August 2014

Time Varying Risk Aversion*

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Abstract

We use a repeated survey of an Italian bank's clients to test whether investors' risk aversion increases following the 2008 financial crisis. We find that both a qualitative and a quantitative measure of risk aversion increases substantially after the crisis. This increase is present even among investors who did not suffer any financial loss and are unlikely to have suffered a reduction in their lifetime income. To test whether this increase might be an emotional response triggered by a scary experience, we conduct a lab experiment. Consistent with a fear-based explanation, we find that subjects who watched a horror movie exhibit a higher risk aversion than subjects who did not. The size of the increase in risk aversion caused by the horror movie is similar to the one experienced by our bank's clients during the crisis.

* We thank Nick Barberis, John Campbell, John Cochrane, James Dow, Stefan Nagel, Ivo Welch, Jeffrey Wurgler for very helpful comments. We also benefited from comments from participants at seminars the University of Chicago Booth, Boston College, University of Minnesota, University of Michigan, Hong Kong University, London Business School, Statistics Norway, The European Central Bank, University of Maastricht, Warwick University, University of Montreal, the 2011 European Financial Association Meetings, the 2012 European Economic Association Meetings, the April 2013 NBER Behavioral Finance Meeting, UCLA behavioral finance association, Stanford University. Luigi Guiso gratefully acknowledges financial support from PEGGED, Paola Sapienza from the Zell Center for Risk and Research at Kellogg School of Management, and Luigi Zingales from the Stigler Center and the Initiative on Global Markets at the University of Chicago Booth School of Business. We thank Filippo Mezzanotti for excellent research assistantship, and Peggy Eppink for editorial help.

To fit historical data, asset pricing models require large fluctuations in the aggregate risk aversion (e.g., Campbell and Cochrane, 1999). Yet, what is the direct evidence that aggregate risk aversion fluctuates over time?

Aggregate risk aversion can change because individual risk aversions change or because the distribution of wealth changes. In this paper we analyze whether *individual* risk aversion increases following the major financial crisis of the last 80 years - the 2008 one. We do so by exploiting some survey-based measures of risk aversion elicited in a sample of clients of a large Italian bank (the Bank) in 2007 and repeated on the same set of people in 2009.

We find that both qualitative and quantitative measures of risk aversion exhibit large increases following the crisis. The risk premium required to accept a risky gamble with a 50% chance of winning 10,000 euros increases from 1,000 euros to 2,500 euros. Similarly, the fraction of respondents who say they do not want to take any financial risk goes from 16% to 43%. Individuals who experience an increase in risk aversion are also more likely to sell their stock holdings during the worst moment of the crisis.

The value-function risk aversion of each individual can exhibit large changes for three reasons. First, wealth changes can affect the curvature of the utility function in the relevant domain as in habit persistent models (Campbell and Cochrane, 1999) or prospect theory ones (Barberis, Huang and Santos, 2001). Second, even in the presence of standard utility models, changes in the outside environment -- either individual background risk (Guiso and Pajella, 2008) or the perception of catastrophic events (Caballero and Krishnamurthy, 2009) can change the measured risk aversion of the value function. Finally, Loewenstein (2000) claims that emotions such as fear, experienced at the time of the decision making, can alter our decisions. We interpret fear as a state-contingent increase in the curvature of the utility function.

Consistent with habit persistence or prospect theory models, individuals who experience extraordinarily big losses seem to exhibit a greater increase in the quantitative measure of risk aversion. Yet, we also find that risk aversion increases even among those individuals who did not experience any loss, suggesting that not all the changes in risk aversion occur via changes in wealth.

To test whether variations in background risk can explain the increased risk aversion among investors who did not face any loss, we focus on people who were less affected (or not affected at all) by the turmoil. We look at retirees (who in Italy enjoy a public pension) and public employees (who at the time faced little or no risk of layoffs) and find very similar results.

Background risk, however, is hard to measure. For example, even a retiree, with a fully guaranteed pension, may rely on his children's income as potential insurance against idiosyncratic shocks. If the financial crisis reduces the children's expected income, it might increase the value

function's risk aversion of the parents. Contrary to this hypothesis, we find that risk aversion increases more among older people, not less.

The surge in risk aversion cannot be explained even by the perceived probability of extreme bad stock market realizations, since we elicit the expected distribution of stock returns and there is no evidence of that. In spite of all these results, it is impossible to rule out that the surge in risk aversion is driven by a perceived risk of an extreme outcome in other domains (for example labor income).

Without full knowledge of all the variables that may affect an agent expected income, there is always a possibility that the surge in the value function's risk aversion is driven by changes in the external environment (or the perceived external environment). Such a perfect control is only available in laboratory experiments, where the outside environment is kept constant. The problem with laboratory experiments, however, is how to generate a shock in the lab similar to the one experienced by depositors in our sample.

To simulate in the lab this change in state, we rely on a fear conditioning model. As for the classical Pavlov (1927) experiment, the fear response can be triggered by conditioning factors, which have little or nothing to do with the experience itself. Kinreich et al. (2012) show that watching a horror movie stimulates the amygdala in a way consistent with the arousal of fear.

Thus, to generate the fear produced by a stock market crash, we treat a sample of students with a five-minute excerpt from the movie, *Hostel* (2005, directed by Eli Roth), characterized by stark and graphic images. It shows a young man inhumanly tortured in a dark basement. We find that treated students exhibit a higher risk aversion (both according to the quantitative and the qualitative measure) very similar to the one experienced by the Italian bank's clients in 2009. The treated subjects' risk premium is $672 (27%) higher than the untreated ones. Interestingly, the effect is entirely concentrated among students who dislike horror movies. The ones who like them seem unaffected.

This experiment shows that fear *causes* an increase in our measures of risk aversion, even in the absence of any change in the outside environment (which is the same for the treated and non-treated sample) and in their endowment (which is unaffected by the treatment). Obviously, the experiment cannot prove in any way that such a causal link exists among bank depositors in our sample. Nevertheless, it does provide evidence that such a large increase in measured risk aversion can indeed occur even when not mediated by wealth changes. The psychology model based on fear is consistent with both the survey and the experimental data, while the other models fail to account for at least some of the evidence.

The paper closest to ours is Weber et al. (2011). In this paper, they survey online customers of a brokerage account in England between September 2008 and June 2009. They find that while risk taking decreases between September and March, their measures of risk attitudes do not change. The difference in the results can be due to their different measure of risk attitudes, which mixes expectations and risk aversion. Furthermore, their baseline measures are taken in September 2008 when the situation is already problematic, while our baseline measures are taken long before the inception of the crisis. Our paper is also broadly related to the research on market sentiments (see Baker and Wurgler, 2007 for a summary), to the literature on fear and risk aversion (e.g. Lerner and Keltner, 2000, 2001) and on the effect of emotions on risk attitudes, portfolio choice, and stock returns (Kamstra et al., 2003 and Kramer and Weber, 2012).

The rest of the paper continues as follows. Section 1 presents our measures of risk aversion. Section 2 describes the data. Section 3 reports the results about the changes in risk aversion. Section 4 tests for possible explanations of these changes. Section 5 discusses how fear can be induced in a lab experiment and reports the results of this experiment. Section 6 concludes.

1. Measuring individual risk aversion

If we want to test whether changes in risk aversion can explain movements in asset prices, we need a way to infer risk aversion that is independent of asset prices. For this reason, we resort to survey-based measures.[1] We have two such measures. The first, patterned after a question in US Survey of Consumer Finance, is a qualitative indicator of risk tolerance. Each participant is asked: "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 losing money; (2) high return and high risk; (3) moderate return and moderate risk; (4) low return and no risk."

In a world where people face the same risk-return tradeoffs and make portfolio decisions according to Merton's formula, their risk/return choice reflects their degree of relative risk aversion. In such a world, the answers to the above questions can fully characterize people's risk preferences. However, if people differ in beliefs about stock market returns and/or volatility these differences will contaminate their answers to the above question. This bias would affect not only cross-sectional comparisons, but also inter-temporal ones, possibly revealing a change in risk preferences

[1] A potential alternative, followed by Friend and Blume (1975), is to infer an individual's relative risk aversion from his share of investments in risky assets. This method is not appropriate to study time series changes in risk aversion, because the necessary maintained assumption is that portfolio shares are instantaneously adjusted. If not, any adjustment costs will be reflected in the estimated changes in risk aversion (Bonaparte and Cooper, 2010).

when none is present. While we elicit expectations about stock market returns and volatility and control for them, the controls are not without errors.

The second measure of risk aversion helps us to deal with this problem. Each respondent was presented with several choices between a risky prospect, which paid 10,000 euros or zero with equal probability and a sequence of certain sums of money. These sums were progressively increasing between 100 euros and 9,000 euros. More risk averse people will give up the risky prospect for lower certain sums. Thus, the first certain sum at which an investor switches from the risky to the certain prospect identifies (an upper bound for) his/her certainty equivalent.

Specifically, respondents were asked: "Imagine being in a room. To get out you have two doors. Behind one of the two doors there is a 10,000 euro prize, behind the other nothing. Alternatively, you can get out from the service door and win a known amount. If you were offered 100 euros, would you choose the service door? "

If he accepted 100 euros the interviewer moved on to the next question, otherwise he asked whether the investor would accept 500 euros to exit the service door and if not 1500 and if not…, 3000, 4000, 5000, 5500, 7000, 9000, more than 9000 euros.

