust in financial advisor" is defined as (1) or (2).

Figure 1. The sample distribution of the Sharpe ratio

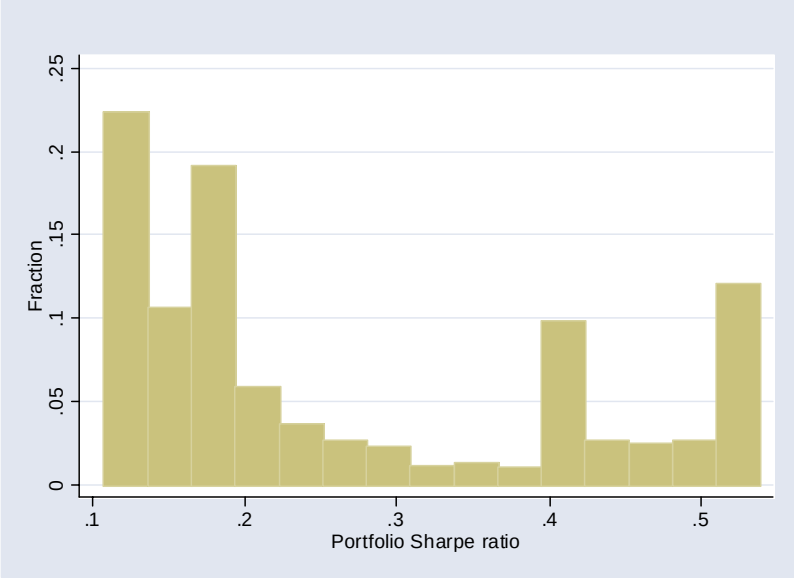

Figure 2. Investment in information and financial wealth

Figure 3. Investment in information and risk aversion

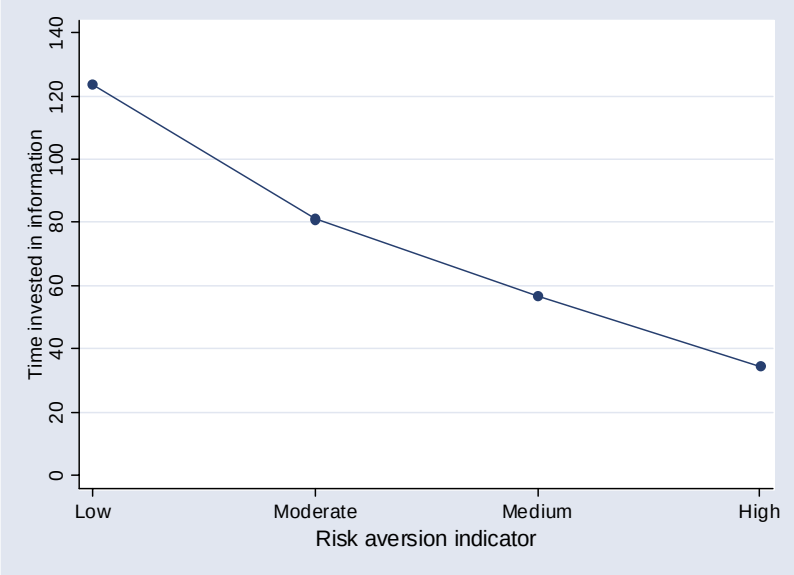

Figure 4. Investment in information and education

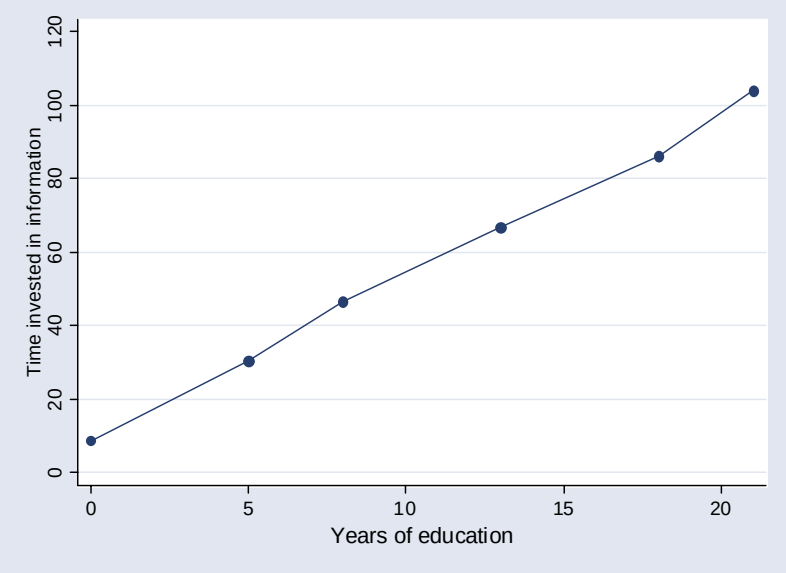

Table 1. Effect of information and risk tolerance on portfolio performance and trading activity

	Model with rational investors		*Model with overconfident investors*	
	Effect of information	Effect of risk tolerance	Effect of information	Effect of risk tolerance
Portfolio expected return	+	+	+	+
Portfolio standard deviation	+	+	+	+
Sharpe ratio	+	0	- (more negative if more overconfident)	- (if RT is correlated with overconfidence)
Trading activity	+	?	+ (more positive if more overconfident)	+ (if RT is correlated with overconfidence)

Table 2. Investment in financial information

The table reports the sample distribution of time spent in financial information in a typical week and the distribution of how often respondents check the value of their financial investments. The distributions refer to the sample of those investing in stocks, held either directly or indirectly through mutual funds and managed investment accounts.

Time spent collecting financial information	*No time*	*Less than 30 minutes*	*30-60 minutes*	*1 to 2 hours*	*2 to 4 hours*	*4 to 7 hours*	More than 7 hours
% of investors	36.48	24.81	14.72	10.96	6.54	2.84	3.65
