

The Impact of Risk Attitudes on Financial Investments

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The Impact of Risk Attitudes on Financial Investments

Abstract

Several scholars analyze the relationship between individuals' willingness to take risks and financial investment decisions. We add to this literature in using data from the German Socio-Economic Panel which allow ruling out that investments in risky assets itself impact on risk attitudes. We show that individuals with a higher willingness to take risks are more likely to hold bonds, stocks, and company assets. When grouping individuals into risk groups, our results reveal that high risk takers are also less likely to own a life insurance. If endogenous adaption of risk attitudes from holding assets in previous years is not taken into account, the impact of risk attitudes on holding risky assets is upward biased.

Keywords: risk attitudes, financial investment, portfolio choice, reverse causality, German Socio-Economic Panel

JEL Classification: D14, D81, G11

1. Introduction

Individual willingness to take risks is decisive for financial investments. Financial assets are characterized by a variety of expected revenues along with different risks. Portfolio theory predicts that investors who are less risk averse will have higher shares of risky assets, such as stocks, in their portfolios. This theoretical link has been used in a number of empirical studies to construct measures of risk aversion out of the portfolio choice of individuals (e.g. Friend and Blume, 1975; Siegel and Hoban, 1982; Riley and Chow, 1992; Bucciol and Miniaci, 2011). Measuring this theoretical relationship empirically has been the objective of several papers in the last years (e.g. Barsky et al., 1997; Kimball et al., 2008; Kapteyn and Teppa, 2011; Dohmen et al., 2011; Barasinska et al., 2012). This literature uses survey data and measures the risk attitudes of the interviewed persons either by direct questions about their behavior and attitudes or by hypothetical decision problems involving income and risk, e.g. about the choice between jobs or the share of money invested in risky assets after a lottery win. All studies find a statistically significant correlation between risk attitudes and portfolio choice.

Standard models in economics assume that individuals are endowed with stable risk attitudes. It is conceivable, however, that investments in risky assets also affect risk attitudes. Malmendier and Nagel (2011) show that macroeconomic shocks experienced over the course of an individual's life affect the willingness to take financial risks. Their results suggest that personal experiences exert an influence on personal attitudes. Heaton and Lucas (2000) find that the presence of background risks, as labor income and entrepreneurial income, influences portfolio allocation. Background risk in turn likely changes over time. Similarly, Guiso and Paiella (2008) demonstrate that the consumer's environment affects risk aversion. Individuals who are more likely to face income uncertainty or to become liquidity constrained exhibit a higher degree of absolute risk aversion.

Individuals' risk attitudes may be related to endogenous adaptation for several reasons. First, holding financial assets means confrontation with risky decisions new to the individual. Second, making risky decisions implies dealing with uncertainty and may contribute to learning in portfolio context. Learning by doing is a pervasive form of personal development which can be applied to attitudes as well as skills (see Bowles 1998). With respect to portfolio choice, this may include the accumulation of finance-specific human capital and an increasing confidence in own skills (Westhead and Wright 1998; Ucbasaran, Wright and Westhead 2008). Thirdly, changes in willingness to take risks in financial matters might be driven by changes in the perception of the risky choices and outcomes that individuals experienced during former financial market participation. Therefore, we cannot rule out that asset holding itself affects risk attitudes.

Most studies on the nature of the relationship between risk attitudes and asset holding are based on common sense or casual observation of behavioral differences between risk averse and risk seeking individuals. The aim of this paper is to shed light on the nature of the relationship between risk aversion and asset holding. Therefore, in this paper we contribute to the existing literature in ruling out that investment decisions affect risk attitudes. We use data from the German Socio Economic Panel which allow addressing the concern for reverse causality. As an identification strategy, we use information on individuals, who did not invest in the asset under investigation *before* risk attitudes were measured. That is to identify the effect of risk attitudes on investment behavior and not vice versa, we rule out that individuals owned the respective financial investment before risk attitudes were measured. If risk attitudes are measured in period t_1 , in each regression we exclude individuals who owned the specific investment in the previous periods, $t \leq t_1$. Individuals are classified as investors if they owned the investment in $t > t_1$. Thus, we identify an investor if an individual did not own the investment up to t_1 *but* in one of the subsequent years. As measure of risk attitude we employ

