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WHO LOST THE MOST?
FINANCIAL LITERACY, COGNITIVE ABILITIES, AND THE FINANCIAL CRISIS

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Who lost the most?
Financial Literacy, Cognitive Abilities, and the
Financial Crisis[*]

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Abstract

We study how and to what extent private households are affected by the recent financial crisis and how their financial decisions are influenced by this shock. Our analysis reveals that individuals with low levels of financial literacy are less likely to have invested in the stock market and thus are less likely to report losses in wealth. Yet, individuals with low financial literacy are more likely to sell their assets which lost in value (realize losses). This reaction to short-term losses has potential long-term consequences if individuals do not participate in markets' recovery and face lower returns in the long run.

1   Introduction

The recent financial downturn and economic crisis provided a major challenge for financial institutions, politicians, companies and private households around the world. We use the financial crisis as a natural experiment to study to what extent private households are affected and how they react to such a shock? Are financially literate and individuals with higher IQ better prepared to shield themselves from shocks like the financial and economic crisis? This question is difficult to assess because individuals with higher levels of expertise are more likely to invest in risky assets, which were particularly affected by declines in value during the financial crisis. Therefore we do not only focus on the losses in wealth individuals incurred during the crisis but additionally analyze if households realized their losses for sure by selling assets.

Our analysis is based on SAVE, a representative panel of German households that contains very detailed information on their financial and socio-economic situation as well as financial literacy and cognitive abilities. We use information from the surveys conducted in the early summers of 2007, 2008, and 2009 and make extensive use of a special module of questions regarding the financial crisis that was added to the questionnaire in 2009. Germany is particularly suited for our analysis because there was no housing or mortgage crisis in 2007/2008. Thus, the losses (or gains) in wealth of households are purely related to the composition of financial portfolios and their adjustments in the course of the crisis. While households with a large share of equity in their portfolio are likely to have suffered from the economic downturn, households could gain higher returns on time deposits, saving accounts and government bonds at the same time.[1]

Our analysis reveals that individuals with low levels of financial knowledge are less likely to have invested in the stock market and are therefore less likely to report losses in wealth due to the financial crisis. Thus, we confirm the finding by Calvet et al. (2007) and van Rooij et al. (2007) that individuals with low levels of financial knowledge stay out of risky assets. We find no effect of financial literacy and IQ on the size of the loss conditional on participation in risky asset markets. However, individuals with lower levels of financial expertise sold the assets which have lost in value with a

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[1]The German DAX, which measures the development of the 30 largest and best-performing companies on the German equity market and represents around 80% of the market capital authorized in Germany (http://deutsche-boerse.com) dropped by about 40% during 2008. In contrast to this the returns on private deposits with a duration of less than 2 years increased from an average of 3.6% in 2007 to an average 4.25% in 2008 (http://www.bundesbank.de/statistik).

higher likelihood. This means that they did not only incur paper losses but realized their losses for sure. This reaction to a shock like the financial crisis potentially has substantial consequences for wealth distribution. Households with less financial expertise and cognitive abilities did not participate in markets' recovery. Moreover, if individuals shy away from risky investments or feel confirmed in their scepticism towards financial markets, they will face lower long-term returns.

The paper is organized as follows: In section 2 we give a brief overview of the literature on household investment behavior and develop our hypotheses. Section 3 describes the SAVE data and the variables used for our analysis. In section 4 we report our empirical results. We conclude in section 5 with a brief discussion.

2 Related Literature and Hypotheses

2.1 Stock Market Participation

One of the central findings of capital market theory is that every household should invest part of their wealth in risky assets in order to profit from the risk premium.[2] Over the life-cycle the absolute amount of assets held in stocks should increase until retirement and decrease thereafter. Without fixed cost of stock market participation the relative amount of stocks in the portfolio should decrease with age; young investors should hold 100% of their assets in stocks.[3] These results persist even when controlling for income risk and other background risks.[4] Empirical examinations of households' portfolio choice reveal that many households do not hold equity.[5] This phenomenon is known as the stock market participation puzzle. One of the arguments put forward to explain the

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[2]This result is based on Markowitz (1952), Merton (1969, 1971), and Samuelson (1969). For a comprehensive overview of the literature on strategic asset allocation see Campbell and Viceira (2003) as well as Curcuru et al. (2004).

[3]See Campbell and Viceira (2003) based on Campbell et al. (2001).

[4]See e.g.Cocco et al. (2005), Curcuru et al. (2004).

[5]See e.g. Mankiw and Zeldes (1991), Haliassos and Bertaut (1995), Guiso et al. (2003), and Christelis, Jappelli and Padula (2010) for international evidence. Börsch-Supan and Essig (2003) find that only around 17% of German households directly participate in the stock market. The amount would increase when including indirect stock holdings, however, the authors argue that there is a large overlap between direct and indirect stock holders. Christelis, Geogarakos and Haliassos (2010) find that around 25% of the households older than 50 in Germany own stocks directly or indirectly. Based on aggregate data, Ramb and Scharnagl (2010) report that the share of direct equity holdings in German households' portfolios moved around 5% since the burst of the "dot com bubble" in 2000. The fraction of mutual funds in portfolios was around 14% in recent years.

reluctance of households to invest in risky assets is the existence of fixed participation cost (e.g., Mankiw and Zeldes (1991), Haliassos and Bertaut (1995), Vissing-Jorgensen (2002, 2003), and Calvet et al. (2007)). Mankiw and Zeldes (1991) find that stock market participation increases with income and education. They argue that this is in line with the existence of participation cost because, firstly, high income households have larger portfolios and can afford to pay the fixed participation cost, and secondly, the cost of information acquisition is lower for highly educated households. However, they also find that even among households with more than $100,000 of liquid assets participation in equity is below 50% and conclude that information cost must be substantial or non-economic reasons influence households' behavior. The introduction of a fixed cost of stock market participation in the model of Campbell and Viceira (2003) merely shifts stock market entry to later ages but does not fundamentally change the predictions of the model. Vissing-Jorgensen (2002) and (2003) estimates that a fixed participation cost of around 50 dollars in 2003 can explain non-participation of half the households in her sample. Andersen and Nielsen (2010) find that fixed entry and participation costs in monetary terms can account for roughly one third of non-participation in the stock market. They conclude that participation seems to be influenced by other factors like for example behavioral biases and cognitive abilities. The authors show that the probability of participation in the stock market after a windfall gain is significantly higher for educated and financially literate individuals. This is in line with other studies which find evidence that in particular individuals with lower financial knowledge and lower cognitive abilities are less likely to participate in the stock market.[6] In particular, Grinblatt et al. (2010) find evidence that even among the most affluent individuals higher IQ increases stock market participation. This implies that individuals with high financial literacy and high cognitive abilities face lower cost of acquiring information and thus lower participation cost than individuals who know little about financial markets and have low cognitive abilities. In addition to this, Calvet et al. (2007) suggest that individuals with low financial literacy might be aware of their weakness and stay out of risky markets to avoid investment mistakes like for example under-diversification. Furthermore, individuals who invest in the stock market have an incentive to acquire knowledge and thus participants have higher levels of financial literacy than non-participants. More-

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[6]See e.g. Guiso and Jappelli (2005), Calvet et al. (2007), van Rooij et al. (2007), Christiansen et al. (2008), Christelis, Jappelli and Padula (2010), McArdle et al. (2009), Cole and Shastry (2009), and Grinblatt et al. (2010).

over, McArdle et al. (2009) and Cole and Shastry (2009) propose several alternative mechanisms through which cognitive abilities and financial education could be related to financial market participation. For example, time preferences simultaneously influence the investment in education and saving behavior. Thus, it is hard to determine causality. However, for our analysis the mechanism that drives stock market participation of households is only of secondary importance. Assuming that the financial crisis was an unanticipated exogenous shock, financial losses of individuals should be closely related to stock market participation and thus, our first hypothesis on the effect of the crisis is:

Hypothesis 1: Households with higher financial literacy/cognitive abilities are more likely to hold risky assets in their portfolio (select portfolios with a higher expected return at higher risk). Thus, they are more likely to incur losses due to the financial crisis.