Equivalent number of working days in a year	0	1.5	4.5	8.4	18	33	42
% owing stocks	59.2	82.0	85.2	95.0	93.3	98.1	98.5
% invested in stocks	12.6	21.8	24.2	31.0	35.6	38.0	43.1

Frequency of checking financial investments	Never	Less than once a year	About once a year	About once every six months	About once every three months	About once a month	About once every two weeks	At least once a week	Every day
% of investors	4.22	5.13	3.95	10.61	24.44	24.25	8.11	11.01	8.30
Time spent collecting financial information (minutes per week)	7.5	20.3	22.0	35.8	46.5	66.4	95.6	115.5	226.2

Table 3. Summary statistics

The table reports summary statistics for the variables used in the estimation. See data Appendix for variables' definitions.

	Mean	Standard deviation
Investment in information		
Time spent collecting financial information	2.49	1.63
Frequency of checking financial investments	5.60	2.77
Sharpe ratio	0.263	0.149
Risk aversion		
High risk, high return	0.034	18.07
Medium risk and return	0.32	46.82
Low risk and return	0.45	49.72
No risk and low return	0.19	
Risk is an opportunity	0.71	0.45
Assets knowledge, trading, delegation and diversification		
Frequency of trade	14.62	56.71
Delegation	1.90	0.72
Claims to know stocks well or fairly well	0.56	1.30
Share of risky assets in mutual funds (portfolio diversification)	0.56	0.42
High trust in financial advisor / bank	0.67	0.47
Medium trust in financial advisor / bank	0.14	0.34
Demographic variables		
Age	54.70	14.37
Male	0.71	0.45
Married	0.69	0.46
Living in the North	0.56	0.50
Living in a city	0.44	0.50
Years of education	11.97	4.41