a self-assessment question, while indicator variables on investments in several asset forms function as dependent variables. We find that risk attitudes play a decisive role in the financial investment decisions of households. Furthermore, results reveal that if endogenous adaption of risk attitudes from holding assets in previous years is not taken into account, the impact of risk attitudes on holding risky assets is upward biased.

2. Data and Identification Strategy

We employ data from the German Socio Economic Panel (SOEP). The SOEP is a representative survey of the German population that started in 1984. It contains detailed information on about 22,000 individuals. We make use of the waves from 2000 to 2010. Measures of risk attitudes were added to the SOEP in the 2004 wave.¹ The survey follows two different approaches in measuring these risk attitudes. In the direct approach the respondents are asked to rate their willingness to take risks in general and in specific domains of life, such as financial matters or health, on 11 point scales, where the value 0 means "risk averse" and the value 10 means "fully prepared to take risks".² The more indirect approach is a lottery question, requiring the respondents to decide how much of a lottery win they are willing to invest in risky assets on a 6 point scale.³

¹ Context specific risk questions are measured a second time in 2009.

² The exact wording of the questions is as follows. For the general risk attitude: "How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks". For the domain specific risk attitude: "People can behave differently in different situation. How would you rate your willingness to take risks in the following areas? How is it... - while driving? - in financial matters? - during leisure and sport? - in your occupation? - with your health? - your faith in other people?"

³ We used this lottery risk question in our robustness regressions. The results were similar to the results presented in this paper. They are available upon request.

Based on the results of Kapteyn and Teppa (2011), who show that simple measures of risk preferences appear to be more powerful predictors of portfolio allocation than a complex lottery question, and the findings of Weber et al. (2002) that risk attitudes are domain-specific, we use the directly asked attitude towards risk in financial matters.⁴ We have information on saving deposits and investment into securities at the household level. We focus on the question that asked whether the household head or another member of the household owned any of the following saving deposits or investment securities in the last year: *savings account*, *savings contract for building a home*, *life insurance*, *fixed interest securities* (e.g. saving bonds, mortgage bonds, federal savings bonds), *other securities* (e.g. stocks, funds), or *company assets* (for the individuals own company, other companies, agricultural assets). We match this information with individual characteristics of the head of the household. Therefore, like Dohmen et al. (2011), we restrict our sample to the head of the household. We construct dummy variables that indicate if a household head owned a financial investment category between 2005 and 2009.

Financial risk attitudes were measured a second time in 2009. Since results might be biased due to the financial crisis, our main analysis is based on the risk measure elicited in 2004. As a robustness test, we run our analysis for 2009. Thereby we make also use of waves 2010, 2011, and 2012. Analog to the main regressions, we restrict the sample to the head of the household in 2009 and construct dummy variables indicating if a household head owned a financial investment category between 2010 and 2012.

⁴ The study of Weber et al. (2002) also shows that the domain-specific attitudes are caused by domain-specific perceptions of risk rather than by actual differences in risk attitudes. Nevertheless, it is sensible to use the finance-specific risk attitude and not a general one, because the SOEP data does not include any information about risk perception.

In table 1 we present descriptive statistics for the six investment categories, for the risk measure, and a variety of socio-economic characteristics as gender, age, education, living in the part of the former German Democratic Republic (GDR), unemployment experience, disability, German nationality, self-employment of father, household income, and job position. These variables later serve as controls in the empirical framework where we analyze the effect of risk attitudes on the probability of owning financial investments.