2.2 Under-Diversification and other Investment Mistakes

There is a growing literature which investigates the relationship between financial investment mistakes, cognitive abilities and financial literacy. The central finding is that individuals with lower cognitive abilities and lower financial knowledge are more likely to suffer from biases and make investment mistakes.[7] Kimball and Shumway (2010) suggest that the most plausible reason is that more financially literate investors are better informed and therefore are better at managing their portfolios.

One of the most investigated deviations of investors from optimal behavior is lack of diversification.[8] In their comprehensive study of 60,000 US brokerage accounts Goetzmann and Kumar (2008) for example find that on average investors hold under-diversified portfolios. The degree of diversification increases with age, income, education, and sophistication.[9] Specifically, they find that under-diversified investors overestimate specific industries, and local stocks, and are sensitive to past returns. Their annual returns were on average 2.4% lower than those of diversified investors. Kimball and Shumway (2010) discover that financially literate investors are less likely to apply naive diversification

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[7]See, e.g., Benjamin et al. (2006), Agarwal et al. (2009), Kimball and Shumway (2010).

[8]See, e.g., Blume and Friend (1975), Moskowitz and Vissing-Jorgensen (2002), Vissing-Jorgensen (2003), Campbell (2006), Calvet et al. (2007), Goetzmann and Kumar (2008).

[9]They define sophisticated investors as those who "trade options, engage in short-selling, and have greater investment experience" (p.435).

heuristics, like the 1/n rule. Moreover, they invest fewer amounts of their assets in stocks of the company they work for; and they are less frequently suffering from a home bias. Guiso and Jappelli (2008) also find that a lack of diversification is related to a lack of financial literacy. They argue that financially illiterate investors are likely to undervalue the benefits from diversification—or even ignore them altogether—and additionally have difficulties to assess the correlation between their assets' returns. Thus, individuals with high financial knowledge hold a larger number of different assets in their portfolio. Similarly Grinblatt et al. (2010) find that individuals with higher IQ invest in a larger number of different stocks and are more likely to hold mutual funds in their portfolio.

Apart from this Goetzmann and Kumar (2008) find that investors with better diversification are also better at selecting stocks with higher returns, probably also because they are better informed. The authors identify a small group of active investors who are under-diversified and perform very well—most likely a group of very well informed investors. Grinblatt et al. (2009) observe that high IQ investors on average earn 11% higher returns than low IQ investors.

If financially literate investors are better at managing their portfolios in "normal times" they most probably were also better prepared during the financial crisis. Thus, we hypothesize:

Hypothesis 2a: Conditional on stock market participation, households with higher financial literacy/cognitive abilities are better at managing their portfolios. Thus, they suffer smaller losses as a percentage of their wealth.

On the other hand, Odean (1998) argues that overconfidence leads investors to overestimate the precision of their own evaluation of signals which leads them to hold portfolios that are more risky than the portfolios of non-overconfident investors with the same degree of risk aversion. Barber and Odean (2001) find that overconfident investors trade too much and thereby lower their returns. Furthermore, they find that men tend to be more overconfident than women with similar sophistication. If men on average hold riskier portfolios due to overconfidence compared to women, they should have incurred larger losses as a fraction of their wealth compared to their female counterparts. Therefore, we propose the following hypothesis:

Hypothesis 2b: Conditional on stock market participation, households with a male

decision maker are more likely to suffer from overconfidence compared to households with female decision makers with a similar degree of financial literacy and cognitive ability. Thus, men compared to women hold riskier portfolios and incur larger losses as a percentage of their wealth.

2.3 Portfolio Adjustments

The German stock market lost about 40% of its value in the course of 2008. On the aggregate level a strong tendency to shift from risky to less risky assets has been observed. Many investors sold their equity in particular at the trough of the crisis in October 2008 (Bundesverband Investment und Asset Management e.V. (2009)) and thus did not only incur paper losses but realized their losses. The re-balancing behavior of households has been subject to many examinations. A variety of different rational as well as irrational reasons for active re-balancing have been examined for example by Odean (1998), Coval and Shumway (2005), Locke and Mann (2005), Massa and Simonov (2005), and Calvet et al. (2009).

In order to understand the mechanisms that were driving individuals' reactions to the financial crisis, we have to examine their motives. It is unclear if the realization of losses can be seen as a financial investment mistake from an ex ante perspective. Ex post it seems that it would have been better not to sell assets which have lost in value but rather buy assets when prices were low and profit from markets' recovery.

We differentiate between selling assets due to constraints and portfolio re-balancing caused by a change in expectations. If individuals need their funds to buffer unexpected shocks to income due to the crisis, they might have to sell assets that lost their value.

Besides smoothing consumption, households might have adjusted portfolios due to a change in expectations. Some households might have realized their losses in order to reduce their (future) tax burden. Moreover, if households had an ex ante rule to sell their stock as soon as the value dropped below a certain threshold in order to avoid suffering from a disposition effect (holding losers too long and selling winners too soon), the selling of loser stocks might have been plausible. We expect that individuals with higher financial literacy and cognitive abilities are more likely to apply these strategies.

On the other hand, if households sold their risky assets because they expected the future returns to be lower permanently, they were not well informed. Households with

higher financial knowledge should have been better informed about the long-term development of future returns and thus were more likely not to sell their risky assets. Moreover, investors might have suffered from "myopic loss aversion" (investors give high weight to losses compared to gains and evaluate their portfolios too often) as argued by Benartzi and Thaler (2007) or were influenced by an atmosphere of panic. Benartzi and Thaler (2007) as well as Duflo and Saez (2003) find that particularly unsophisticated investors are strongly influenced by peer effects. Calvet et al. (2009) examine re-balancing behavior of Swedish households and observe that in particular financially sophisticated households were less likely to exit financial markets between 1999 and 2002 when the stock market declined. Assuming that financial sophistication is related to financial literacy and cognitive abilities one would expect individuals with low financial literacy/cognitive abilities to sell loser stocks more frequently.

Thus, we end up with two competing hypotheses:

*Hypothesis 3a: Households with **higher** financial literacy/cognitive abilities are more likely to realize their losses.*
and
*Hypothesis 3b: Households with **lower** financial literacy/cognitive abilities are more likely to realize their losses.*

The empirical analysis can contribute to clarify which of the two effects prevails.

3 Data

3.1 SAVE

We use SAVE, a panel of German households that contains detailed information on households' financial situation and socio-economic as well as psychological characteristics.[10] The analysis is based on the surveys conducted in the early summer of 2007, 2008, and 2009, and we make extensive use of a special module of questions regarding the financial crisis which was added to the questionnaire in 2009. In 2009 there are 2,222 households in the panel.

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[10]SAVE was first conducted in 2001 by the Mannheim Research Institute for the Economics of Aging (MEA). Consecutive waves were in the field in 2003/2004, and every year since 2005. A detailed description of the scientific background, design and results of the survey can be found in Börsch-Supan et al. (2009).

Due to item non-response, the SAVE data set is imputed using an iterative multiple imputation procedure based on a Markov-Chain Monte-Carlo method (Schunk (2008)). The goal of this procedure is to increase the efficiency of our estimates due to a larger number of observations and to reduce the item non-response bias that occurs if observations with and without missing values differ systematically. For our analysis, all five multiply imputed data sets are used and the results are derived using Rubin's method (Rubin (1987, 1996)). In the case of our explained variables (absolute and relative loss) and key explanatory variables (financial literacy and cognitive abilities), we do not use imputed values. Thus, our basic sample consists of 2,012 households. The socio-demographic characteristics of the sample are provided in Table C1 in the appendix.