Table 4. Determinants of investment in financial information

Ordered probit estimates of time spent to acquire financial information. The trimmed sample excludes investors who spend more than 7 hours per week. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	Total sample				Stockholders only	Trimmed sample
	(1)	(2)	(3)	(4)	(5)	(6)
Financial wealth	0.619	0.609	0.469	0.480	0.339	0.441
	(0.092)**	(0.092)**	(0.094)**	(0.094)**	(0.095)**	(0.099)**
Years of education	0.049	0.048	0.059	0.064	0.051	0.056
	(0.006)**	(0.006)**	(0.006)**	(0.006)**	(0.007)**	(0.007)**
Very low risk aversion	0.919	0.919	0.966		0.900	0.878
	(0.147)**	(0.147)**	(0.148)**		(0.165)**	(0.157)**
Low risk aversion	0.561	0.559	0.572		0.443	0.521
	(0.076)**	(0.076)**	(0.077)**		(0.087)**	(0.078)**
Medium risk aversion	0.356	0.359	0.371		0.281	0.386
	(0.072)**	(0.072)**	(0.072)**		(0.083)**	(0.073)**
Income risk		-0.172	-0.158	-0.165	-0.134	-0.127
		(0.059)**	(0.059)**	(0.059)**	(0.066)*	(0.060)*
Male			0.445	0.458	0.474	0.420
			(0.061)**	(0.060)**	(0.068)**	(0.061)**
Married			0.073	0.078	0.086	0.065
			(0.058)	(0.058)	(0.066)	(0.059)
Age			0.007	0.006	0.002	0.007
			(0.002)**	(0.002)**	(0.002)	(0.002)**
Resident in the North			0.326	0.315	0.278	0.342
			(0.053)**	(0.052)**	(0.059)**	(0.054)**
Resident in a small city			-0.034	-0.038	-0.018	-0.004
			(0.053)	(0.053)	(0.060)	(0.054)
Risk is an opportunity				0.153		
				(0.056)**		
Observations	1834	1834	1834	1834	1419	1767

Table 5. Determinants of the frequency of checking financial investment

Ordered probit estimates of frequency of checking financial investments. The variable is defined only for respondents with financial investment. The trimmed sample excludes investors who check their financial investment every day. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	Total sample		Stockholders only		Trimmed sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Financial wealth	0.349	0.337	0.276	0.283	0.229	0.255
	(0.092)**	(0.092)**	(0.093)**	(0.093)**	(0.094)*	(0.101)*
Years of education	0.022	0.021	0.023	0.027	0.019	0.021
	(0.006)**	(0.006)**	(0.007)**	(0.006)**	(0.007)**	(0.007)**
Very low risk aversion	0.827	0.837	0.832		0.780	0.584
	(0.155)**	(0.155)**	(0.156)**		(0.165)**	(0.177)**
Low risk aversion	0.398	0.399	0.372		0.312	0.373
	(0.079)**	(0.079)**	(0.080)**		(0.085)**	(0.083)**
Medium risk aversion	0.258	0.265	0.256		0.226	0.275
	(0.075)**	(0.075)**	(0.076)**		(0.082)**	(0.078)**
Income risk		-0.234	-0.215	-0.210	-0.224	-0.226
		(0.062)**	(0.062)**	(0.062)**	(0.066)**	(0.065)**
Male			0.386	0.399	0.429	0.306
			(0.063)**	(0.062)**	(0.067)**	(0.064)**
Married			0.141	0.142	0.165	0.097
			(0.061)*	(0.061)*	(0.065)*	(0.063)
Age			-0.000	-0.002	-0.006	-0.000
			(0.002)	(0.002)	(0.002)*	(0.002)
Resident in the North			0.220	0.216	0.185	0.255
			(0.055)**	(0.055)**	(0.058)**	(0.058)**
Resident in a small city			-0.109	-0.115	-0.094	-0.103
			(0.055)*	(0.055)*	(0.059)	(0.058)
Risk is an opportunity				0.049		
				(0.058)		
Observations	1518	1518	1518	1518	1360	1392