The question was framed so as to resemble a popular TV game (Affari Tuoi, the Italian version of the TV game Deal or no Deal), analyzed by Bombardini and Trebbi (2010). Incidentally, it is similar to the Holt and Laury (2002) strategy which has proved particularly successful in overcoming the under/over-report bias implied when asking willingness to pay/accept.

We code answers to this question as the certainty equivalent value required by the investor to give up the risky prospect. We then compute a risk premium as the difference between the expected value of the gamble and an individual's certainty equivalent.

We will refer to the measure based on preferences for risk-return combinations as the qualitative indicator and to the one based on the lottery as the quantitative indicator. The first is a measure of relative risk aversion, while the second is a measure of absolute risk aversion.

These risk-aversion measures should be thought of as measures of the risk aversion for the respondent's value function and as such are potentially affected by any variable that impacts people's willingness to take risk, such as their wealth level or any background risk they face.

2. Data Description

2.1 Sample

Our main data source is the second wave of the clients' survey run between June and September 2007 done by a large Italian bank. The survey is comprised of interviews with a sample of 1,686

Italian customers. The sample was stratified according to three criteria: geographical area, city size, and financial wealth. To be included in the survey, customers must have had at least 10,000 euros worth of assets with the bank at the end of 2006. The survey is described in greater detail in Appendix 1 where we also compare it to the Bank of Italy survey.

Besides collecting detailed demographic information, data on investors' financial investments, information on beliefs, expectations, and risk perception, the survey collected data on individual risk attitudes by asking both qualitative questions on people's preferences regarding risk/return combinations in financial decisions as well as their willingness to pay for a (hypothetical) risky prospect.

For the sample of investors who participated in the 2007 survey, the bank gave us access to the administrative records of the assets that these clients have with them. Specifically, we can merge the survey data with administrative information on the stocks and on the net flows of 26 assets categories that investors have at the bank. We describe in detail this dataset and its content in the Appendix. These data are available at monthly frequency for 35 months beginning in December 2006 and we use them to obtain measures of variation in wealth and portfolio investments over time. Since some households left the bank after the interview, the administrative data are available for 1,541 households instead of the 1,686 in the 2007 survey.

In order to study time variations in risk attitudes, in the spring of 2009 we asked the same company that ran the 2007 survey to run a telephone survey on the sample of 1,686 investors interviewed in 2007. The telephone survey was fielded in June 2009 and asked a much more limited set of questions in a short 12-minute interview.[2] Specifically, investors were asked the two above-mentioned risk aversion questions, a question about trust in their bank advisor or financial broker, and a question about stock market expectations using exactly the same wording that was used to ask these questions in the 2007 survey. Before asking the questions the interviewer made sure that the respondent was the same person who answered the 2007 survey by collecting a number of demographic characteristics and matching them with those from the 2007 survey.

Of the 1,686 who were contacted, roughly one third agreed to be re-interviewed so that we end up with a two-year panel of 666 investors. Table I compares the characteristics of respondents and non-respondents to the 2009 survey along several dimensions. In the first part of the table, we compare the two samples according to the demographic characteristics collected in the 2007 survey such as age, gender, marital status, geographical location, and education. The differences are small and not statistically significant, with the exception of education where we cannot statistically reject

[2] Since the second survey was filled during the same season as the first, the differences in risk aversion cannot be due to season variations in the length of day (see Kamstra et al. (2003)).

the hypothesis that the two samples differ. Still the economic magnitude of the difference is small (less than a year of education).

In the middle part of the table, we compare the two samples according to their risk attitudes, as measured in 2007. Along this dimension, which is the most important one for our analysis, participants in the 2009 survey do not differ from non-participants. For instance, the average 2007 risk premium for the hypothetical risky prospect is 865 euros among non-respondents to the 2009 telephone survey and 792 euros among respondents (p-value =0.66).

While the two samples do not differ in observable characteristics in 2007, they might differ in time-varying characteristics. For example, the crisis might have affected the two groups differentially, in a way that is correlated with their willingness to be re-interviewed. Fortunately, we have the administrative data (and hence the portfolio choices) of both the respondents and the non-respondents both in 2007 and in 2009. Hence, the last part of Table I compares these choices. The stock of financial assets, before and after the crisis, does not differ between the two groups, nor does the fraction of financial wealth invested in stock or risky financial assets. Similarly, there are no differences in the percentage of people who own stock or risky financial assets. From this we conclude that there does not seem to be any systematic selection in the investors' decisions to be re-interviewed in June 2009.

2.2. Our Risk Aversion Measures

As Figure 1a shows, in the 2007 only 16 percent of the sample chooses the "low return and no risk" answer to the qualitative risk aversion question. So most respondents are willing to accept some risk if compensated by a higher return, but very few (1.8 percent) are ready to choose very high risk and very high return. From the answers to this question we construct a categorical variable ranging from 1 to 4 with larger values corresponding to greater risk aversion.

Figure 1b presents the risk premia associated to the answers to the quantitative question. Interestingly, roughly one third of the respondents appears risk loving in 2007. The extreme risk averse people (with a risk premium equal to 4900) are 17% in 2007.

Furthermore, in the 2009 survey we ask "After the stock market crash did you become more cautious and prudent in your investment decisions?" The possible answers are: "More or less like before," "A bit more cautious," or "Much more cautious." Thirty-five percent of the respondents declare to have become much more cautious, while 18% a bit more. Therefore, we create a "change in cautiousness" variable equal to zero if the response is no change, 1 if the response is a bit more, and 2 if it is much more. The summary statistics for these measures and all the other variables are contained in Table II.

2.3 Validating the risk aversion measures

A large and increasing literature shows that questions like the ones above predict risk taking behavior in various domains (see for instance Dohmen et al. (2011), Donkers et al. (2001), Barsky et al. (1997), Guiso and Paiella (2006, 2008)). They are also robust to the specific domain of risk: using a panel of 20,000 German consumers Dohmen et al. (2011) show that indicators of risk attitudes over different domains tend all to be correlated, with correlation coefficients of around 0.5 - a feature that is consistent with the idea that risk aversion is a personal trait.

To validate our measures, we run various tests. First, in Table III we document that our qualitative and quantitative measures are positively correlated either when using the 2007 cross, section (correlation coefficient 0.12) or the 2009 cross section (correlation 0.16) or when looking at the correlation between the changes in the two measures between 2007 and 2009 (correlation coefficient 0.12). We also find that the change in cautiousness variable has a 12% correlation (p-value 0.002) with the changes in the qualitative measure of risk aversion and a 7.4% correlation (p-value 0.056) with changes in the quantitative measure of risk aversion.

Second, we document that our measures tend to be correlated in expected ways with classical covariates of risk attitudes.[3] As Panel A of Table IV shows risk aversion decreases with total wealth levels in both the 2007 and the 2009 cross sections. Also, as documented in the literature, men are less risk averse than women (Byrnes, 1999).

Third, we document that our measures have predictive power on investors' financial choices. Panel B of Table IV shows that the qualitative indicator of risk aversion is strongly negatively correlated with ownership of risky financial assets (a dummy variable equal 1 if an individual owns stocks and corporate bonds in her portfolio). The correlation with the lottery-based measure is negative but weaker. This is partly due to some investors providing noisy answers in the quantitative measure, which is more difficult to understand. When we drop inconsistent answers - those who are highly risk averse according to the first indicator (a value greater than 2), but highly risk lovers on the basis of the lottery question (a risk premium less or equal to -4000 euros) - we also find that the quantitative measure significantly predicts risky asset ownership. Furthermore, the change in risk aversion predicts the change in assets ownership: those whose risk aversion increased more between 2007 and 2009 are more likely to become non-stockholder over the same period (Table IV.C). In the Appendix (Table A.3 and Table A.4), we also document a similar pattern for the level and in the change in the share of wealth held in risky assets.

[3] These patterns of correlations have been documented in several studies, either using surveys or experiments (e.g. Croson and Gneezy (2009) for gender; Barsky et al. (1997), Guiso and Paiella (2006, 2008), Hartog et al. (2002)).

2.4 Changes in wealth and financial losses

For all the participants in the survey, we have access to the administrative data, which include the amount of deposits at the bank, the amount and composition (by broad categories) of their brokerage account at the bank, the proportion of financial wealth represented by their holdings at bank, and the value of their house. Thanks to these data we can infer the changes in respondents' total wealth and the losses incurred on their financial portfolio. The change in total wealth is computed as the sum of the actual changes in their financial wealth held at the bank (divided by the proportion of financial wealth held at the bank to obtain an estimate of total household assets) and the imputed changes in home equity. To impute these changes we look at the variation in local indexes of real estate prices. The losses on the financial portfolio are computed by multiplying the holdings of risky securities (stocks, stock mutual funds, corporate bonds and corporate bonds funds) before August 2008 by the proportional change in their price between September 2008 (before Lehman collapse) and February 2009 (when the stock market started to rebound) and then scaling by the stock of financial assets before August 2008.

3 Changes in Risk Aversion

3.1 Changes in Individual Risk Aversion

Figure 1A compares the distribution of the qualitative measure of risk aversion before and after the crisis. Before the crisis the average response was 2.87, after the crisis it has jumped to 3.28 (recall, a higher number indicates higher risk aversion). This change is statistically different from zero at the 1% level. In 2007, only 16% of the respondents chose the most conservative option "low return and no risk;" in 2009, 43% did. In the Appendix (Table A.5) we show the transition matrix of the responses. There is a homogenous shift toward more conservative combinations of risk and return. 83% of the people who chose the most aggressive option ("Very high returns, even at the risk of a high probability of losing part of the principal") change toward a more conservative one. 74% of those who had chosen the second more risky combination ("high return and high risk") move to more conservative options, while only 2% move to the more aggressive one. 44% of those who chose "moderate return and moderate risk" move to "low return and no risk," while only 9.5% move to more aggressive options.