All descriptive statistics are weighted and results are representative for the German population.[11] For the regression analyses no weights are used.[12]

3.2 Measuring Financial Losses

3.2.1 Reported Losses

Absolute Financial Losses. We measure losses due to the financial crisis by directly asking households. The question in SAVE 2009 was phrased in the following way: *Have you and /or your partner personally suffered losses in wealth due to the financial crisis? If yes, how high was your total loss in 2008 in Euros?*[13] At this point it is unclear if households reported paper or realized losses. However, we will elaborate on this in the course of our analysis.

About 79.5% of the households responded that they did not incur financial losses due to the crisis. 20.5% reported a loss. The average loss reported by households conditional on reporting a loss is 13,153 Euros. The median loss is 5,000 Euros. The distribution of losses is skewed to the right and is plotted in figure A1 in the appendix. The unconditional average loss of all households in Germany is 2,562 Euros. In comparison, the average loss of German households calculated on the basis of aggregate financial

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[11]The reference statistic to calibrate weights according to income and age classes is the German Mikrozensus. For a detailed description see Börsch-Supan et al. (2009), pp. 48-52.

[12]Deaton (1997) mentions that "when the sectors [sub populations] are homogeneous, OLS is more efficient, and when they are not, both estimators are inconsistent. In neither case is there an argument for weighting." (p. 70).

[13]We do not compare households' balance sheets at the end of 2007 and 2008 as the net wealth position of households can also be influenced by consumption-saving decisions and bequests, etc.

account statistics of the Deutsche Bundesbank is 3,105 Euros.[14] The difference may at least partly be explained by the fact that some households have not reported paper losses.

In order to evaluate how well households estimate their losses we simulate financial losses on the basis of their portfolios at the end of 2007. We apply the approach taken by Börsch-Supan et al. (2010), i.e., we use households' portfolio composition at the end of 2007 and apply average realized returns of these assets during 2008. We deduct the simulated wealth level at the end of 2008 from the wealth level at the end of 2007 to obtain paper losses and gains during 2008. To construct our simulated loss variable we exclude gains as our direct question only covered losses. According to the simulation about 29.6% of households in Germany were affected by losses in financial wealth. The difference compared to reported losses can be due to two reasons: First, some of the households did not report their paper losses when asked directly and some households might be unaware of the fact that they were affected by the financial crisis. We will comment on this aspect after we introduce measures of financial literacy and cognitive abilities. Second, in SAVE we have information on rather broad classes of assets. We calculated the returns on asset classes using average returns of these assets as we do not have information of the precise composition of households' portfolios. Thus, for some households the simulated loss might not reflect their true situation very well.

The average simulated loss of households is 2,658 Euro. This is quite close to the reported average loss of 2,562 Euros.[15] Conditional on reporting a loss the average simulated loss is 10,692 Euros, i.e. the value is below the average reported loss of 13,153 Euros. We also analyze the difference between simulated and reported losses on the individual level and find that about 13% report losses below the simulated loss and about 22% report losses above the simulated loss. For 64% of the respondent reported and simulated losses both are zero. Again the deviations can be due to misreporting of the households as well as due to the imprecise estimation of simulated returns to wealth during 2008. Overall, we come to the conclusion that households on average seem to have a plausible notion of their losses during the financial crisis. We will comment on the deviation in more details below.

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[14]Estimated on the basis of Deutsche Bundesbank (2009): Geldvermögen und Verbindlichkeiten der privaten Haushalte. Tabelle aus der Finanzierungsrechnung; http://www.bundesbank.de/statistik/statistik_wirtschaftsdaten_tabellen.php

[15]The correlation of simulated and reported losses is 0.52 (p-value 0.000).

Relative Financial Losses. We divide financial losses by households' total financial wealth at the end of 2007. Total financial wealth is constructed using deposits held in savings accounts, building savings contracts, fixed income securities, stocks, stock mutual and real estate funds, life insurance contracts, private and employer-based pension wealth as well as other financial assets. On average households lost about 3.6% of their gross financial wealth. Conditional on suffering a loss, households lost about 18.6% of their gross financial wealth. The median loss is 9.5%. Overall, about 9.2% of the households lost more than 10% and about 1.8% lost more than half of their financial assets. The average simulated loss relative to financial wealth at the end of 2007 is 3.7% which is again quite close to the reported one.

Additionally we relate losses to total wealth. Thus, we add housing and business wealth as well as other real assets (e.g. jewelery, antiques etc.) to our financial wealth variable. Related to their total gross wealth at the end of 2007, households on average lost 1.7% of their wealth. Conditional on reporting a loss, the fraction of total wealth lost is 8.9% with a median of 2.5%. 3.8% lost a fraction of wealth higher than 10% of all assets. Less than 1% of all households lost more than half of their total wealth.

3.2.2 Realized Losses

As a follow up question we asked respondents: *What did you do with the assets that lost in value? We kept the assets. / We sold some of the assets. / We sold all of them.*

This question was only asked conditional on reporting a loss. Thus, 458 households gave an answer to this question. 75.2% responded that they kept the loser assets in their portfolio. Thus, these households reported paper losses. 13.2% report that they sold all of the assets that lost in value and 11.6% sold at least some of them (see Table 1). For the analysis conducted later on we construct a variable equal to 1 if households sold some or all of their assets.

Table 1 also relates the absolute and relative losses of households to their reaction. We find that the average loss of households who kept their assets is little over 12,000 Euros. The average loss of households who sold some of the assets is almost twice as large (about 23,500 Euros). However, the loss of households who sold all their assets is only around 9,000 Euros. Investors who kept their assets on average lost 17.4% of their wealth which is about 23% less than the average relative losses of investors who sold some or all of their assets and who suffered an average relative loss of 22.5%.

Table 1: Households' Reaction to Financial Losses

This table contains the frequency and the proportion of respondents who gave the respective answers to the question "What did you do with the assets that lost in value?" Additionally the average loss and the average fraction of wealth lost are reported.

	Freq.	Percent	Mean Loss	Fraction of Wealth Lost
I/we kept the assets	344	75.2	12196	17.4%
I/we sold some of the assets	53	11.6	23518	22.5%
I/we sold all of them	61	13.2	9187	22.5%
Total	458	100.0	13153	18.7%

Source: SAVE 2009, data is weighted.

3.3   Measuring Financial Literacy

We measure financial sophistication using an "objective" —as opposed to a "subjective", i.e. self-assessed—measure of financial literacy. A set of three quiz-like questions was developed by Lusardi and Mitchell (2006) for the Health and Retirement Study in 2004. The questions are designed to assess the fundamental skills that are at the core of individual saving and investment decisions. In the meantime, the same (or very similar) questions were included in several household surveys around the world, including the German SAVE survey. Two of the questions are classified as measuring basic financial concepts (van Rooij et al. (2007)). The first question concerns the understanding of interest and requires the ability to calculate. The second question examines the understanding of the joint effects of interest and inflation. The third question is categorized as measuring advanced financial knowledge and deals with risk and diversification. The wording of the questions can be found in appendix D.

We use the answers to the financial quiz from the SAVE survey in 2007 because the financial crisis might have changed financial knowledge of households. The survey was conducted in the early summer of 2007 before the start of the financial crisis. In 2007 respondents were requested to answer financial literacy questions for the first time in SAVE.

Finally, we define two measures of financial literacy. We construct an index taking values 0 to 3 according to the number of correct answers given by each respondent. The answers given by the respondents are displayed in Table 2. The second variable is a dummy, which takes the value 1 if all questions were answered correctly and 0 otherwise. In our sample 53.2% of the respondents were able to answer all three financial literacy questions correctly, whereas 46.8% had a least one incorrect answer or "do not

know".[16] A comparison of these responses with results from earlier studies like Lusardi and Mitchell (2006) and van Rooij et al. (2007) is difficult due to the missing "do not know" option in SAVE. We compare the answers across countries on the basis of SAVE 2009 in Bucher-Koenen and Lusardi (2010).