Table 6. Sharpe ratio and investment in financial information

The dependent variable is the Sharpe ratio, computed as the ratio of the portfolio expected excess return and the portfolio standard deviation. Column 1 reports OLS estimates, the other columns the second stage estimates of a Heckman selection model. The IV-Selection adjusted estimates use as instruments education, stock market experience, and dummies for income risk and retirement. The Sargan test is a test of over-identifying restrictions (p-value in parenthesis). The sample includes only those with financial investment. The last column excludes investors who spend more than 7 hours per week in information. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	OLS		Selection adjusted		IV-Selection adjusted	
	(1)	(2)	(3)	(4)	(5)	(6)
Investment in information	-0.018	-0.017	-0.014	-0.095	-0.086	-0.095
	(0.002)**	(0.003)**	(0.003)**	(0.025)**	(0.024)**	(0.033)**
Male			-0.015	0.028	0.026	0.023
			(0.009)	(0.018)	(0.017)	(0.018)
Married			-0.010	-0.012	-0.011	-0.013
			(0.009)	(0.011)	(0.011)	(0.011)
Age			0.001	-0.001	-0.001	-0.001
			(0.000)**	(0.001)	(0.001)	(0.001)
Resident in the North			-0.004	-0.014	-0.018	-0.017
			(0.008)	(0.011)	(0.010)	(0.011)
Resident in a small city			0.005	0.003	0.004	0.008
			(0.008)	(0.010)	(0.010)	(0.010)
Very low risk aversion					-0.057	-0.072
					(0.031)	(0.032)*
Low risk aversion					-0.082	-0.091
					(0.015)**	(0.016)**
Medium risk aversion					-0.049	-0.050
					(0.014)**	(0.014)**
Mills ratio		0.004	0.026	-0.263	-0.261	-0.254
		(0.016)	(0.018)	(0.091)**	(0.087)**	(0.103)*
Observations	1365	1365	1365	1365	1365	1299
%ΔSharpe ratio of an increase in information from 30 minutes to 2-4 hours	-13.5	-13.2	-12.6	-61.5	-41.5	-45.6

Table 7. The effect of investment in financial information on excess return and standard deviation

OLS estimates of the relation between the portfolio expected return (columns 1-3) and standard deviation (columns 4-6) and investment in financial information. See Appendix for variables' definitions. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	Excess return			Standard deviation		
	(1)	(2)	(3)	(4)	(5)	(6)
Investment in	0.135	0.125	0.112	0.999	0.936	0.813
information	(0.008)**	(0.008)**	(0.008)**	(0.068)**	(0.070)**	(0.070)**
Male		-0.004	-0.009		0.293	0.242
		(0.031)	(0.031)		(0.261)	(0.258)
Married		0.014	0.010		0.159	0.133
		(0.030)	(0.030)		(0.253)	(0.249)
Age		0.005	0.006		0.009	0.018
		(0.001)**	(0.001)**		(0.008)	(0.008)*
Resident in		0.153	0.162		0.703	0.787
the North		(0.027)**	(0.027)**		(0.228)**	(0.224)**
Resident in a		-0.083	-0.080		-0.649	-0.620
small city		(0.027)**	(0.026)**		(0.225)**	(0.222)**
Very low risk			0.350			3.755
aversion			(0.078)**			(0.655)**
Low risk			0.253			2.142
aversion			(0.038)**			(0.323)**
Medium risk			0.159			1.238
Aversion			(0.036)**			(0.300)**
Observations	1780	1780	1780	1780	1780	1780

Table 8. Sharpe ratio and investment in financial information: sample splits

Selectivity adjusted estimates of the relation between investment in information and the portfolio Sharpe ratio for various sample splits. The first stage probit of the two stage Heckman estimator includes as investment in information, financial wealth linear and square, three dummies for risk tolerance, education and demographics. High education are individuals with more than 8 years of schooling (compulsory education); low education with up to 8 years. Low and high knowledge of stocks split the sample between those who report knowing very well or well stocks, and those who don't. The sample includes only people with financial investment. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	High education	Low education	Low knowledge of stocks	High knowledge of stocks	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Investment in information	-0.013	-0.020	-0.003	-0.013	-0.008	-0.015
	(0.003)**	(0.007)**	(0.007)	(0.003)**	(0.006)	(0.003)**
Observations	973	392	482	883	376	989
%Δ Sharpe ratio of an increase in information from 30 minutes to 2-4 hours	-10.6	-18.6	-5.9	-10.8	-8.2	-15.7

Table 9. The effect of investment in information on trading activity

The table reports ordered probit regressions of the frequency an investor changes the portfolio. The sample includes people with financial investment. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	Total sample		
	(1)	(2)	(3)
Investment in information	0.281	0.272	0.261
	(0.017)**	(0.018)**	(0.018)**
Very low risk aversion			0.510
			(0.160)**
Low risk aversion			0.205
			(0.084)*
Medium risk aversion			0.033
			(0.080)
Observations	1421	1421	1421

Table 10. The effect of investment in information on trading activity: sample splits