Table 1
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Ownership of the following investment forms (between 2005 and 2009)					
Savings account	1256	0.233	0.423	0	1
Home savings	5565	0.110	0.313	0	1
Life insurance	3659	0.134	0.341	0	1
Bonds	8369	0.102	0.303	0	1
Stocks	6836	0.093	0.290	0	1
Company assets	11527	0.026	0.159	0	1
Financial risk attitude	7923	2.546	2.268	0	10
Female	12940	0.389	0.487	0	1
Lives in East Germany	12940	0.234	0.423	0	1
Education	11499	3.775	1.461	0	6
Age	12940	50.756	16.448	17	97
Age squared	12940	2846.682	1753.061	289	9409
Unemployment	11685	0.833	1.959	0	25.300
Disability	11648	0.141	0.348	0	1
German Nationality	11697	0.933	0.249	0	1
Father self-employed	11073	0.134	0.341	0	1
Log(household income)	11128	7.646	0.616	4.248	11.513
Occupational position					
Unemployed	11578	0.069	0.253	0	1
Non-working	11578	0.351	0.477	0	1
Unskilled Blue Collar / Helping Family Member	11578	0.073	0.260	0	1
Skilled Blue Collar / Blue Collar Craftsman	11578	0.093	0.291	0	1
Self-employed	11578	0.077	0.267	0	1
White Collar	11578	0.285	0.451	0	1
Civil Servant	11578	0.052	0.221	0	1

Notes: Covariates refer to 2004. See the Appendix for a description of the variables.

The identification strategy to reduce a potential reverse causality between risk attitudes and portfolio choice is illustrated in figure 1. In order to reduce any possible feedback effects of experiences with investments in an asset on risk attitudes, the sample only consists of individuals who did not hold the respective asset during five years before

obtaining information about their risk attitudes. The analysis then strives to estimate the relationship between the measured attitude towards financial risk in 2004 and the probability to hold a specific asset between 2005 and 2009, while controlling for various socio-demographic characteristics.

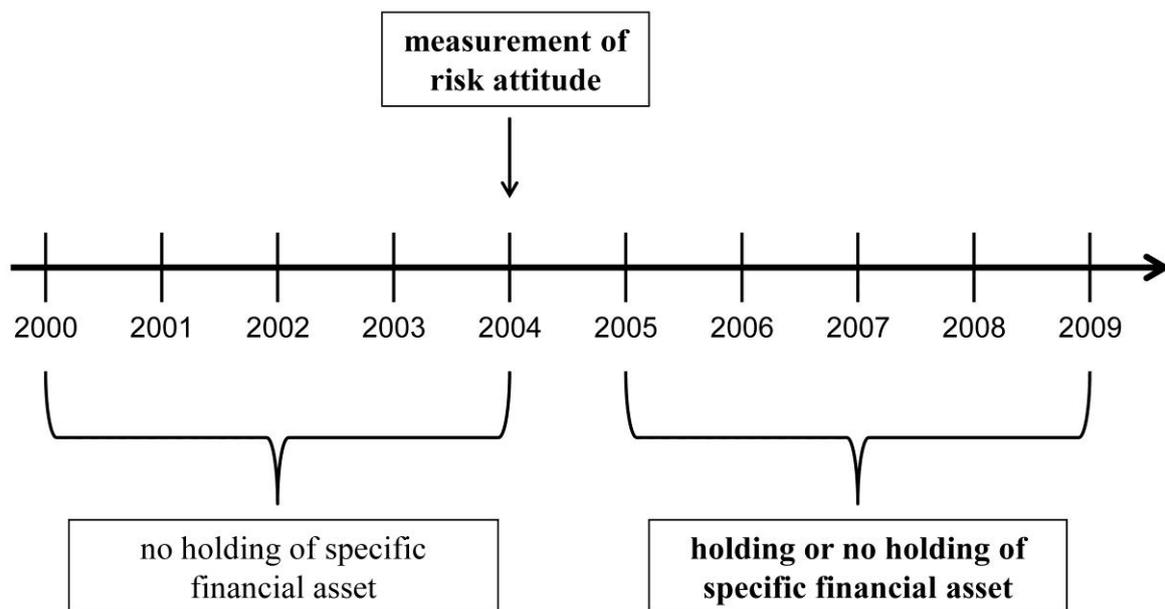


Figure 1. Identification strategy. The figure illustrates the timing underlying the construction of the main regression variables.