Table 2: Financial Literacy 2007

This table contains the frequency and the proportion of respondents who were able to answer zero to three questions on the financial literacy task.

no. of correct answers	Freq.	Percent	Cum.
0	138	6.9	6.9
1	178	8.8	15.7
2	626	31.1	46.8
3	1070	53.2	100.0

Source: SAVE 2007, data is weighted according to sample weights 2009, N= 2012.

Previous analysis of financial literacy among SAVE respondents revealed that financial literacy is relatively low among women, individuals with low education, low income and individuals living in east Germany (Bucher-Koenen and Lusardi (2010)).

3.4 Measuring Cognitive Abilities

Cognitive abilities are measured using the cognitive reflection test (CRT) developed and tested by Frederick (2005). To our knowledge, SAVE is the first representative sample which contains this measure. The CRT consists of three quiz-like questions. All questions have an intuitive but incorrect answer and a correct answer that is a little more tricky to find. The CRT has been found to be a very efficient way to estimate cognitive abilities of individuals in questionnaires. It correlates well with more comprehensive intelligence tests. The wording of the questions can be found in appendix D.

The CRT was only introduced in the SAVE survey in 2009. However, there is no reason to assume that the crisis influenced cognitive abilities of our respondents. Thus we do not see any difficulty in using this data.

Similar to our measures of financial literacy we define a measure of cognitive abilities. We construct an index taking the values 0 to 3 corresponding to the number of correct answers given. The results can be found in Table 3. 43% of our respondents gave no correct answer. Around 20% gave one and 21% two correct answers. 15% of the

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[16]In the questionnaire 2007 the interest and the inflation question did not have a "do not know" option. For this reason we treat missing answers as "do not know" and do not drop them from the sample.

respondents were able to answer all three questions correctly. Moreover, we construct a dummy variable which takes the value 1 if all questions were correctly answered. The percentage of individuals with three correct responses in the study by Frederick (2005) ranges between 48% (sample of 61 students at Massachusetts Institute of Technology) and 5% (sample of 138 students at the University of Toledo). On average around 17% of the participants—mostly young university students—in his samples give three correct answers.

Table 3: Cognitive Reflection Test

This table contains the frequency and the proportion of respondents who were able to answer zero to three questions on the cognitive abilities task.

no. of correct answers	Freq.	Percent	Cum.
0	871	43.3	43.3
1	434	21.6	64.9
2	403	20.0	84.9
3	303	15.1	100.0

Source: SAVE 2009, data is weighted, N= 2012.

There is a significantly positive correlation (spearman rank correlation: 0.2899, p-value 0.000) between our measures of financial literacy and cognitive abilities. About 4.3% of the respondents answer none of the questions correctly and 11.2% give six correct answers. Financial literacy increases with cognitive capacity: Among those with low cognitive abilities (0 correct answers) 37% give three correct answers on the financial literacy task whereas among those with high cognitive abilities (3 correct answers) the probability of correctly answering all financial literacy questions is roughly 75%.

4 Empirical strategies and results

4.1 Who is affected by financial losses due to the crisis?

4.1.1 Model to test hypothesis 1

In section 2.1 we argued that the probability of incurring a financial loss during the crisis depends on whether the household invested in risky assets, which in turn depends on factors like participation cost, income volatility, and risk preferences. In order to test *hypothesis 1* we substitute the determinants of risky asset investment into the equation

to estimate the loss probability. Thus, we estimate the following reduced form probit:

$$L = \beta_0 + \beta_1 z + \beta_2 w + \beta_3 k + \beta_4 c + \epsilon. \tag{1}$$

Where L is an indicator equal to one if a household incurred a loss, z is a vector of socio-demographic variables, w is the log of gross financial wealth, k is financial literacy, and c is cognitive abilities. ϵ is a standard normal random error.

We proposed that households with high financial literacy/high cognitive abilities are more likely to hold risky assets in their portfolio and thus are more likely to incur losses due to the financial crisis.[17] Therefore, we expect β_3 and β_4 to be positive. The awareness of individuals of their exposure to risk during the crisis and the losses related to this might depend on the knowledge of individuals about their own financial situation which might again depend on their levels of financial literacy. However, it is unclear if individuals with lower levels of financial literacy are more likely to over- or underestimate their losses. An analysis of the deviations between reported and simulated financial losses with respect to financial literacy and cognitive abilities reveals that there are no systematic over- or under-estimations of the losses depending on abilities. Furthermore, there is no relation between financial literacy and the squared difference between simulated and reported losses, i.e. financially illiterate households are not deviating more strongly. Thus, we do not think that our estimates are systematically biased.

4.1.2 Empirical results: model 1

We restrict our analysis to households with positive gross financial wealth at the end of 2007 because only households with positive assets had something to lose during 2008. We have 1673 observations in the sample. As proposed in hypothesis one, households with high financial literacy are more likely to incur losses due to the financial crisis. Bi-variate analysis reveals that 13.6% of the households with a respondent who was unable to answer all financial literacy questions report to be affected by a loss in wealth as a result of the financial crisis. In contrast, 32.2% of the respondents who answered all questions correctly report financial losses. Moreover, the fraction of households suffering from

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[17]Figure B2 in the appendix shows relative stock market participation over percentiles of gross financial wealth for individuals with high and low financial literacy. It can be observed that the stock market participation of those with high financial literacy is higher compared to those with low financial literacy in the top 70% of the wealth distribution. There are no differences at the bottom, most likely due to budget limitations.

losses increases from 23.2% for low cognitive abilities (less than three correct answers) to 31% for high cognitive abilities (three correct answers).

To understand the effect of financial literacy and cognitive abilities on being affected by losses in wealth, we conduct multivariate regression as specified in equation 1. The results are reported in Table 4.

We measure financial literacy by using a dummy variable for three correct answers to the financial literacy task and cognitive abilities by using a dummy variable for three correct answers in the cognitive abilities task.[18] Furthermore, we include financial wealth at the end of 2007, income, education and whether individuals are non German as controls. These variables are used as proxies for the ability and willingness of households to incur fixed participation cost. Moreover, Campbell and Viceira (2003) argue that the participation in risky asset markets can be influenced by income risk of households. We include two variables to proxy income risk: one measure for subjective income volatility of households in the past 5 years[19] and one variable controlling for self-employment of the person answering the questionnaire. We also include a measure for risk aversion in the domain of financial matters.[20] We proxy diversification by including the number of asset categories that households own at the end of 2007 and we include a dummy equal to one if households consulted a financial advisor. Additionally, controls for age, living in east Germany[21], living in a rural region, being retired and gender are included.

Our regression reveals that financially literate individuals have a more than 11% higher chance to incur a loss during the crisis compared to financially illiterate respondents (significant at 1%). Therefore, hypothesis 1 is confirmed with respect to the effect of financial literacy. The effect of cognitive abilities is insignificant. Besides, the probability to report losses increases with age, financial wealth, the number of asset categories and risk preferences and with consulting a financial advisor. It decreases if households

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[18]All our results maintain for alternative definitions of cognitive abilities and financial literacy. More specifically, we ran regressions using variables taking values from 0 to 3 for cognitive abilities and financial literacy, respectively.

[19]The wording of the question is: "Over the past five years did your personal income fluctuate considerably, fluctuate somewhat, or not fluctuate at all?"

[20]The wording of the question is: "To what extent do the following statements apply to you? Please answer on a scale from 0 to 10, where 0 means "does not apply at all" and 10 means "applies very well". I do not mind taking risks with respect to financial matters." Dohmen et al. (2010) establish the predictive validity of this measure. We take the measure from SAVE 2008, i.e. it is measured in spring 2008.

[21]There are still substantial differences in the economic situation between the former communist and non-communist part of Germany, thus it seems appropriate to control for these structural differences.