The table reports ordered probit regressions of the frequency an investor changes the portfolio. High education are individuals with more than 8 years of schooling (compulsory education); low education with up to 8 years. Low and high knowledge of stocks split the sample between those who report knowing very well or well stocks, and those who don't. The sample includes people with financial investment. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	High education	Low education	Low knowledge of stocks	High knowledge of stocks	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Investment in information	0.242	0.271	0.240	0.196	0.215	0.276
	(0.034)**	(0.022)**	(0.022)**	(0.038)**	(0.040)**	(0.020)**
Male	0.141	0.013	-0.031	0.104		
	(0.134)	(0.076)	(0.086)	(0.103)		
Married	-0.019	0.029	0.020	0.001	0.129	-0.031
	(0.124)	(0.074)	(0.082)	(0.103)	(0.112)	(0.081)
Age	-0.004	-0.004	-0.002	-0.006	0.000	-0.005
	(0.004)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)*
Resident in the North	0.418	0.214	0.218	0.318	0.286	0.262
	(0.109)**	(0.068)**	(0.072)**	(0.097)**	(0.114)*	(0.067)**
Resident in a small city	-0.172	-0.210	-0.232	-0.045	-0.210	-0.182
	(0.122)	(0.065)**	(0.071)**	(0.094)	(0.111)	(0.066)**
Very low risk aversion	0.577	0.481	0.750	-0.225	0.605	0.459
	(0.333)	(0.184)**	(0.197)**	(0.307)	(0.316)	(0.187)*
Low risk aversion	0.207	0.211	0.302	-0.056	0.417	0.109
	(0.186)	(0.096)*	(0.120)*	(0.129)	(0.159)**	(0.100)
Medium risk aversion	0.058	0.029	0.101	-0.074	0.117	-0.008
	(0.181)	(0.090)	(0.117)	(0.115)	(0.146)	(0.096)
Observations	378	1043	900	521	389	1032

Table 11. The effect of trading activity on the Sharpe ratio

The left-hand-side variable is the portfolio Sharpe ratio. In the selection-adjusted estimates, the first stage probit includes investment in information, financial wealth (linear and square terms), dummies for risk tolerance and demographic variables. The sample includes people with financial investment. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	OLS	Selection adjusted	
	(1)	(2)	(3)
Frequency of trading	-0.004	-0.003	-0.003
	(0.001)**	(0.001)**	(0.001)**
Male			-0.024
			(0.010)*
Married			-0.016
			(0.009)
Age			0.001
			(0.000)**
Resident in the North			-0.008
			(0.008)
Resident in a small city			0.003
			(0.008)
Mills ratio		0.049	
		(0.013)**	
Observations	1280	1280	1280
%Δ Sharpe ratio for one s.d. increase in frequency of trading	-6.5	-6.5	-4.4

Table 12. Delegation and investment in information

Ordered probit estimates of willingness to delegate financial decisions. The dependent variable is a categorical variable measuring the degree of delegation of financial decisions to financial advisors/banks/brokers. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	Total sample		Low knowledge of stocks	High knowledge of stocks	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Investment in information	-0.058	-0.070	-0.054	-0.026	-0.031	-0.062
	(0.017)**	(0.023)**	(0.018)**	(0.037)	(0.039)	(0.021)**
High trust in advisor	1.052	1.202	1.031	0.864	0.964	1.070
	(0.073)**	(0.105)**	(0.074)**	(0.108)**	(0.138)**	(0.089)**
Medium trust in advisor	0.588	1.003	0.575	0.200	0.639	0.556
	(0.097)**	(0.142)**	(0.097)**	(0.139)	(0.188)**	(0.115)**
Financial wealth	0.445	0.343	0.381	0.908	0.369	0.388
	(0.100)**	(0.118)**	(0.103)**	(0.313)**	(0.193)	(0.122)**
Very low risk aversion	-0.689	-0.841	-0.604	-0.253	-0.160	-0.785
	(0.165)**	(0.220)**	(0.166)**	(0.290)	(0.317)	(0.198)**
Low risk aversion	-0.355	-0.360	-0.268	-0.238	-0.023	-0.376
	(0.078)**	(0.125)**	(0.080)**	(0.113)*	(0.146)	(0.097)**
Medium risk aversion	-0.225	-0.287	-0.182	-0.136	-0.146	-0.210
	(0.073)**	(0.121)*	(0.074)*	(0.098)	(0.132)	(0.090)*
Years of education		0.001	-0.013	-0.029	-0.033	-0.004
		(0.010)	(0.007)	(0.010)**	(0.013)*	(0.008)
Male		-0.122	-0.158	-0.172		
		(0.092)	(0.063)*	(0.089)		
Married		-0.057	-0.058	-0.080	-0.118	-0.025
		(0.089)	(0.061)	(0.088)	(0.103)	(0.080)
Age		0.010	0.008	0.005	0.008	0.008
		(0.003)**	(0.002)**	(0.003)	(0.004)*	(0.003)**
Resident in the North		0.176	0.131	0.095	0.078	0.166
		(0.078)*	(0.056)*	(0.083)	(0.103)	(0.067)*
Resident in a small city		0.030	-0.150	-0.334	-0.247	-0.106
		(0.079)	(0.057)**	(0.083)**	(0.105)*	(0.068)
Observations	1834	1029	1834	805	530	1304