3. Risk attitudes of investors and non-investors

In figure 2 we show the distributions of responses to the risk question in financial matters for investors and non-investors along all six investment categories. Note that risk attitudes have been asked in 2004, that is, before the respondents have invested in the respective assets. For bonds, stocks, and company assets, a higher proportion of investors than of non-investors expresses a relatively higher willingness for risk-taking in financial matters. Similar results are found for savings accounts, home savings, and life insurance. There is a larger share of non-investors for risk values 5, 9, and 10 for savings accounts, for risk values 4, 5, and 10 for

home savings, and for risk values 6, 7, and 8 for life insurance. Risk-seeking individuals seem to be more in favor of more risky investment strategies. Furthermore, all investment categories suggest that a relatively high fraction of non-investors is very risk averse.

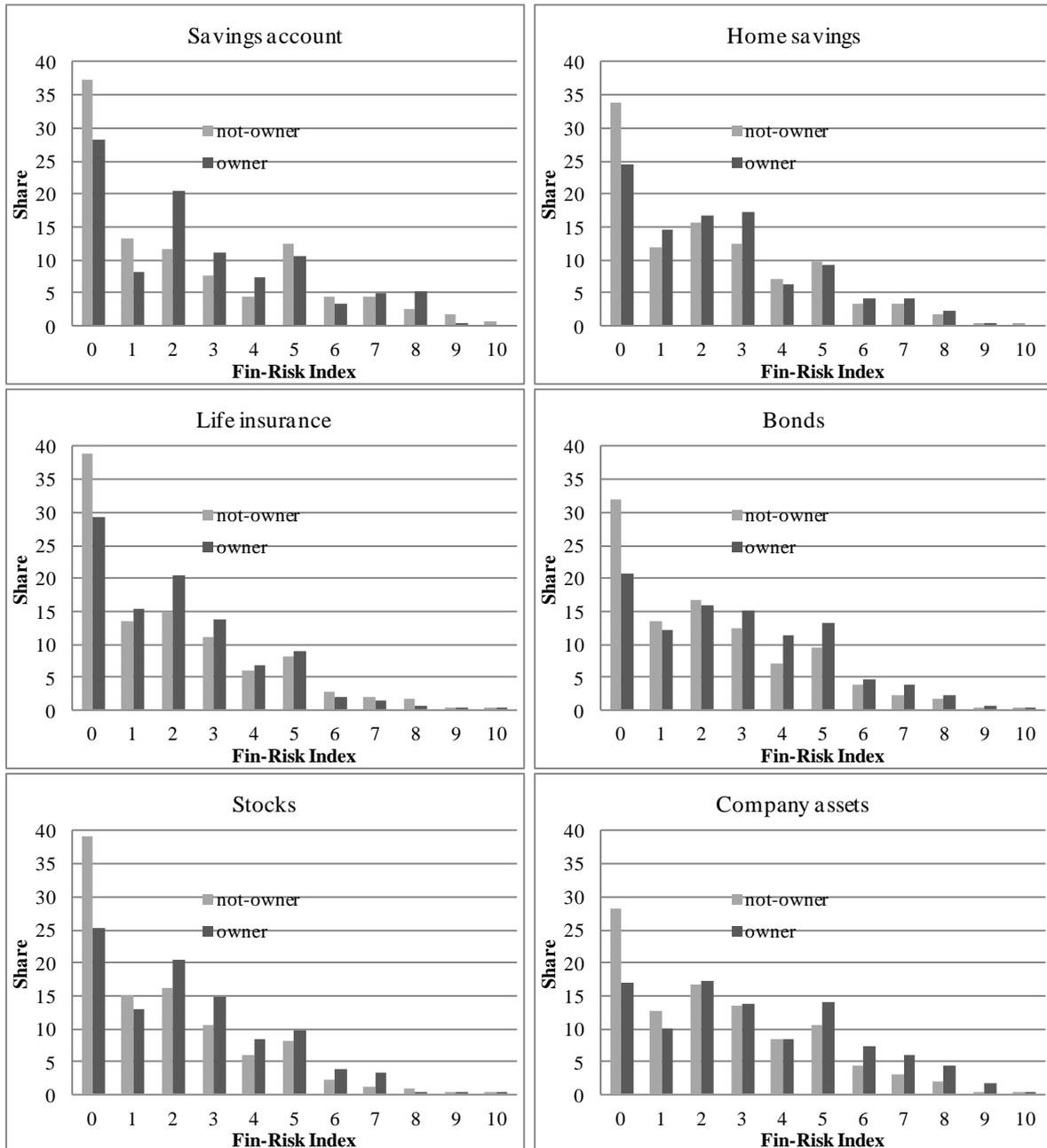


Figure 2. Risk attitudes of investors vs non-investors in 2005 to 2009. The figure shows the distribution of financial risk attitudes for owners and non-owners of six different asset categories. The abscissa is willingness to take risks in financial matters in 2004, measured on a 11-point scale, while the ordinate is the share of individuals who state this willingness in

percent. The dark gray bars show the distribution for the individuals who hold the specific asset and the light gray bars show the distribution for those individuals who do not hold the specific asset. Source: SOEP, calculation of the authors.

4. Results