Figure 1B compares the distribution of the risk premium before and after the crisis and Figure 1C the mean and median risk premium before and after the crisis (the transition matrix is in Table A.6). As Figure 1C shows, before the crisis the average risk premium investors are willing to pay

to avoid a gamble offering 10,000 euros and zero with equal probability was 973 euros. In 2009, the risk premium for the same group of people increased to 2,215 euros. The median increased from 1,000 to 3,500. All these changes are statistically different from zero. Interestingly, the large surge in the risk premium is driven by a much higher number of people who choose the lowest certainty equivalent (and thus the highest risk premium).

Since the risk premium is proportional to the investor risk aversion, these estimates imply that the (absolute) risk aversion of the average investor has increased by a factor of 2 and that of the median investor by a factor of 3.5!

One benign reason why risk aversion might have increased is that from the first to the second survey our respondents became older. While true, this effect is likely to be small, since only two years went by. Nevertheless, we computed the average risk aversion by age and then took the difference of risk aversion between the first and the second survey keeping the age constant (i.e. between the average of people who were thirty in 2009 and the people who were thirty in 2007). The results are unchanged.

This increase cannot be attributed solely to a worsening of expectations about the distribution of future investments since it manifests itself also in the quantitative measure, which is unrelated to the stock market. In fact, the probability distribution underlying the gamble in the quantitative measure is objective, not subjective. For the qualitative one, we report the distribution of expected returns. As one can see in Figure 3, the worst outcomes has not become more extreme.

3.2 Changes in Aggregate Risk Aversion

Our sample is representative of Italian individual investors, but not of all investors: institutional investors and professional traders are not represented. Yet, if we treat it as a representative sample, we can compute the aggregate risk aversion. This is what we do in Table V.

We map the risk premium computed from the quantitative question into a coefficient of absolute risk aversion by using a CRRA utility function. Then, we compute the aggregate risk aversion by weighting these coefficients by the net total wealth of each individual. As Table V shows the aggregate risk aversion in 2007 was 1.3. If we maintain the individual risk aversions estimated in 2007 and multiply them by the 2009 wealth weights, the aggregate risk aversion does not change at all. By contrast, if we use the 2009 estimated individual risk aversion, the aggregate risk aversion almost doubles. If we repeat the analysis restricting the sample to people who were stockholders in 2007 the results are the same.

Now that we have computed the changes in aggregate risk aversion, we can estimate whether this change is sufficient to justify the large drop in stock prices that took place. What is relevant for

asset prices is the relative risk aversion. Since the total wealth changed little, all the increase in absolute risk aversion results is an increase in the relative risk aversion. How should this increase affect asset prices? Let's assume (a strong assumption) that the future expected cashflow remains unchanged and that after one year even the risk aversion returns to normal. Then, next year stock price P_1 should remain unchanged and all the adjustment should take place in today's stock price P_0. By using the Merton (1969) model, we can write

$$r^e = \frac{P_1}{P_0} - r_f = \gamma\sigma^2$$

where the left hand side is the equity premium and σ^2 the variance of stock returns. If risk aversion γ doubles to $\gamma'=2\gamma$, as it does in our sample, then the initial stock price $P_0^{'}$ should be

$$\frac{P_0^{'}}{P_0} = \frac{1}{\frac{\gamma'}{\gamma}\left[1 - \frac{P_0}{P_1} r_f\right] + \frac{P_0}{P_1} r_f},$$

which is roughly half of what it was before. Hence stock price roughly halves if risk aversion doubles. Thus, the sharp increase in risk aversion is quantitatively sufficient to explain the severe drop in stock prices during the crisis. Yet, it begs the question of what caused this increase in risk aversion.

3.3 Portfolio Rebalancing

Before answering the important question above, we want to perform one last test on the practical relevance of our measures. In Table IV.C we have shown that there is a correlation between the changes in the share of risky assets and the changes in individual risk aversion. Our sample, however, allows us to go deeper. We have the active portfolio decisions, so we can test whether the change in risk aversion predicts active portfolio rebalances after the crisis.

Let assume that before the crisis individual portfolios were at the optimal Mertonian share $\omega_i^M = \frac{r^e}{\gamma_i \sigma^2}$. This assumption is realistic given that before the crisis stock prices were fairly flat for a while and thus investors did have all the time to adjust. Denote with p the value of stocks after the shock, $p < 1$. Then, after the severe market downturn the actual share of risky assets became

$$\omega_i = \frac{p\omega_i^M}{p\omega_i^M + 1 - \omega_i^M}$$

We have seen that after the crisis the distribution of expected returns did not change. If the individual risk aversion did not change either, the portfolio rebalance of individual *i* would be given by

(1) $$R_i = \omega_i^M - \frac{p\omega_i^M}{p\omega_i^M + 1 - \omega_i^M}$$

If the risk aversion moves to $\gamma_i^{'}$, then the portfolio rebalance of individual *i* is

(2) $$R_i = \frac{\gamma_i}{\gamma_i^{'}}\omega_i^M - \frac{p\omega_i^M}{p\omega_i^M + 1 - \omega_i^M}.$$

We can nest these two specifications as

(3) $$R_i = \alpha[\frac{\gamma_i}{\gamma_i^{'}} - 1]\omega_i^M + \beta[\omega_i^M] + \delta[\frac{p\omega_i^M}{p\omega_i^M + 1 - \omega_i^M}]$$

where if $\alpha = 0$, $\beta = 1$, $\delta = -1$ we obtain (1), i.e., the optimal rebalancing under the standard mertonian model with no changes in risk aversion, while if $\alpha = 1$, $\beta = 0$, $\delta = -1$ we obtain (2), i.e. the optimal rebalancing when the risk aversion parameter changes.

To test this we build empirical counterparts of the terms on the right hand side of (3); the details are reported in Appendix A4. We define the shock as the drop in stock prices that occur after August 2008, i.e. the pre-Lehman month. Since prices continue to fall until February 2009 we define various measures of the drop in risky asset prices since August 2008 computed at different months from September 2008 until February 2009. Importantly, we construct an investor specific measure of *p* by taking portfolio-weighted means of the drop in different components of the risky portfolio using as weights the risky portfolio compositions of each individual as of August 2008. $R_i(t)$ is computed as the net flow of risky assets (positive for net purchases and negative for net sales) and scale it by the value of total financial assets in August 2008.

The results are reported in Table VI. In all regressions we add some demographic controls and the change in total assets; results are invariant to these controls. The left hand side variable represents the active reallocation in the period that goes from August 2008 to the date written at the top of each column. Thus, in column 1 the reallocation considered is the one during the period August ’08 to September ’08. In all the specifications except one the α coefficient is significantly bigger than zero, albeit also significantly less than 1. In all the specifications the coefficient β is not different from zero, while the coefficient δ is negative and sometimes significantly different

from zero, albeit always significantly different from -1. Thus, while none of the two models fits well the data, model (2) seems closer to reality than model (1).

4 What Explains the Changes in Risk Aversion?

A characteristic that standard expected utility models have in common with the non-standard ones is that any change in risk aversion is mediated by changes in wealth. For this reason, we start by plotting a non-parametric estimation of the relationship between changes in risk aversion (both the qualitative and the quantitative measures) and the size of financial losses incurred between September 2008 and February 2009 (if we use total wealth the results are the same). As Figure 2a shows, there is no consistent relationship between the increase in the *qualitative* measure of risk aversion and the size of the losses in the financial portfolio during the financial crisis. For losses between zero and 20%, the increase in risk aversion is stable at 0.4, around 14% of the sample mean in 2007. For losses above 20%, the increase in risk aversion seems to first decrease and then increase.

As Figure 2b shows, for the *quantitative* measure there seems to be a negative relation between the size of the financial loss and the relative risk premium (the risk premium divided by the expected value of the lottery), which is consistent with NSEU models. Yet, even people with no losses exhibit a significant increase in the relative risk premium (by 20 percentage points), which seems at odd with NSEU models.

To better understand the robustness of these results we focus on the 295 people who did *no*t experience any financial loss between September 2008 and February 2009 (either because they gained or because they did not have any risky assets and thus did not experience any loss).[4] Before the crisis the *qualitative* measure of risk aversion of this subsample was 2.82 (statistically not different from the rest of the sample). After the crisis their qualitative measure jumped to 3.25, again not statistically different from the jump in the rest of the sample.

The same is true for the *quantitative* measure. Before the crisis the mean risk premium was €831, not statistically different from the rest of the sample. After the crisis, the mean risk premium rises to €2,260, not statistically different from the rest of the sample. Therefore, investors who did not experience any loss exhibit an increase in risk aversion equal to those who did.

[4] The people with inconsistent answers are 59. We focus on financial losses; households could have suffered losses on housing wealth. This is not the case: between the second quarter of 2009 and the first quarter of 2008 house prices increased in all local markets but one where they dropped by 3.7%. A non parametric estimate of the relation between the change in the qualitative and quantitative measures of risk aversion and the proportional change in total wealth leads to a similar conclusion. The certainty equivalent increases by a similar amount even for households whose total wealth holdings do not change or even increase.

One possible explanation is that investors are responding to a change in the background risk caused by the crisis. The income from financial assets is generally small relative to labor income. If there is a significant change in the labor income risk, this might affect the measured risk aversion.