Table 4: Probit "Financial Loss"

This table reports the effect of cognitive abilities, financial literacy, and various covariates on reporting a loss due to the financial crisis. The dependent variable is a dummy that indicates if a household incurred a loss in wealth due to the financial crisis. We report marginal effects after estimating a probit evaluated at the median of all variables and the respective standard errors. Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Cognitive abilities and financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used. Model 1 contains all households with positive financial assets (N=1,673). Model 2 contains all households (N=2,012).

	Model 1		Model 2	
	dy/dx	se	dy/dx	se
Cognitive abilities 3 (d)	0.006	0.023	0.022	0.019
Financial literacy 3 (d)	0.114***	0.027	0.087***	0.023
Age: 35 and younger (d)	-0.003	0.034	-0.024	0.027
Age: 36-50 (d)	Ref.	Ref.	Ref.	Ref.
Age: 51-65 (d)	0.049**	0.022	0.061***	0.017
Age: 66 and older (d)	0.078***	0.026	0.086***	0.020
Log financial wealth 2007	0.054***	0.012	0.013***	0.005
Men (d)	-0.026	0.018	-0.024	0.016
Living in east Germany (d)	0.006	0.022	-0.002	0.017
Low level of schooling (d)	Ref.	Ref.	Ref.	Ref.
Intermediate schooling (d)	-0.001	0.024	-0.008	0.019
High schooling (d)	0.006	0.024	0.006	0.019
Log monthly net income	0.005	0.021	0.021	0.016
Number of asset categories	0.030***	0.005	0.030***	0.005
Risk preferences	0.021***	0.004	0.017***	0.004
Financial advisor (d)	0.066***	0.019	0.053***	0.015
High income volatility (d)	0.029	0.023	0.017	0.018
Self-employed (d)	0.044	0.033	0.038	0.026
Living in a rural region (d)	-0.083***	0.032	-0.061**	0.025
non German (d)	0.127	0.088	0.082	0.064
retired (d)	0.032	0.029	0.022	0.022
N	1673		2012	
R2	0.21		0.22	

Source: SAVE 2007 to 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

18

live in a rural region.

Our results are robust to including all households (Model 2). Again we find that individuals with higher financial literacy are more likely to be affected by losses in financial wealth.

4.2 Who lost the most?

4.2.1 Model to test hypothesis 2

In section 2.2 we proposed that households better at managing their portfolios should incur smaller losses relative to their financial wealth. The ability to manage ones portfolio in turn depends on financial knowledge and cognitive capacity. In order to test *hypothesis 2* we estimate a model of the form:

$$l = \beta_0 + \beta_1 z + \beta_2 r + \beta_3 k + \beta_4 c + \beta_5 m + \lambda + \epsilon. \tag{2}$$

Where $l = loss/w_{07}$ is the loss relative to financial wealth at the end of 2007, z is a vector of socio-demographic variables, r is a proxy for the share of risky assets in the portfolio and k and c are financial literacy and cognitive abilities, respectively. m is an indicator if the household has a male decision maker. ϵ is a standard normal random error.

We estimate model 2 in two different ways. First, we estimate a simple linear regression using OLS and condition on households reporting a loss. Second, we use a Heckman two-step estimation (Heckman (1976, 1979)) to correct for selection of reporting a loss, and include the inverse mills ratio λ in the estimated equation. The first step is estimated using the model developed in the previous section (equation 1). We use income volatility, living in a rural region, and being retired as exclusion restrictions. We assume that these variables only influence whether households participate in risky asset markets, i.e. report a loss, but have no effect on the size of the loss. This is confirmed by Chi2-test of the joint significance of these variables in the first and the second stage of the equation.[22]

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[22]In the first stage the three variables are jointly highly significant in all five of our imputed data sets. Wald-statistics range between 8.71 and 11.42; p-values are below 5% in all cases. Whereas in the second stage equation their joint significance is rejected in all five cases (Wald statistics between 1.15 and 3.16, p-values not significant).

We hypothesize that households with higher financial literacy/cognitive abilities are better diversified and therefore suffer smaller losses as a percentage of their wealth, i.e., we expect β_3 and β_4 to be negative. Moreover, we expect households with male decision makers to incur higher losses, i.e., β_5 should be positive.

Potential problem of truncation. Respondents in SAVE 2009 were only asked for their losses in financial wealth and not for their gains. Therefore, our dependent variable is potentially truncated. In SAVE 2010 we modified this question and instead asked respondents for their gains and losses over the last two years. A first glance at data from SAVE 2010 gives us the opportunity to estimate an upper limit of the fraction of respondents which might have reported gains when asked in 2009.[23] The comparison of losses reported in 2009 compared to losses and gains reported in 2010 reveals a very high correlation of 0.6751 (p-value 0.000). About 1.4% of all respondents report no loss during 2008 and a gain over a two year period between 2008 and 2010. This is the maximum fraction of respondents that are subject to truncation because it also contains those households who incurred no loss during 2008 but a gain during 2009. Thus, we do not think that we have a substantial problem of truncation in our data.

4.2.2 Empirical results: model 2

The analysis of this model is restricted to households with positive financial wealth in 2007. The descriptive analysis reveals that the fraction of wealth lost is around 10.3% for individuals low financial literacy and decreases slightly for highly literate households (9.1%). The difference between the two groups is insignificant. The analysis of relative losses over levels of cognitive abilities shows that individuals with lower cognitive abilities on average lost a higher fraction of their wealth (9.8%) than individuals with higher cognitive abilities (8.1%). Again, the difference between the two groups is insignificant.

We conduct multivatiate regression as specified in equation 2 to test hypothesis 2a and 2b. The results of an OLS regression and of Heckman two-step estimations can be found in Table 5. Our dependent variable in these regressions is the loss (measured in Euros) divided by financial wealth at the end of 2007.

We find that the fraction of wealth lost is higher, the higher the share of financial

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[23]We can assume that this is an upper limit because of very high returns of the stock markets during 2009. We think that there is a negligible fraction of households which report a loss over the two year period from 2007 to 2009, but would have reported a gain between 2007 and 2008.

wealth invested in stocks or other risky assets.[24] The number of asset categories as well as being younger than 36 and having a low schooling degree have weakly significant negative effects on the faction of wealth lost in the OLS but the effects become insignificant when correcting for selection (Heckman 1 and 2 in Table 5). Self-employment and being of non German origin are significantly positively related to the size of the loss.

Contrary to our expectation financial literacy and cognitive abilities are not negatively related to the fraction of wealth lost—both effects are insignificant in the OLS regression. When correcting for reporting a loss (Heckman 1) the effect of financial literacy becomes positively significant at 10%. Thus, we do not find support for hypothesis 2a, that individuals with higher levels of financial literacy are better at shielding themselves from losses due to the financial crisis..

To test hypothesis 2b we include two dummy variables to control for decision making within the household. The reference group are single female decision makers. We find no significant differences in the size of the loss between single female or male decision makers, as proposed in hypothesis 2b. In the OLS regression we find week evidence that joint decision makers incurred smaller losses compared to female decision makers. However, the effect is not significant in the selection models.

As a robustness check we changed the dependent variable of the selection equation (Heckman 2). Here the selection is not whether households report a loss, but whether households own stocks or stock mutual funds at the end of 2007. The results regarding the effect of financial literacy and cognitive abilities do not change in this specification. However the significance of some of the control variables changes. Mainly due to the different sample size because of the different selection modeled.

To check if our results are influenced by the performance of households with very risky portfolios and accordingly very large losses, we conducted a sensitivity check and restricted our estimation to households with a fraction invested in stocks that is smaller than 80%, i.e. we exclude the top 9 to 10% of households with the highest share of risky investments in their portfolio (depending on the sample). Financial literacy is still positively related to the fraction of wealth lost, but the effect is smaller and insignificant in all three specifications.

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[24]These variable are not included in the selection equation because for all individuals without risky assets the fractions are 0. There is no variation in these variables for the households not selected.