In the analysis that follows, first, we show how risk attitudes affect asset choice if individuals do *not* hold the respective asset *before* risk attitudes are measured. Note that the low number of observations of savings accounts reveals that most individuals already had a savings account prior to 2005. In turn, the high number of observations for company assets indicates that company assets play no decisive role in financial portfolios of households (see tables 2, 4-7). Second, we show that not taking into account a possible feedback affect of prior asset holding on risk attitudes leads to upward biased results.

In all tables that follow, we present marginal effects at the mean from estimating probit models where our dependent variable is an indicator whether an individual owned any of the six different savings or investment securities during the period 2005 to 2009.

4.1 Baseline regressions

In our first set of regressions depicted in table 2 we find statistical evidence that a higher willingness to take risks is correlated with a higher probability of owning bonds, stocks, or company assets. We find no correlation between risk attitudes and owning a savings account, home savings, or life insurance. With regard to the control variables, we find the expected significant and positive correlations between household net income and financial investments in all regressions except for savings account. The coefficient on education is significant for savings account, bonds, and stocks. Note that education can be seen as a proxy for financial

literacy.⁵ Therefore, the result is also in line with Van Rooij, Lusardi and Alessie (2011), who show that higher financial literacy is correlated with a higher probability for being active in the stock market. It is interesting that nearly no significant statistical effect can be found for being female or living in the part of the former GDR, implying that if controlled for other characteristics female individuals and individuals from East Germany do not exhibit a different investment behavior.