For this reason we focus on people who face much less (possibly no) labor income risk. People in the first category are government employees. Note that 2009 predates the Greek and euro crisis and the Italian government solvency was not seriously in doubt (the spread between the 5 year Italian bond and the German one was around 60 basis points). As Table VII shows, government employees who did not face any financial loss still exhibit a surge in risk aversion (both the qualitative and quantitative measures), which is statistically different from zero. Interestingly, if we compare the surge in risk aversion between government employees who did not face any financial loss and non-government employees who did not face any financial loss, we find no difference, casting down that background risk can explain the surge.

Our measure of financial losses is based on the wealth investors have deposited at the Bank. We cannot exclude, thus, that they might have faced a loss in other investments. For this reason, in the third and fourth rows of Table VII we restrict the attention to individuals who declare that they only have financial wealth at the Bank (144 observations). The results are very similar. In fact, if anything the qualitative and quantitative measures of risk aversion increase by more among government employees than non-government employees.

We repeat the same analyses dividing the sample of investor who did not face financial losses between retirees and non retirees. In Italy retirees enjoy a defined benefit plan backed by government guarantee. Thus, the same considerations above apply. We find no difference between the surge in risk aversion of retirees and non retirees.

Yet, it is still possible that risk aversion changes because individuals perceive an increased background risk, which is hard to measure. For example, even a retiree, with a fully guaranteed pension, may rely on his children's income as potential insurance against idiosyncratic shocks. If the financial crisis reduces the children's expected income, it might increase the value function's risk aversion of the parents.

Another possibility is that the surge in absolute risk aversion is due to a large non-financial loss, such as a permanent reduction in labor income. If we use a standard CRRA utility model, we need a 50% reduction in future labor income to account for a doubling of the absolute risk aversion. Such a large drop is unlikely, especially for government employees or for retirees. In a habit persistence model, however, a much lower reduction of permanent income is able to account for a doubling of the absolute risk aversion.

Yet, if this is the reason for the surge in risk aversion, risk aversion should increase much more for younger people (who have most of their wealth in human capital) than for older people. For this reason, in the bottom part of Table VII we split the sample of people who did not suffer any financial loss between young (age below 45) and old (age above 65). The change in qualitative risk aversion is the same for the two groups, while the change in the quantitative measure is *larger* for older people than for younger ones.

In Table VIII we repeat all this analysis in a regression form. The results are the same. In sum, we document that people become more risk averse because of a state variable in the environment that has little or nothing to with their own personal present and future wealth. Instead of an internal or external habit, they might respond to the losses of their friends and neighbors. While this possibility has not been explicitly modeled in the financial literature, it has been developed in Lowenstein (2000).

4.3 The Fear Alternative

According to Loewenstein (2000), decisions are not made only on the basis of anticipated results as in a standard expected utility framework. Emotions experienced at the time of decision-making (immediate emotions) can play a part too. Emotions originate in the brain's limbic system (amygdala, cingulate gyrus and hippocampus) and they are processed and moderated by the frontal cortex (Pinel, 2009). A simple way to embed the role of emotions in the standard utility framework is to assume that emotions can alter some parameter of an individual utility function. Thus, we interpret fear as a state-contingent increase in the curvature of the utility function.

This hypothesis can explain why, in the 2008 financial crisis context, investors who did not lose any money became more risk averse even with respect to known probabilities gamble such as our quantitative measure. The terrifying news appearing on television, the interaction with friends who lost money in the market, the pictures of fired people leaving their failed banks might have triggered an emotional response.

While suggestive, this hypothesis cannot be tested with our data because it is observationally equivalent to a background risk model. Does the picture of Lehman fired employees trigger an emotional fear response or does it increase the subjective probability of a very bad outcome?

5 Fear-Inducing Experiment

5.1 The advantage of a laboratory experiment

With non-experimental data, it is impossible to separate the emotional response from a Bayesian response, based on an updated probability of a large disaster (a revolution, a Great Depression, etc.)

or an increase in a non-measurable background risk. Indeed, individuals might be reluctant to take risks because they believe that the realization of extreme events is now more likely (e.g., Caballero and Krishnamurthy, 2009) or because they overestimate the realization of negative outcomes. To separate the emotional response from a Bayesian response, we rely on a laboratory experiment where the outside environment is controlled for. As long as the treatment provides no information about the real world, the probability of an extreme event should remain constant between treated and untreated samples. To discriminate between the two hypotheses, thus, the key feature of such an experiment is to induce fear in the lab without altering a subject's perception of her financial and economic prospects. To achieve this goal we rely on the fear conditioning model used in psychology.

5.2 The fear conditioning model

As for the classical Pavlov (1927) experiment, the fear response can be triggered by conditioning factors, which have little or nothing to do with the experience itself. As Pavlov's dog salivates when a bell rings, the fear response arises in the presence of stimuli associated to past traumatic events. This evidence suggests that a fear-based response can be triggered by fear stimuli in an unrelated domain. For example, Kinreich et al. (2012) show that watching a horror movie stimulates the amygdala in a way consistent with the arousal of fear. Yet, they do no provide evidence that this experience can alter a risk aversion measure like ours, nor that it can alter it to the extent we observe after the financial crisis. This is what we try to test.

We chose a brief horrifying scene from a movie that was sufficiently recent to be really scary for undergraduates used to the scariest videogames (Psycho would not cut it), but sufficiently old to minimize the chance they had already seen it. We chose a five-minute excerpt from the 2005 movie, Hostel, directed by Eli Roth, which is characterized by stark and graphic images and that show a young man inhumanly tortured in a dark basement. This movie won "Best Horror" at the Empire Awards in 2007.

Our experiment was run at Northwestern University in March 2011 in three different sessions. A total number of 249 students took part. The participants were recruited through an internal mailing list service that is normally employed for experiments at Northwestern.[5] A compensation of $5 was paid in cash to each subject taking part in the experiment, which in general takes around 10-15 minutes.

[5] The students can freely enroll to the mailing list and, after they have completed an introductory demographic survey, they receive periodic communications on the experiments that are going on at the University.

All the participants were asked to complete a questionnaire of approximately 40 questions. The main scope of this is to construct some measures of risk aversion, as well as to provide other controls. In order to identify the effect of fear on the subjects, we relied on a simple treatment and control framework. In particular, around half of the participants were asked to watch a short video before completing the questionnaire. Since the subjects were randomly assigned to watch the video, the idea is that the difference in risk aversion between the two groups should be completely driven by this difference in the treatment.

Given the nature of the video, which potentially disturbs some of the subjects, we had to give them the option to skip the video at any moment. We dropped the observations of the subjects (27) who decided to skip the video in the first minute of the five minute presentation, since they did not really experience much horror. This choice might underestimate the effect of the treatment, since those most sensitive to the treatment dropped out.

Another possible concern is that, if a subject has already watched the video, its perceived effect would be different from the true effect. We therefore decide to drop those 13 subjects who declared to have already watched it.

In order to guarantee the reliability of the results, the experiment was designed in such a way that the participants were not aware that the treatment was not identical for everyone. As measures of risk aversion, we use answers to the very same questions that were used in the bank survey, where we translated euro into dollars at a 1:1 ratio.

As Table IX shows, the random assignment assumption cannot be rejected: none of the main personal characteristics and demographic information has been found to be statistically different between treatment and control groups. Furthermore, around 40% of the participants were female and the average age is 20, which is not surprising given that the sample is selected from undergraduate students.

When we look at the risk aversion measure, we find that there is a large and statistically significant difference in the quantitative measure of risk aversion. Among the treated students the risk premium they are willing to pay for avoiding the risky lottery is $672 (i.e., 27%) higher. This holds true without controls and controlling for observables (Table A.8).

In the qualitative measure we observe a drop, but this drop is not statistically significant at the conventional level (p-value =0.111). In part, this phenomenon is due to the fact that students bunched their choices in the two central values: 96% of the responses are either 2 or 3. Hence, the scale 1-4 is probably better reduced to a dichotomous choice: low risk aversion (1 and 2) and high risk (3 and 4). When we look at the proportion of people choosing the low risk option, this

proportion increases by 13.5 percentage points (30% of the sample mean) among the treated group. This difference is statistically significant at the 5% level.

In the second half of the sample, we asked people how much they liked horror movies on a scale from 0 to 100. Roughly a third of the sample declared they do not like it at all (i.e., like=0) and 50% report a value of liking below 20. In Figure 5 we split the sample on this basis. In the first group, there are students who do not like horror movies (liking indicator below median). Their risk premium raises from $2,124 to $3,256 as a result of the treatment (Panel A). This difference is statistically significant at the 1% level.

The second group is formed by those subjects who moderately like horror movies ((liking indicator above 20). Here the treatment has a no effect (the risk premium rises from 2,435 to 2,437) and this difference is not statistically significant.

We get a similar result when we look at the qualitative measure of risk aversion, where we bunched the responses into two groups. Among people who dislike horror movies the treatment effect increases the probability of buying risky assets by 25 percentage points. Among those who moderately like horror movies the increase is significantly smaller by 7 percentage points.

7. Conclusions

We show that investors' risk aversion surged after the 2008 financial crisis even when investors are confronted with a gamble of known probabilities. Overall, this surge appears consistent with what asset pricing studies document (Campbell et al, 2011, Martin (2013)).

It is puzzling, though, that we observe an increase in risk aversion even among those investors who did not experience *any* financial loss. One possible explanation is that individuals have a habit-persistent utility and faced large losses in their non-financial wealth. An alternative explanation, laid out in Delong, Shleifer, Summers, and Waldmann (1990), is that investors are subject to sentiments: when people witness a scary event (such as a financial crisis), they become more risk averse independently of any economic loss they incur. In the habit model, individual psychology (the habit formation) contributes to amplifying the effect of a shock. In our fear-based model it is a social phenomenon (the fear contagion) that contributes to amplifying the effect of a shock.