Table 5: Heckman Two-Step "Loss/Wealth 2007"

This table reports coefficients (Coef.) and standard errors (SE) of linear models. Model 1 is estimated using OLS, model 2 and 3 are estimated using Heckman two-step. The dependent variable is defined as loss in Euro relative to financial wealth at the end of 2007 in Euro. Coefficients and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Cognitive abilities and financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the omitted category if various dummies are used. Heckman 1 and 2 contain selection corrections (Lambda). In Heckman 1 we correct for reporting a loss. heckman Selection 2 corrects for selection into stock ownership. In OLS and Heckman 1 we include all households who report a loss and positive financial wealth at the end of 2007 (N=411). In Heckman 2 we include all households with positive financial wealth and who invested in stocks or mutual funds at the end of 2007 (N=563).

	OLS		Heckman 1		Heckman 2	
	Coef.	SE	Coef.	SE	Coef.	SE
Cognitive abilites (d)	-0.030	0.026	-0.026	0.028	-0.004	0.017
Financial literacy 2007 (d)	0.015	0.027	0.070*	0.041	0.014	0.019
Age: 35 and younger (d)	-0.072**	0.041	-0.071	0.044	-0.010	0.024
Age: 36-50 (d)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age: 51-65 (d)	0.021	0.029	0.047	0.034	0.045**	0.020
Age: 66 and older (d)	0.009	0.035	0.043	0.041	-0.002	0.023
Share of bonds	-0.009	0.064	-0.011	0.062	0.044	0.056
Share of stocks	0.214***	0.039	0.212***	0.038	0.236***	0.026
Share of other risky assets	0.401***	0.107	0.396***	0.104	0.079	0.082
Log financial wealth 2007	-0.080***	0.011	-0.050***	0.021	-0.016	0.011
Men (d)	0.014	0.025	-0.004	0.029	-0.008	0.017
Living in east Germany (d)	-0.029	0.026	-0.022	0.028	-0.004	0.017
Low level of schooling (d)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Intermediate schooling (d)	-0.039*	0.028	-0.043	0.029	0.004	0.019
High schooling (d)	-0.011	0.028	-0.005	0.030	0.003	0.019
Log monthly net income	-0.005	0.025	-0.006	0.026	-0.014	0.016
Number of asset categories	-0.009**	0.005	0.002	0.008	0.000	0.005
Risk preferences	0.003	0.004	0.014*	0.007	0.012***	0.003
Financial advisor (d)	-0.006	0.022	0.027	0.031	0.020	0.017
Female decision maker (d)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Male decision maker (d)	-0.050	0.041	-0.035	0.045	-0.019	0.029
Joint decision making (d)	-0.045*	0.035	-0.044	0.036	-0.008	0.023
Self-employed (d)	0.091***	0.036	0.110***	0.040	0.063**	0.025
non German (d)	0.388***	0.107	0.432***	0.116	0.011	0.167
Lambda	-	-	0.181*	0.100	0.006	0.044
Constant	1.076***	0.179	0.421**	0.403	0.220	0.194
N	411		411		563	
R2	0.33					
Wald chi2 (21) and p-val			133.5	0.000	146.5	0.000

Source: SAVE 2007 to 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

4.3 Who realizes their loss?

4.3.1 Model to test hypothesis 3

In section 2.3 we argued that different reasons might have existed to sell ones assets during the crisis and realize a loss. To investigate our competing *hypotheses 3a and 3b* we estimate a model of the following form:

$$s = \beta_0 + \beta_1 z + \beta_2 k + \beta_3 c + \beta_4 y + \lambda + \epsilon, \tag{3}$$

where s indicates whether the household has sold assets that lost in value, and y indicates a shock to income. All other variables are defined as before. Again we estimate two specifications: a linear model conditional on reporting a loss and a Heckman two-step. The Heckman two-step might be necessary because only households reporting a loss were asked how they reacted to the crisis.

We use income volatility, living in a rural region, self-employment, being non German and being retired as exclusion restrictions. We assume that these variables only influence whether households participate in risky asset markets, i.e. report a loss, but have no effect on their reaction to the loss. This is confirmed by Chi2-Test of the joint significance of these variables in the first and the second stage of the equation. [25]

As argued in section 2.3, individuals with higher financial literacy and cognitive abilities might be more or less likely to sell their assets, thus β_2 as well as β_3 can be positive or negative.

4.3.2 Empirical results: model 3

The question about the realization of losses was asked conditional on reporting a loss. As before we condition on positive gross financial wealth at the end of 2007, i.e. 442 households are included in our regression.[26] Descriptive analysis reveals that the fraction of households who sold their assets that lost value is 21% for highly financially literate respondents compared to 36% on average for respondents answering less than 3 questions correctly. Similarly, the percentage of households who sold at least some of their loser stocks deceases from 26% for low cognitive abilities to 21% for high cognitive abilities.

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[25]In the first stage the variables are highly significant jointly in all five of our imputed data sets (Wald statistics between 12.2 and 16.4, p-values below 5%). Whereas in the second stage equation their joint significance is rejected in all five cases (Wald statistics between 6.1 and 7.2, p-values not significant.

[26]The different sample size compared to model 2 is due to differences in the number of missing values.

The results of linear regressions modeled as suggested in equation 3 are shown in Table 6.[27] In specification 1 and 3 the dependent variable is a dummy equal to one if the respondent households sold some or all of the asset which lost in value. In specification 2 and 4 we use a stricter definition: The dependent variable is a dummy equal to one only if a households sold all the assets which lost in value.

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[27]We report OLS regressions for ease of interpretation. Our results do not change when estimating probit regressions.

Table 6: Probit "Realized Loss"

This table reports the effect of cognitive abilities, financial literacy, and various covariates on selling assets during the financial crisis. The dependent variable in specification 1 and 3 is a dummy that indicates if households sold some or all of their assets which lost in value during the crisis (realized loss). The dependent variable in specification 2 and 4 is a dummy that indicates if households sold all of their assets which lost in value during the crisis (realized loss (strict definition)). Coefficients (Coef.) and standard errors (SE) are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Cognitive abilities and financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used. The first two specifications are ordinary least squares. Specification 3 and 4 are estimated using Heckman's two-step procedure. We correct for reporting a loss. N=442.

| | OLS | | | | Heckman twostep | | | |
| | 1. realized loss | | 2. realized loss (strict definition) | | 3. realized loss | | 4. realized loss (strict definition) | |
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Cognitive Abilities 3 (d)	-0.040	0.053	-0.066	0.042	-0.041	0.053	-0.065	0.041
Financial Literacy 3 (d)	-0.118**	0.052	-0.125***	0.041	-0.133**	0.062	-0.118**	0.049
Age: 35 and younger (d)	0.043	0.081	-0.053	0.063	0.042	0.079	-0.053	0.062
Age: 36-50 (d)	ref.		ref.		ref.		ref.	
Age: 51-65 (d)	0.073	0.058	0.039	0.044	0.068	0.057	0.041	0.044
Age: 66 and older (d)	0.150**	0.063	0.063	0.049	0.145**	0.063	0.065	0.049
Log financial wealth 2007	-0.033	0.022	-0.038**	0.017	-0.044	0.035	-0.033	0.026
Men (d)	0.008	0.053	0.005	0.041	0.014	0.053	0.003	0.042
Living in East Germany (d)	0.047	0.055	-0.007	0.043	0.044	0.054	-0.006	0.042
Low level of schooling (d)	ref.		ref.		ref.		ref.	
Intermediate schooling (d)	0.058	0.058	0.036	0.045	0.058	0.057	0.036	0.044
High schooling (d)	-0.006	0.057	-0.021	0.044	-0.009	0.056	-0.019	0.044
Log monthly net income	0.036	0.049	-0.015	0.039	0.034	0.048	-0.014	0.038
Risk Preferences	-0.005	0.008	-0.009	0.007	-0.008	0.010	-0.007	0.008
Financial Advisor (d)	0.105**	0.043	0.026	0.034	0.094*	0.049	0.030	0.039
Female decision maker (d)	ref.		ref.		ref.		ref.	
Male decision maker (d)	0.125	0.086	0.065	0.066	0.121	0.085	0.067	0.066
Joint decision making (d)	0.056	0.069	0.095*	0.053	0.057	0.067	0.094*	0.052
Limited budget (d)	0.004	0.066	0.015	0.051	0.008	0.065	0.014	0.050
Other effects of the crisis (d)	0.071	0.048	-0.013	0.037	0.059	0.057	-0.008	0.043
Lambda	-		-		-0.049	0.119	0.021	0.093
Constant	0.197	0.357	0.688**	0.280	0.409	0.629	0.598	0.485
N	442		442		442		442	
R2	0.067		0.087					
Wald chi2 (17) and p-val					31.68	0.017	27.60	0.051