Table 2
Financial risk and investments in 2005 to 2009.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.005 (0.010)	-0.002 (0.003)	-0.006 (0.005)	0.011*** (0.003)	0.014*** (0.003)	0.002** (0.001)
Female	-0.038 (0.052)	-0.008 (0.016)	0.033 (0.023)	0.003 (0.012)	-0.015 (0.014)	-0.004 (0.004)
Lives in East Germany	-0.037 (0.058)	0.025 (0.018)	-0.003 (0.024)	-0.021* (0.013)	-0.009 (0.015)	0.009* (0.005)
Education	0.046** (0.019)	-0.006 (0.006)	-0.006 (0.008)	0.023*** (0.004)	0.019*** (0.005)	0.002 (0.002)
Age	-0.011 (0.012)	-0.004 (0.003)	-0.012*** (0.004)	-0.006** (0.003)	-0.006** (0.003)	-0.000 (0.001)
Age squared	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000* (0.000)	-0.000 (0.000)
Unemployment	-0.016* (0.008)	-0.009** (0.005)	-0.014** (0.006)	-0.011** (0.005)	-0.007* (0.004)	-0.002 (0.002)
Disability	-0.071 (0.074)	-0.029 (0.021)	0.000 (0.029)	-0.011 (0.018)	-0.017 (0.018)	-0.017*** (0.005)
German Nationality	-0.091 (0.106)	0.050 (0.031)	0.102*** (0.035)	0.036 (0.024)	0.100*** (0.015)	-0.007 (0.011)
Father self- employed	0.019 (0.080)	-0.030 (0.021)	0.012 (0.031)	0.026 (0.019)	-0.017 (0.019)	0.009 (0.007)
Log(household income)	-0.016 (0.044)	0.047*** (0.014)	0.113*** (0.022)	0.070*** (0.013)	0.076*** (0.014)	0.019*** (0.004)
Observations	436	2,471	1,506	3,807	2,978	5,587

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

⁵ Bucher-Koenen and Lusardi (2011) show that higher education is correlated with higher financial literacy.

4.2 Robustness checks

Excluding the individuals who did hold the respective asset in the years before 2005 might lead to sample selection. In order to rule out that our results are impaired by a selection bias, we use the Heckman selection correction. The corresponding results are presented in table 3. It can be seen that the risk coefficients are of similar statistical significance and size as in our baseline regression.

Table 3
Heckman correction model: Financial risk and investments in 2005 to 2009.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.004 (0.008)	-0.002 (0.004)	-0.005 (0.005)	0.011*** (0.004)	0.006*** (0.001)	0.003** (0.002)
Female	-0.029 (0.047)	-0.013 (0.022)	0.011 (0.026)	0.009 (0.013)	-0.039*** (0.011)	-0.006 (0.006)
Lives in East Germany	-0.035 (0.048)	0.032 (0.024)	0.009 (0.020)	-0.015 (0.019)	-0.015 (0.012)	0.011 (0.009)
Education	0.035** (0.031)	-0.009 (0.009)	-0.012* (0.007)	0.018** (0.013)	0.044*** (0.004)	0.002 (0.003)
Age	-0.005 (0.014)	-0.005 (0.005)	-0.004 (0.008)	-0.005 (0.004)	-0.013*** (0.002)	0.000 (0.002)
Age squared	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000 (0.000)
Unemployment	-0.008 (0.016)	-0.014* (0.011)	-0.021*** (0.007)	-0.009* (0.006)	-0.021*** (0.003)	-0.003 (0.003)
Disability	-0.058 (0.073)	-0.037 (0.029)	0.002 (0.024)	-0.010 (0.018)	-0.011 (0.015)	-0.031** (0.016)
German Nationality	-0.076 (0.089)	0.073 (0.056)	0.140*** (0.074)	0.023 (0.039)	0.213*** (0.026)	-0.009 (0.013)
Father self- employed	0.011 (0.063)	-0.039 (0.030)	0.013 (0.026)	0.017 (0.022)	0.028* (0.016)	0.010 (0.016)
Log(household income)	-0.035 (0.040)	0.070** (0.052)	0.178 (0.044)	0.050* (0.043)	0.199*** (0.010)	0.024** (0.019)
Observations	6,354	6,354	6,354	6,354	6,354	6,354

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from heckprobit regressions. Robust standard errors are in brackets. Covariates refer to the year 2004. Additional covariate not displayed: job position. Selection equation includes as additional controls: married and childcare.

Furthermore, because our risk measure might be affected by the different use of scales by survey respondents we, first, introduce a dummy indicator for whether an individual

chooses a risk value of 5 or higher, and, second, group individuals into three risk groups, ranging from 0-3, 4-6, and 7-10. Results for the dummy specifications are reported in table 4. According to table 4, high risk individuals are more likely to invest in bonds, stocks, and company assets. For example, the probability that a high risk individual invests in stocks is 5.7% points larger compared to low risk individuals.