To test whether just the emotion of fear can create such large increases in risk aversion, we conduct a lab experiment where we treat a random sample of students with a very scary movie. We find that the students treated exhibit a significant increase in risk aversion, similar to the one observed in the data. A question we are unable to answer in this paper is how persistent such fear-induced change in risk aversion is. The evidence of Malmendier and Nagel (2011), who find a

cohort effect of “Depression era babies” in the risk aversion measure of the Survey of Consumer Finances, suggests it might be long-lasting. Our sample is unable to answer whether fear provokes long term consequences because of the subsequent events in the Eurozone, which made the 2008 shock not an isolated crisis.

Note that our conclusion that individual risk aversion increase is not in contradiction with the “institutional finance” hypothesis (e.g., Vayanos, 2004; He and Krishnamurthy, 2012), which attributes the rise in aggregate risk aversion during the crisis to an increase in the leverage of financial intermediaries. In fact, we see the two hypotheses as complementary. A surge in individual risk aversion can have no impact on prices as long as institutional investors are not highly leveraged and can absorb the sales by scared individuals. When institutional investors do not have this flexibility, however, individual panic might end affecting prices. How these two ideas can be combined is left for future research.

If investors are caught by fear in a downturn and tend to sell in those moments, the effective return of their equity investments would be much lower. To what extent this feature of a fear-based model can explain the famous equity premium puzzle? This is another topic for future research.

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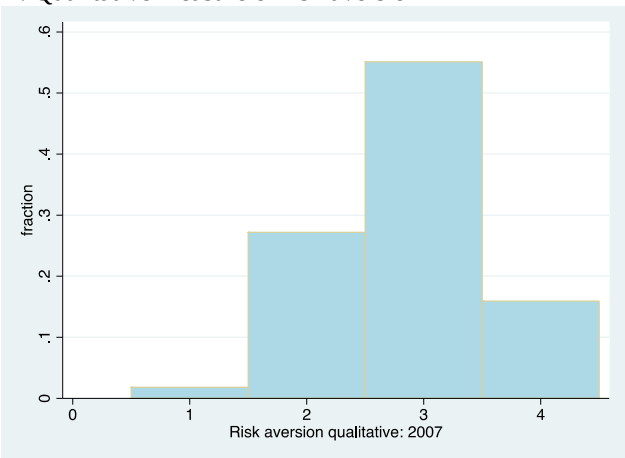
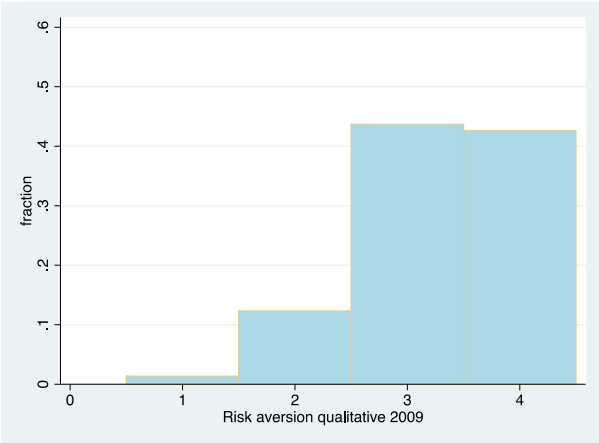
Figure 1: Frequency distribution of the level of risk aversion indicators in 2007 and 2009

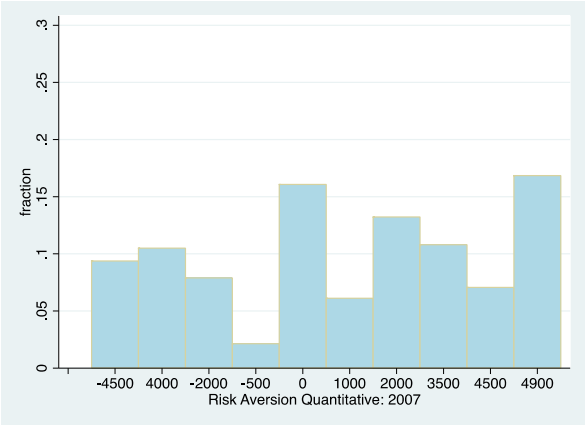
Panel A reports the frequency distribution of the qualitative measure of risk aversion in 2007 and 2009. The qualitative indicator elicits the investment objective of the respondent, offering them the choice among "Very high returns, even at the risk of a high probability of losing part of my principal"; "A good return, but with an ok degree of safety of my principal;" "An ok return, with good degree of safety of my principal," "Low returns, but no chance of losing my principal." Responses are coded with integers from 1 and 4, with a higher score indicating a higher aversion to risk. Panel B shows the frequency distribution of the risk aversion indicator based on the answers to the lottery that delivers 10,000 euros or zero with equal probability in 2007 and 2009. The risk premium for this gamble is computed as the difference between the expected value of the lottery (5,000€) and each respondent's certainty equivalent. Panel C reports the average and median risk premium for this gamble in the two years.

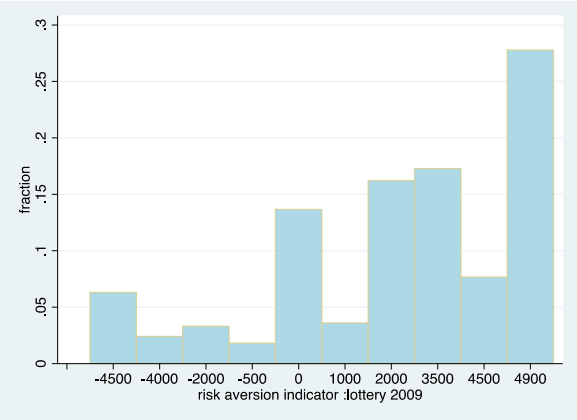
A. Qualitative measure of risk aversion





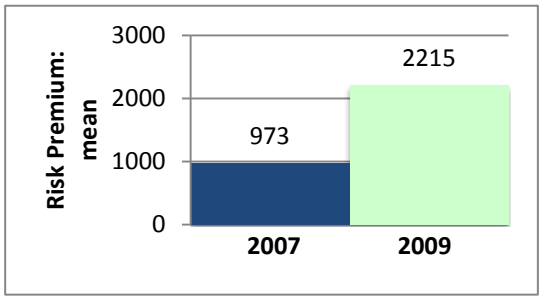
B. Quantitative measure of risk aversion (risk premium)





C. Quantitative measure of risk aversion (risk premium) over time

Mean



Median

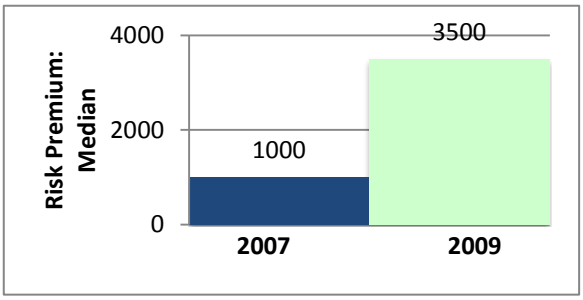
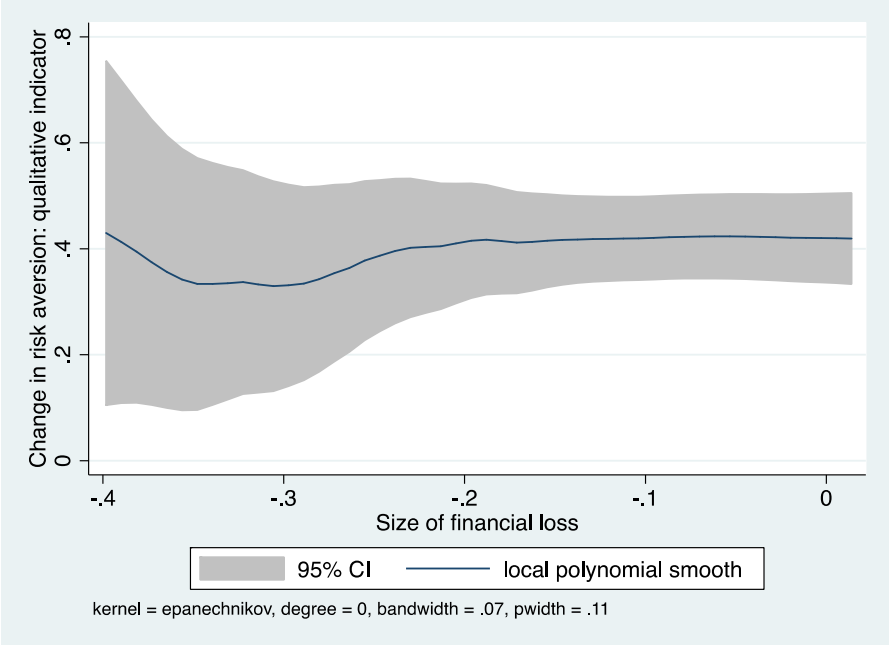


Figure 2. Financial loss and change in risk aversion

The figure plots the relation between potential losses in the financial portfolio between September 2008 and February 2009 and the change in the qualitative indicator of risk aversion (Panel A) and in the risky premium of the quantitative lottery (Panel B). The change in risk premium is scaled by the expected value of the lottery (Euros 5,000). The figures show the 95% confidence interval around the estimated polynomial. The relation is estimated using a kernel-weighted local polynomial regression. The financial loss is computed as loss in value of risky investments held at the end of September 2008 over the above period, scaled by the initial value of financial assets.