Source: SAVE 2007 to 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

Cognitive abilities as well as financial literacy have a negative effect on selling the loser stocks which is in line with the descriptive results. However, only the effect of financial literacy is significant. The ability to answer all financial literacy questions correctly decreases the probability to sell assets after a loss by between 11 and 13% depending on the specification. Correcting for selection into reporting a loss only slightly changes our results compared to the OLS. And using a stricter definition of realizing losses hardly changes the results.

The second interesting point to notice is that individuals older than 66 are significantly more likely to sell their assets, compared to individuals between 36 and 50. The reason is probably that they were pessimistic about medium term future stock returns and have shorter future time horizons compared to younger investors. The effect disappears when using the strict definition of realizing the losses. Apart from the variables we already introduced, a variable is included to take account of shocks to income and whether individuals had to sell the assets to smooth consumption. We have information if households were affected by the crisis via the labor market. Specifically we asked respondents if they lost their job, whether their income declined and if they worked shorter hours due to the crisis. We do not find any significant impact of these other effects of the crisis on realizing losses.

For households who sold at least some of the assets, there was a follow up question asking for the destination of the money:

What did you do with the money from selling the assets? We used most of it for consumption. / We transferred most of it to our checking account or other forms of assets.

This analysis confirms that most of the households who sold the assets did not aim at smoothing consumption. Only about 17% of the respondents consumed most of the money from the assets they sold. The majority (83%) transferred the money to other assets.

Summing up, we are able to reject hypothesis 3a according to which households with higher financial literacy are more likely to realize their losses. We find robust evidence that higher financial literacy is positively related to keeping the loser assets. Thus, individuals with lower financial literacy were more likely to realize their losses and leave the equity market during the crisis.

5   Conclusions

Our analysis of the effects of the financial crisis on households' portfolios and their reactions reveals the following results:

- On average, households in Germany do not seem to have suffered substantially from the financial crisis. Little more than 20% of households in Germany report financial losses. Mean losses are about 2,560 Euros or 3.6% of gross financial assets.

- Comparing reported and simulated losses reveals that households have a plausible notion of their losses during the financial crisis.

- Households with lower financial literacy and cognitive abilities are less likely to participate in risky asset markets and thus less frequently report financial losses due to the crisis. The effect of financial literacy is significant even if we control for socio-demographic differences, risk preferences and income risk. Thus, our results are consistent with previous results in the literature, e.g. Calvet et al. (2007), van Rooij et al. (2007). The main explanation is that financially illiterate households are skeptical about financial markets and thus stay out of risky assets to avoid investment mistakes.

- Contrary to the predictions derived from existing theory, households with lower financial literacy and cognitive abilities did not lose larger fractions of their wealth if they participated in the stock market. Moreover, our indicator of overconfidence does not reveal any significant effects on the size of the loss.

- Financially illiterate households were more likely to sell the assets which lost in value during the crisis. Calvet et al. (2009) observe that financially unsophisticated households in Sweden are more likely to exit risky asset markets when incurring a loss. We confirm these findings using German household data.

However, one should not jump to conclusions too fast. Even though the effects of the financial crisis on private households in Germany appear to be limited in the short run they can have substantial consequences in the long run. In Germany, participation in risky assets has been traditionally low but has increased slightly in recent years. If the shock to financial market returns has a negative impact on financial market participation, the rising trend in stock market participation might slow down or even be

reversed (we observe households leaving the stock market due to the crisis).Malmendier and Nagel (2010) find evidence that past returns matter for households' participation in stock and bond markets. Consequentially, there might be substantial losses in future welfare for households who leave or stay out. This might impact households' financial well-being particularly in the light of demographic transition and declining pension benefits. Mankiw and Zeldes (1991) estimate that consumption patterns of stockholders and nonstockholders differ substantially: stock holding households have overall larger volatility of consumption, but at the same time they have higher average levels of consumption. Cocco et al. (2005) estimate a welfare loss of 1.5 to 2% of annual consumption due to lack of stock market participation.

Thus, due to different investment strategies of financially literate and illiterate investors income inequality might increase. The main reasons for this are: first, financially illiterate will miss the higher long-term returns of the stock market; second, there is a high probability that households who realized returns during an economic downturn do not reinvest in risky assets very soon, which means that they do not participate in potential recovery processes directly after economic crises. Börsch-Supan et al. (2010) show that financial losses due to the 2007/2008 financial crisis are around 0.2 percentage points in the long-run. The loss of not participating in the stock market would be larger if one looks at the historical outperformance of equity in stocks vs. government bonds over the past century for Germany, the US and other countries. The equity premium from 1900-2005 was at least 5 percentage points per annum higher on average (Mehra (2006)). The foregone future losses are even higher if households sell their stock when the market value is very low. Overall, we find that despite the moderate impact of the financial crisis on households in Germany the long-term effects on wealth distribution can be substantial. The reason is that households with higher levels of financial literacy are better at reacting to a shock like the financial crisis compared to households with low financial literacy.

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A   Appendix A: Financial Losses

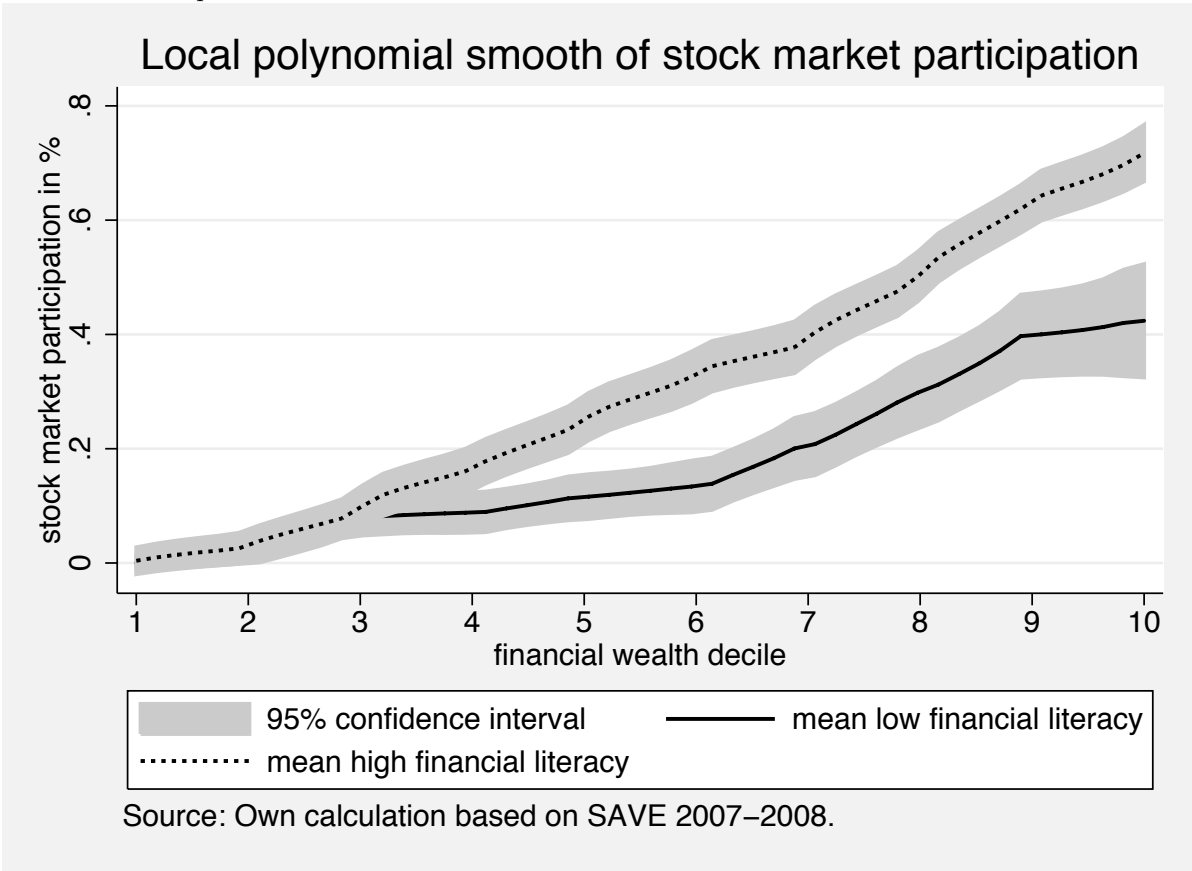Figure A1: Density Function Financial Losses