Table 4
Financial risk dummy and investments in 2005 to 2009.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk dummy	-0.043 (0.058)	-0.024 (0.018)	-0.045 (0.027)	0.037*** (0.015)	0.057*** (0.021)	0.011** (0.005)
Female	-0.051 (0.052)	-0.010 (0.015)	0.033 (0.023)	-0.002 (0.012)	-0.019 (0.014)	-0.004 (0.004)
Lives in East Germany	-0.041 (0.058)	0.025 (0.018)	-0.003 (0.024)	-0.022* (0.013)	-0.009 (0.015)	0.009* (0.005)
Education	0.046** (0.019)	-0.006 (0.006)	-0.006 (0.008)	0.024*** (0.005)	0.019*** (0.005)	0.002 (0.002)
Age	-0.013 (0.012)	-0.004 (0.003)	-0.012*** (0.004)	-0.006** (0.003)	-0.006** (0.003)	-0.000 (0.001)
Age squared	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000*** (0.000)	0.000 (0.000)	-0.000 (0.000)
Unemployment	-0.016** (0.008)	-0.009** (0.005)	-0.014** (0.006)	-0.011** (0.005)	-0.007* (0.004)	-0.002 (0.002)
Disability	-0.070 (0.075)	-0.028 (0.021)	-0.000 (0.028)	-0.012 (0.018)	-0.017 (0.019)	-0.017*** (0.005)
German Nationality	-0.094 (0.107)	0.050 (0.031)	0.103*** (0.035)	0.038 (0.024)	0.101*** (0.015)	-0.006 (0.011)
Father self- employed	0.013 (0.080)	-0.030 (0.021)	0.012 (0.031)	0.026 (0.019)	-0.016 (0.019)	0.010 (0.007)
Log(household income)	-0.009 (0.044)	0.047*** (0.014)	0.112*** (0.022)	0.074*** (0.013)	0.079*** (0.014)	0.019*** (0.004)
Observations	436	2,471	1,506	3,807	2,978	5,587

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

Regressions for the model with risk groups are depicted in table 5. As mentioned before, we form three risk groups: low risk individuals (reference group), medium risk individuals, and high risk individuals. The results in table 5 reveal that the probability of owning bonds or stocks is higher for individuals from the medium risk group. These effects

are much larger for the high risk group, as the probability to own stocks is 14.2% points larger for high risk individuals compared to low risk individuals. Furthermore, only the high risk seeking group is statistically more likely to own company assets. In comparison to the previous results, we also find that high risk individuals are less likely to own a life insurance.

Table 5
Financial risk groups and investments in 2005 to 2009.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	-0.002	-0.032*	0.001	0.055***	0.030*	0.003
Medium	(0.061)	(0.017)	(0.028)	(0.015)	(0.018)	(0.005)
Financial risk attitude	0.023	-0.033	-0.082*	0.055**	0.142***	0.028***
High	(0.088)	(0.026)	(0.038)	(0.030)	(0.052)	(0.012)
Female	-0.041	-0.011	0.034	0.002	-0.019	-0.004
	(0.052)	(0.016)	(0.023)	(0.012)	(0.014)	(0.004)
Lives in East Germany	-0.039	0.024	-0.002	-0.021	-0.009	0.009*
	(0.058)	(0.018)	(0.024)	(0.013)	(0.015)	(0.005)
Education	0.046**	-0.006	-0.006	0.024***	0.019***	0.002
	(0.019)	(0.006)	(0.008)	(0.004)	(0.005)	(0.002)
Age	-0.012	-0.004	-0.012***	-0.006**	-0.006**	-0.000
	(0.012)	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)
Age squared	0.000	-0.000	0.000	0.000***	0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	-0.016**	-0.010**	-0.014**	-0.011**	-0.007*	-0.002
	(0.008)	(0.005)	(0.006)	(0.005)	(0.004)	(0.002)
Disability	-0.072	-0.028	-0.000	-0.012	-0.018	-0.017**
	(0.074)	(0.021)	(0.028)	(0.018)	(0.018)	(0.005)
German Nationality	-0.092	0.050	0.103**	0.039*	0.103***	-0.006
	(0.107)	(0.031)	(0.035)	(0.024)	(0.015)	(0.011)
Father self- employed	0.016	-0.029	0.012	0.025	-0.016	0.009
	(0.080)	(0.021)	(0.031)	(0.019)	(0.019)	(0.007)
Log(household income)	-0.013	0.048***	0.112***	0.071***	0.078***	0.019***
	(0.044)	(0.014)	(0.022)	(0.013)	(0.014)	(0.004)
Observations	436	2,471	1,506	3,807	2,978	5,587