A. Qualitative measure of risk aversion



B. Quantitative measure of risk aversion (risk premium)

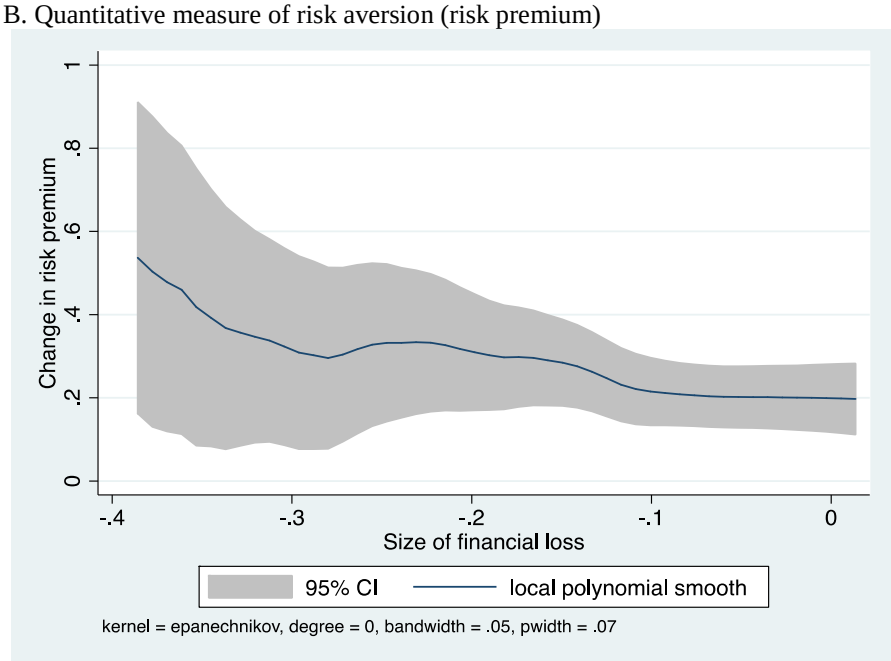
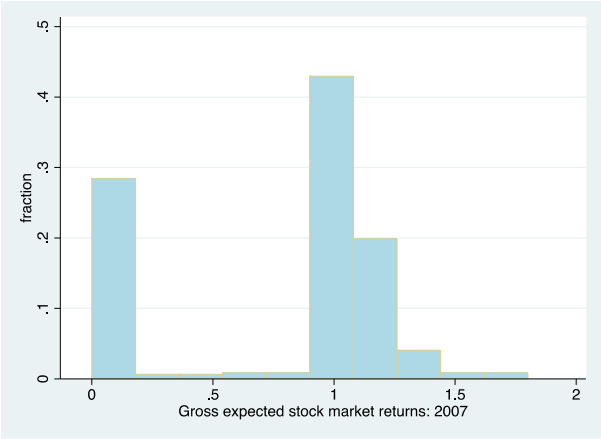


Figure 3: Distribution of expected gross stock returns

The figure shows the cross sectional distribution of one-year ahead subjective expected stock returns in 2007 and 2009. Expected returns are obtained from the answers to a question asking the minimum and maximum value an investment of 10000 euros in a fund representative of the Italian stock market one year later and the probability that the value is below the mid point of this range. The reported distributions are for the respondents to both the 2007 and 2009 surveys.

2007



2009

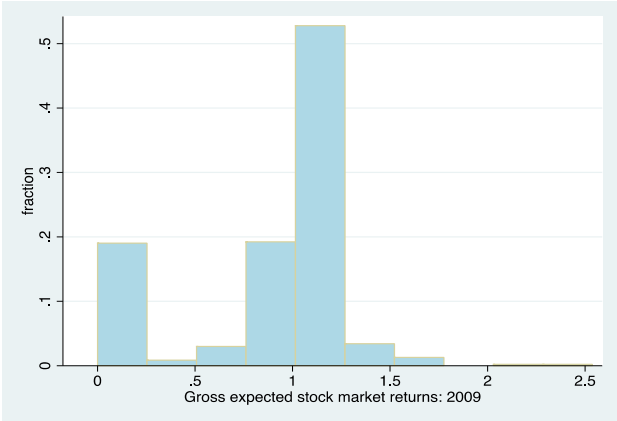
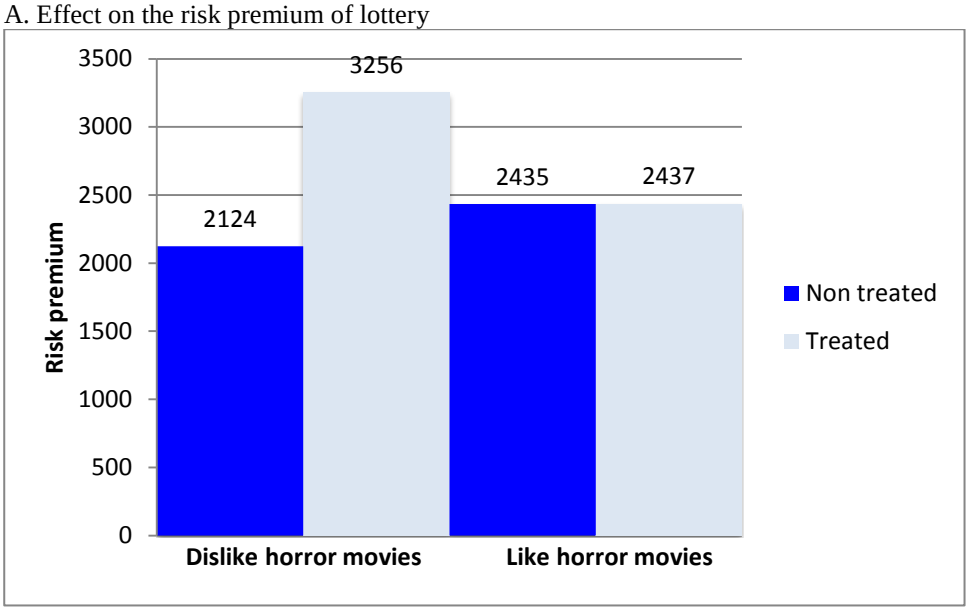


Figure 4: Effect of fear on risk aversion

The figure shows the average risk aversion of subjects "Treated" with the horror movies, or "Not treated.", for groups of subjects that differ in how much they like horror movies. "Like horror movies" is calculated from a survey measure asking subjects whether they like horror movies in a scale ranging from 0 to 100 increasing in liking. Subjects who replied with a value of 20 (the median) or more are classified as liking horror movies. "Dislike horror movies" is the group that report less than 20 in liking of horror movies; Panel A shows the effect on the risk premium of the lottery; Panel B presents the effect on the risky investment choice. *** indicates statistical significance at the 1% level.

A. Effect on the risk premium of lottery



B. Effect on preference for low risk/low return investments

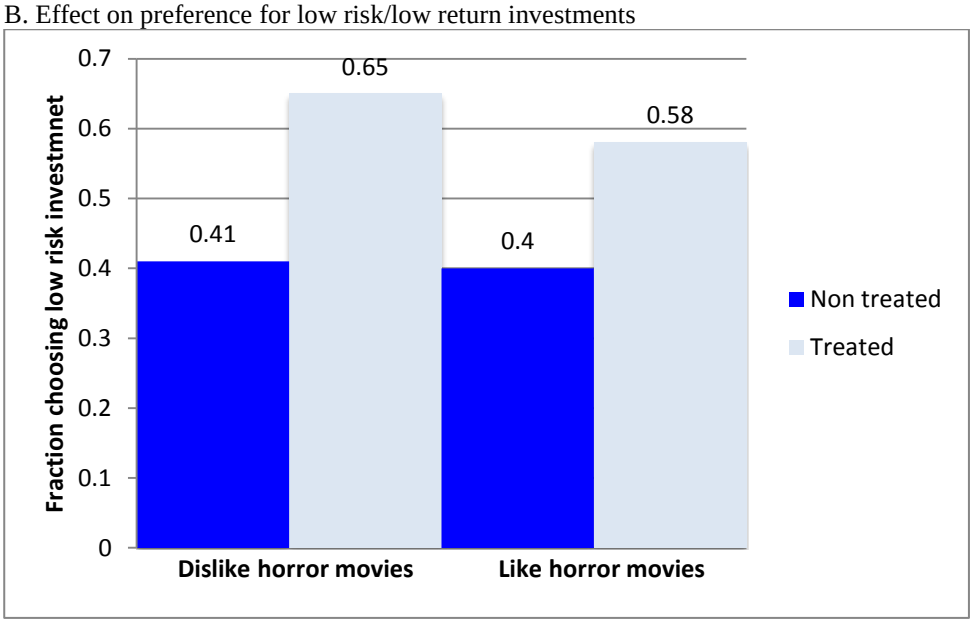


Table I: Comparing the sample of non-participants and participants to the second interview

This table shows summary statistics for a set of variables for the two samples of respondents to the 2007 bank survey: those that did not participate to the 2009 survey and those who did. The third column reports the p-value for the null that the means of the two samples are the same. The variables are defined in the appendix.