This figure shows the distribution of losses conditional on reporting a loss. The function is smoothed using a univariate kernel density estimation (Epanechnikov kernel function).

Source: SAVE 2009, weighted data.
Observations up to the 95% percentile included (N=412).
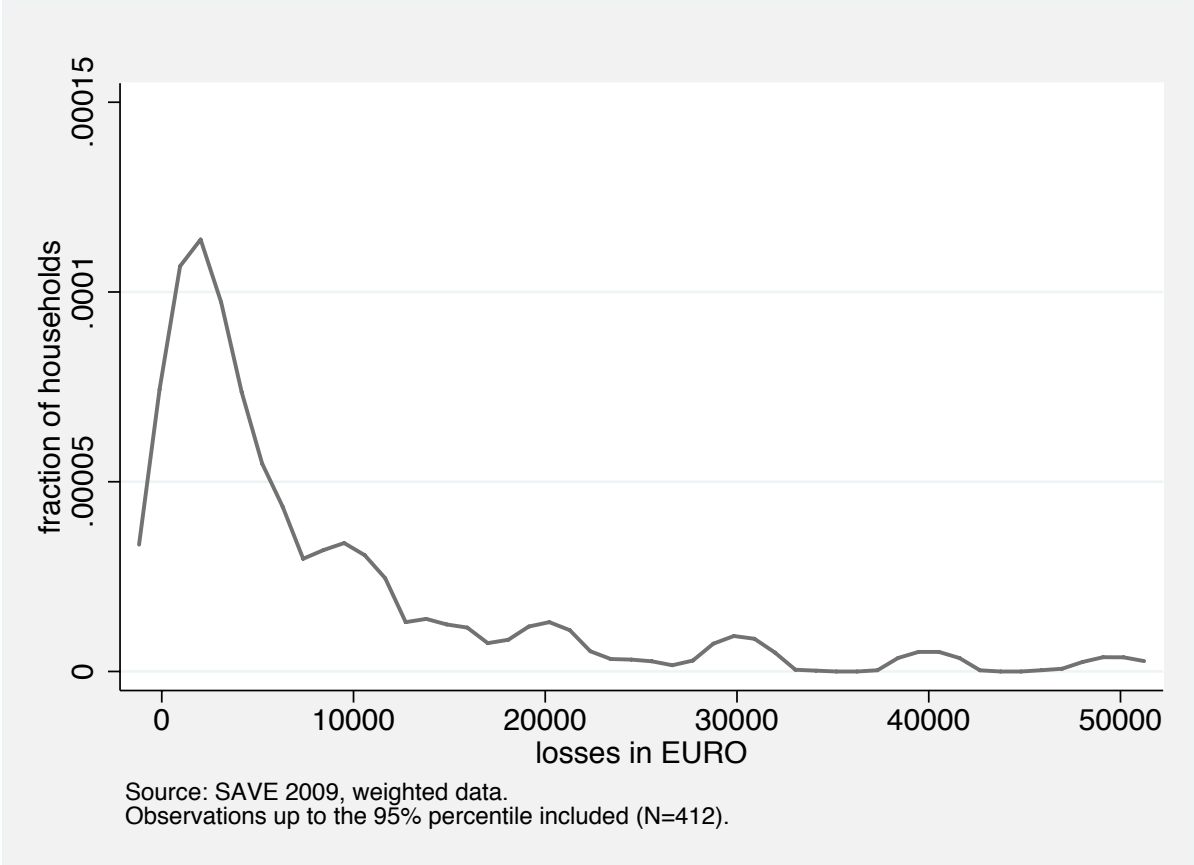
B Appendix B: Financial Literacy and Stock Market Participation over Deciles of Financial Wealth

Figure B2: Financial Literacy and Stock Market Participation over Deciles of Financial Wealth

This figure shows average stock market participation of households with high and low levels of financial literacy over deciles of gross financial wealth. Households with high (low) financial literacy are (not) able to answer all financial literacy questions correctly. Financial wealth and stock market participation are measured at the end of 2007 (SAVE 2008). Financial literacy is taken from SAVE 2007. N=2,012. The graph is based on one imputed data set. Results do not differ when using any of the other imputed data sets.

Local polynomial smooth of stock market participation

95% confidence interval — mean low financial literacy
mean high financial literacy

Source: Own calculation based on SAVE 2007–2008.

C   Appendix C: Summary Statistics

Table C1: Summary Statistics

This table contains summary statistics for 2,012 respondents in SAVE 2009.

Variable	Mean	Std. Dev.	Min	Max
Age	50.8	15.9	21	90
Men	0.47	0.50	0	1
East	0.28	0.45	0	1
Rural	0.15	0.36	0	1
Married	0.57	0.50	0	1
Single	0.21	0.40	0	1
Divorced	0.13	0.33	0	1
Widowed	0.08	0.26	0	1
Separated	0.03	0.16	0	1
Partner	0.65	0.48	0	1
Employed	0.55	0.50	0	1
Fulltime	0.34	0.47	0	1
Parttime	0.20	0.40	0	1
Unemployed	0.08	0.28	0	1
Homemaker	0.19	0.40	0	1
Retired	0.28	0.45	0	1
Household size	2.43	1.22	1	9
Households with children	0.37	0.48	0	1
Number of children	1.67	1.38	0	8
Lower secondary education	0.08	0.27	0	1
Upper secondary education	0.60	0.49	0	1
Post secondary, non tert. education	0.12	0.33	0	1
First stage tertiary education	0.17	0.38	0	1
Other education	0.03	0.17	0	1
Household income (Euro/month)	2,127	1,389	22	22,500
Gross wealth - end of 2007 (Euro)	187,281	384,198	0	7,720,000
Gross financial wealth - end of 2007 (Euro)	38,855	114,128	0	2,870,000

Source: SAVE 2008 and 2009, data is weighted and imputed.

D Appendix D: Measures of Financial Literacy and Cognitive Abilities

Financial Literacy

1. *Understanding of Interest Rate (Numeracy)*

   "Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102?"

2. *Understanding of Inflation*

   "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?"

3. *Understanding of Risk and Diversification*

   "Do you think that the following statement is true or false? Buying a single company stock usually provides a safer return than a stock mutual fund." do not know

Cognitive Reflection Test

1. "A bat and a ball cost 110 cents in total. The bat costs 100 cents more than the ball. How much does the ball cost?"

2. "If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?"

3. "In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?"