Table 13. Diversification and investment in information

Tobit estimates of the effect of investment in information on portfolio diversification. The dependent variable is the share of stocks held indirectly in the form of managed investment accounts and stock mutual funds on total stocks (directly plus indirect). The sample includes people with financial investment. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	Total sample	Low knowledge of stocks	High knowledge of stocks	Women	Men
	(1)	(2)	(3)	(4)	(5)
Investment in information	-0.046	-0.008	-0.039	-0.032	-0.049
	(0.009)**	(0.020)	(0.011)**	(0.021)	(0.010)**
High trust in advisor	0.152	0.021	0.183	-0.023	0.190
	(0.042)**	(0.076)	(0.049)**	(0.102)	(0.046)**
Medium trust in advisor	0.126	0.037	0.133	0.063	0.138
	(0.056)*	(0.098)	(0.067)*	(0.134)	(0.062)*
Financial wealth	0.133	0.115	0.150	0.155	0.118
	(0.046)**	(0.100)	(0.050)**	(0.089)	(0.053)*
Very low risk aversion	-0.198	-0.195	-0.124	-0.066	-0.246
	(0.085)*	(0.174)	(0.100)	(0.168)	(0.099)*
Low risk aversion	-0.158	-0.112	-0.098	-0.028	-0.198
	(0.046)**	(0.071)	(0.061)	(0.089)	(0.054)**
Medium risk aversion	-0.100	-0.126	-0.040	-0.058	-0.113
	(0.044)*	(0.063)*	(0.060)	(0.081)	(0.052)*
Years of education	0.006	0.003	0.013	0.003	0.007
	(0.004)	(0.006)	(0.005)**	(0.008)	(0.004)
Male	0.036	0.025	0.052		
	(0.036)	(0.057)	(0.045)		
Married	-0.076	0.005	-0.103	-0.036	-0.117
	(0.034)*	(0.055)	(0.042)*	(0.062)	(0.042)**
Age	0.002	0.002	0.001	-0.001	0.003
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)*
Resident in the North	0.038	0.057	0.035	0.036	0.029
	(0.031)	(0.053)	(0.037)	(0.064)	(0.035)
Resident in a small city	0.050	0.041	0.043	0.035	0.050
	(0.031)	(0.053)	(0.037)	(0.063)	(0.036)
Observations	1172	369	803	297	875

Table 14. The effect of diversification and delegation on the Sharpe ratio

Two stage selectivity adjusted estimates of the effect of the willingness to delegate financial decisions and stock market diversification on the Sharpe ratio. The dependent variable is the portfolio Sharpe ratio. Delegation of financial decisions is a categorical variable ranging from 1 (investors decide alone and don't delegate) to 4 (investors let financial advisors/banks decide without asking details). Portfolio diversification is the share of stocks held indirectly on total stocks. The first stage regression includes investment in information, financial wealth (linear and square), dummies for risk tolerance and demographics. The sample includes people with financial investment. Standard errors are reported in parenthesis. Two stars denote significance at 1% or less; one star significance at 5% or less.

	(1)	(2)	(3)	(4)
Delegation of financial decisions	0.014	0.007		
	(0.006)*	(0.006)		
Observations	1365	1365	1172	1172
%Δ Sharpe ratio if delegate totally (columns 1 and 2), or holds only stocks indirectly (columns 3 and 4)	15.8	14.1	39.2	38.9