	Non participants (N. 1,020)	Participants (N. 666)	*p*-value of test of equality
Age	55.02	54.5	0.39
Male	0.7	0.7	0.77
Married	0.69	0.67	0.40
North	0.53	0.49	0.12
Center	0.24	0.25	0.61
Education	12.44	13.18	0.00
Trust Advisors 2007	2.25	2.17	0.05
Qualitative measure of risk aversion	2.88	2.85	0.31
Quantitative measure of risk aversion: risk premium	865	792	0.66
Financial Asset 2007	150,980	158,950	0.22
Financial Asset 2009	139,720	142,290	0.73
Stockownership Jan 2007	0.44	0.44	0.93
Stockownership Jun 2009	0.41	0.42	0.80
Share in Stocks Jan 2007	0.1	0.11	0.54
Share in Stocks Jun 2009	0.08	0.08	0.51
Risky Assets Ownership Jan 2007	0.79	0.81	0.41
Risky Assets Ownership Jun 2009	0.74	0.73	0.63
Risky Assets Share Jan2007	0.56	0.58	0.29
Risky Assets Share Jun 2009	0.50	0.50	0.90

Table II: Summary statistics of risk aversion measures, other variables and controls

Panel A reports the summary statistics for the risk aversion measures. The qualitative measure of risk aversion elicits the investment objective of the respondent, offering them the choice among "Very high returns, even at the risk of a high probability of losing part of the principal;" A good return, but with an ok degree of safety of the principal;" "A ok return, with good degree of safety of the principal," "Low returns, but no chance of losing the principal." The responses are coded with integers from 1 to 4, with a higher score meaning a higher risk aversion. The quantitative measure of risk aversion is calculated by eliciting the certainty equivalent for a gamble that delivers either 10,000 euro or zero with equal probability; the risk premium is then obtained as the difference between the expected value of the gamble (5,000 Euro) and each respondent's certainty equivalent. Panel B, C and D report the summary statistics for all the other variables used later in estimates and defined in the Appendix.

A. Risk aversion measures in 2007 and 2009

	Quantitative measure (risk premium in euros)			Qualitative measure		
	Mean	Median	Sd	Mean	Median	Sd
Level in 2007	792	1,000	3,248	2.87	3	0.72
Level in 2009	2,215	3,500	2,815	3.28	3	0.73
Change 2009/2007	1,423	2,500	3,994	0.42	0	0.81
Fraction of People with Increase in Risk Aversion		0.55			0.46	
Fraction of People with Unchanged Risk Aversion		0.18			0.44	
1- Fraction of People with a decrease in Risk Aversion		0.73			0.90	

B. Other variables: levels

	Mean	Median	Sd
Male	0.70	1	0.46
Age	54.81	57	12.3
Educations (years)	12.73	13	4.25
Retired	0.33	0	0.47
Government Employee	0.33	0	0.47
Log Net Wealth: 2007	13.11	13.10	0.59
Log Net Wealth: 2009	13.05	13.03	0.64
Risky Asset Ownership 2007	0.79	1	0.40
Risky Asset Share 2007	0.57	0.70	0.37
Knightian Uncertainty	0.29	0	0.46
Trust Advisors 2007	3.78	4	0.91
Change in cautiousness	2.13	2	0.90

C. Other variables: first differences

	Mean	Median	Sd
Δ Log Net Wealth 2009-2007	-0.06	-0.051	0.27
Δ Log Net Wealth 2009-2008	-0.04	-0.005	0.20
Δ Ownership of Risky Assets	-0.06	0	0.35
Δ Share Risky Assets	-0.04	0	0.24
Δ in Advisors Trust	-0.23	0	1.11
Δ in Expected Stock Return	819	47	6,626
Δ in Range Stock Market Return	-144	50	5,674

Panel D. Variables in the rebalancing equation

	Mean	Median	Sd
Risk aversion ratio: $[\frac{\gamma_i}{\gamma_i^*}-1]\omega_i^M$	-0.05	0.0	0.21
Mean risky asset share 2007: ω_i^M	0.52	0.59	0.36
Post shock share: $[\frac{p\omega_i^M}{p\omega_i^M+1-\omega_i^M}]$	0.65	0.72	0.28

Table III: Correlation between the various measures of risk aversion

The table reports the correlation between the two measures of risk aversion for the two waves 2007 and 2009, the correlation between their changes, and the correlations between their changes and a measure of change in cautiousness in investing defined in the Appendix.

	Correlations between measure of risk aversion				
	Qualitative and quantitative indicator: 2007	Qualitative and quantitative indicator: 2009	Change in qualitative and change in quantitative indicator: 2007-2009	Change in qualitative indicator and change in cautiousness	Change in quantitative indicator and change in cautiousness
	0.116	0.160	0.118	0.119	0.074
p-value	0.00	0.00	0.002	0.002	0.056

Table IV: Validation

Panel A, Columns 1 and 2 report estimates of an ordered probit model where the dependent variable is the qualitative measure of risk aversion for the two different waves, 2007and 2009. Columns 3 and 4 report interval regressions; the dependent variable is the interval of the risk premium obtained from the lottery question as described previously divided by the expected value of the lottery.

Panel B reports marginal effects of probit models, where the dependent variable is a dummy variable equal to one if the individual holds risky assets in her portfolio. The quantitative indicator of risk aversion is the risk premium defined in previously divided by 5000 (the expected value of the lottery) in 2007. The last column reports the results eliminating individuals who reported inconsistent answer to the risk aversion question (those who are highly risk averse according to the first measure - a value greater than 2 - but risk lover on the basis of the quantitative question - a certainty equivalent greater or equal to 9000 euro).

Panel C reports the marginal effects for ordered probit regressions; the dependent variable is the change in a dummy variable equal to one if an individual owns risky assets between June 2009 and June 2008 (just before the financial collapse). The change in risk aversion is calculated as the difference between the reported answers in the 2009 and 2007 surveys. The change in the quantitative indicator of risk aversion is the change in risk premium divided by 5000 (the expected value of the lottery). All the other variables are defined in the Data Appendix. Robust standard errors are in brackets. */**/*** indicates statistical significance at the 10%, 5%, and 1% level. In panel C, changes in wealth have been trimmed out at the first and ninety-ninth percentile.

A. Cross sectional correlates of risk aversion

	Risk aversion qualitative		Risk aversion quantitative			
			Whole sample		Eliminate inconsistent answers	
	2007	2009	2007	2009	2007	2009
Male	-0.338***	-0.497***	0.006	0.150**	-0.031	0.011
	(0.063)	(0.109)	(0.046)	(0.075)	(0.041)	(0.059)
Age	-0.047**	-0.011	-0.001	0.026	0.010	0.031*
	(0.020)	(0.032)	(0.014)	(0.021)	(0.013)	(0.017)
Age2/100	0.049***	0.020	0.008	-0.015	-0.004	-0.022
	(0.019)	(0.031)	(0.014)	(0.021)	(0.012)	(0.017)
Education	-0.035***	-0.044***	-0.013**	-0.010	-0.021***	-0.016***
	(0.007)	(0.012)	(0.005)	(0.008)	(0.005)	(0.006)
Log Net Wealth: 2007	-0.139***		-0.057		-0.042	
	(0.047)		(0.036)		(0.033)	
Log Net Wealth: 2009		-0.147**		0.013		0.001
		(0.074)		(0.050)		(0.040)
Observations	1,494	584	1,494	584	1,311	548

B. Risk aversion and risky assets ownership

	Whole sample		Eliminate inconsistent answers
	(1)	(2)	(3)
Risk Aversion Qualitative: 2007	-0.122***		
	(0.032)		
Risk Aversion Quantitative: 2007		-0.001	-0.055***
		(0.005)	(0.004)
Male	0.129***	0.154***	0.162***
	(0.016)	(0.028)	(0.027)
Age	0.022**	0.025***	0.026***
	(0.010)	(0.008)	(0.009)
Age2/100	-0.020**	-0.023***	-0.023***
	(0.009)	(0.007)	(0.008)
Education	0.018***	0.020***	0.019***
	(0.005)	(0.002)	(0.002)
Trust Advisor 2007	0.039***	0.047***	0.049***
	(0.011)	(0.007)	(0.008)
Log Net Wealth: 2007	0.145***	0.152***	0.137***
Observations	1,494	1,464	1,311

C. Effect of changes in risk aversion on changes in ownership of risky assets

	Whole sample		Eliminate inconsistent answers
	(1)	(2)	(3)
Δ Risk Aversion: Qualitative Measure	-0.172		
	(0.105)		
Δ Risk Aversion: Quantitative Measure		-0.154*	-0.243**
		(0.088)	(0.100)
Male	0.367**	0.379**	0.308
	(0.172)	(0.171)	(0.189)
Age	0.074	0.071	0.070
	(0.062)	(0.062)	(0.070)
Age2/100	-0.069	-0.066	-0.071
	(0.058)	(0.058)	(0.065)
Education	0.006	0.008	0.011
	(0.019)	(0.020)	(0.020)
Δ in Advisor Trust	-0.065	-0.082	-0.088
	(0.072)	(0.072)	(0.082)
Δ Log Net Wealth 2009-2007	1.467***	1.351***	1.214***
	(0.371)	(0.366)	(0.462)
Observations	569	569	500

Table V: Aggregate risk aversion

This table computes measures of the aggregate absolute risk aversion for the two sample years 2007 and 2009 using as weights the total net wealth of the individuals in the sample. The absolute risk aversion measure is obtained from the elicited risk premium assuming an exponential utility function.

	Total sample *Wealth weights:*		Stockholders *Wealth weights:*	
	2007	2009	2007	2009
ARA 2007	1.30	1.30	1.22	1.22
ARA 2009	2.28	2.25	2.42	2.40
Change in ARA	0.98	0.95	1.20	0.98

Table VI: Portfolio rebalance

Panel A reports regressions where the dependent variables is the flow of risky assets bought (positive) or sold (negative) in the three months following the period specified in each column scaled by the value of total financial assets at the end of August 2008, prior to the Lehman Brothers collapse. The risk aversion ratio is the ratio between the risk aversion before and after Lehman collapse multiplied by the average share of risky assets in 2007; the mean risky asset share is computed as the average share in risky assets over the months from January to December 2007. The post shock share is the risky share implied by the level of the risky asset price at the various dates specified in the columns after the collapse of Lehman. Robust standard errors are in brackets. */**/*** indicates statistical significance at the 10%, 5%, and 1% level. Change in wealth is computed as the log difference in the value of net wealth in the second quarter of 2009 and the value in the second quarter of 2008. Changes in wealth have been trimmed out at the first and ninety-ninth percentile.

	(1) September 08	(2) October 08	(3) November 08	(4) December 08	(5) January 09	(6) February 09
Risk aversion ratio: $[\frac{\gamma_i}{\gamma_i'}-1]\omega_i^M$	0.048**	0.043*	0.036	0.077**	0.088**	0.083*
	(0.023)	(0.026)	(0.027)	(0.036)	(0.038)	(0.044)
Mean risky asset share 2007: ω_i^M	0.005	0.015	-0.001	0.001	0.006	-0.000
	(0.012)	(0.015)	(0.017)	(0.020)	(0.022)	(0.024)
Post shock share: $[\frac{p\omega_i^M}{p\omega_i^M+1-\omega_i^M}]$	-0.029**	-0.028	-0.016	-0.030	-0.044*	-0.033
	(0.013)	(0.017)	(0.019)	(0.021)	(0.024)	(0.025)
Male	-0.005	-0.020	-0.026*	-0.028*	-0.034**	-0.031*
	(0.010)	(0.013)	(0.014)	(0.015)	(0.016)	(0.017)
Age	0.007**	-0.001	0.002	-0.000	-0.001	-0.003
	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Age2	-0.007**	0.001	-0.002	0.000	0.001	0.003
	(0.003)	(0.005)	(0.006)	(0.006)	(0.006)	(0.007)
Education	0.001	0.001	0.002	0.002	0.003	0.002
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Δ Log Net Wealth 2009-2008	0.221***	0.313***	0.309***	0.342***	0.383***	0.450***
	(0.072)	(0.087)	(0.089)	(0.088)	(0.091)	(0.099)
Observations	502	502	502	502	502	502
R-squared	0.087	0.098	0.089	0.101	0.123	0.124

Table VII: Background risk and expectations about future income

Panel A computes changes in the qualitative and quantitative measures of risk aversion for groups non-exposed (government employed retired) and exposed (non-government employees and non-retired) to background labor income risk among investors facing no financial losses. The third and sixth column computes the difference between the two groups and the p-value of the null hypothesis that the difference is zero (in brackets). The lower part of Panel A computes mean changes and differences in mean changes for the sample of those with no financial losses that keep all their financial assets at the bank. Panel B does a similar calculation for the groups whose permanent income should respond more (the younger) or less (the older) for two subsamples: (a) respondents who had no losses during the crisis and (b) respondents with no losses and all their financial assets at the bank

A. Background risk

	No financial losses					
	Government employees (Nobs=96)	Non-Government employees (Nobs=180)	Difference (p-value)	Retired (Nobs=94)	Non retired (Nobs=201)	Difference (p-value)
Change in qualitative measure	0.479	0.399	0.085 (0.420)	0.468	0.423	0.045 (0.661)
Change in quantitative measure (risk premium/5000)	0.316	0.318	-0.002 (0.989)	0.423	0.275	0.149 (1.132)
	No financial losses and all assets at bank					
	Government employees (Nobs=65)	Non-Government employees (Nobs=105)	Difference (p-value)	Difference (p-value)	Non retired (Nobs=118)	Difference (p-value)
Change in qualitative measure	0.477	0.291	0.182 (0.193)	0.440	0.358	0.091 (0.491)
Change in quantitative measure (risk premium/5000)	0.330	0.299	0.030 (0.811)	0.397	0.285	0.112 (0.361)

B. Expected future income: Sample no losses

	No financial losses			**No financial losses and all assets with bank**		
	Age<=45 (Nobs=70)	Age>=65 (Nobs=48)	Difference (p-value)	Age<=45 (Nobs=41)	Age>=65 (Nobs=34)	Difference (p-value)
Change in qualitative measure	0.358	0.438	-0.081 (0.585)	0.255	0.415	-0.159 (0.400)
Change in quantitative measure (risk premium/5000)	0.189	0.388	-0.199 (0.134)	0.132	0.370	-0.238 (0.161)

Table VIII: Controlled regression

Panel A reports ordered probit estimates for the first difference of the qualitative measure of risk aversion. Panel B reports interval regressions estimates for the changes in the risk premium scaled by the expected value of the lottery. All the other variables are defined in the Data Appendix. Robust standard errors are in brackets. */**/*** indicates statistical significance at the 10%, 5%, and 1% level. Change in wealth is computed as the log difference in the value of net wealth in the second quarter of 2009 and the value in the second quarter of 2008. Changes net wealth have been trimmed out at the first and ninety-ninth percentile.

A. Change in qualitative indicator (ordered probit)

	(1)	(2)	(3)	(4)	(5)
Risk Aversion Qualitative: 2007	-1.159***	-1.068***	-1.161***	-1.066***	-1.164***
	(0.089)	(0.101)	(0.089)	(0.100)	(0.088)
Male	-0.417***	-0.307**	-0.417***	-0.306**	-0.346***
	(0.113)	(0.143)	(0.112)	(0.142)	(0.113)
Age less or equal to 45	-0.528	-0.324	-0.512	-0.310	-0.448
	(0.401)	(0.425)	(0.404)	(0.429)	(0.410)
Age greater or equal to 65	-0.458	-0.418	-0.447	-0.409	-0.412
	(0.404)	(0.430)	(0.407)	(0.433)	(0.413)
Education	-0.042***	-0.035**	-0.043***	-0.036**	-0.038***
	(0.013)	(0.016)	(0.013)	(0.016)	(0.013)
Size of financial loss	0.541	0.504			
	(0.608)	(0.721)			
Δ Log Net Wealth 2009-2008			0.396	0.294	0.394
			(0.434)	(0.492)	(0.449)
Retired	0.112	0.174	0.109	0.169	0.094
	(0.118)	(0.142)	(0.118)	(0.142)	(0.118)
Government employee	0.113	0.171	0.112	0.168	0.098
	(0.106)	(0.121)	(0.106)	(0.122)	(0.106)
Δ in Expected Stock Return		0.000		0.000	
		(0.000)		(0.000)	
Δ in Range Stock Market Return		-0.000		-0.000	
		(0.000)		(0.000)	
Knightian uncertainty					0.449***
					(0.110)
Observations	533	390	533	390	533

B. Quantitative indicator of RA, interval regressions

	(1)	(2)	(3)	(4)	(5)
Risk Aversion Quantitative: 2007	-0.863***	-0.830***	-0.861***	-0.832***	-0.861***
	(0.044)	(0.050)	(0.045)	(0.052)	(0.045)
Male	0.141**	0.150*	0.140**	0.149*	0.152**
	(0.063)	(0.082)	(0.063)	(0.082)	(0.064)
Age less or equal to 45	0.040	0.161	0.042	0.164	0.054
	(0.185)	(0.168)	(0.184)	(0.169)	(0.191)
Age greater or equal to 65	0.133	0.262	0.135	0.268	0.143
	(0.187)	(0.173)	(0.185)	(0.173)	(0.192)
Education	0.002	0.007	0.002	0.008	0.003
	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)
Size of financial loss	-0.183	-0.426			
	(0.326)	(0.363)			
Δ Log Net Wealth 2009-2008			-0.208	-0.353	-0.206
			(0.200)	(0.247)	(0.202)
Retired	0.075	0.026	0.076	0.028	0.075
	(0.057)	(0.067)	(0.057)	(0.067)	(0.057)
Government employee	0.011	-0.019	0.011	-0.016	0.008
	(0.049)	(0.058)	(0.050)	(0.058)	(0.050)
Δ in Expected Stock Return		-0.000		-0.000	
		(0.000)		(0.000)	
Δ in Range Stock Market Return		-0.000		-0.000	
		(0.000)		(0.000)	
Knightian uncertainty					0.068
					(0.053)
Observations	468	336	468	336	468

Table IX: Experimental evidence: comparison between the group of treated and untreated

This table shows the summary statistics for treated and untreated subjects in the experiment run at Northwestern University and *t*-tests for the differences (last column). The risk aversion measures are elicited as described in Table II. The indicator for low risk investment is constructed from the qualitative question, setting it equal to 1 if the person chose "A OK return, with good degree of safety of my principal" or "Low returns, but no chance of losing my principal," and zero otherwise. */**/*** indicates statistical significance at the 10%, 5%, and 1% level

Variable	Obs. Tot.	Mean treated	Mean non-treated	Difference
Quantitative Measure of Risk Aversion (Risk Premium)	207	3,198	2,526	672**
Qualitative Measure of Risk Aversion	210	2.54	2.41	0.13
Low Risk Investment	210	0.53	0.39	0.14*
Male	206	0.39	0.34	0.05
Age	203	19.77	19.83	-0.06
Caucasian	206	0.41	0.40	0.01
Income (Thousands of dollars)	210	111.68	120.96	- 9.28