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

Our regression results so far rely on the assumption that risk attitudes are stable over time – at least for the period between 2004 and 2009.⁶ We next address this concern and analyze whether the probability of owning a specific investment in 2005 is correlated to

⁶ Several scholars suggest that risk attitudes are stable (e.g. Harrison et al., 2005; Andersen et al., 2008).

financial risk attitudes from the previous year. This robustness test also allows ruling out that our results are driven by the financial crisis of 2008. As shown in table 6, while the magnitude of the coefficients decreases, risk attitudes remain an important determinant for holding bonds or stocks.

Table 6
Financial risk and investments in 2005.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	-0.001 (0.006)	-0.002 (0.002)	-0.001 (0.003)	0.003** (0.001)	0.004*** (0.002)	0.001 (0.000)
Female	-0.044 (0.028)	0.004 (0.008)	0.007 (0.012)	-0.000 (0.005)	-0.011 (0.008)	-0.002 (0.002)
Lives in East Germany	-0.054* (0.030)	-0.002 (0.008)	-0.026** (0.011)	-0.003 (0.005)	0.004 (0.008)	0.004 (0.002)
Education	0.017* (0.010)	-0.006** (0.003)	-0.004 (0.004)	0.003 (0.002)	0.002 (0.003)	0.000 (0.001)
Age	-0.008 (0.007)	0.000 (0.002)	-0.001 (0.002)	0.001 (0.001)	-0.004*** (0.001)	0.000 (0.000)
Age squared	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000** (0.000)	-0.000* (0.000)
Unemployment	-0.001 (0.005)	-0.000 (0.002)	-0.004 (0.003)	-0.006*** (0.002)	-0.002 (0.002)	-0.001 (0.000)
Disability	-0.028 (0.042)	-0.015 (0.010)	-0.015 (0.014)	-0.005 (0.007)	-0.003 (0.011)	-0.001 (0.002)
German Nationality	-0.073 (0.079)	0.029*** (0.009)	0.052*** (0.008)	0.008 (0.010)	0.036*** (0.006)	-0.002 (0.005)
Father self- employed	-0.038 (0.038)	-0.008 (0.011)	-0.006 (0.015)	0.005 (0.008)	0.001 (0.010)	0.001 (0.003)
Log(household income)	0.027 (0.024)	0.012* (0.007)	0.032*** (0.011)	0.023*** (0.005)	0.019*** (0.007)	0.006*** (0.002)
Observations	432	2,448	1,492	3,771	2,949	5,536

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

Since investment behavior might have an impact on risk attitudes, we already ruled out that the investment under consideration has a feedback effect on risk attitudes. As a further check for reverse causality, we restrict the sample on individuals that neither had

bonds, stocks, nor company assets, or the investment under consideration prior to 2005.⁷

According to table 7 we still find a highly significant effect of the willingness to take risks in owning bonds or stocks.

Table 7
Financial risk and investments in 2005-2009, subsample.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.008 (0.012)	-0.001 (0.005)	-0.009 (0.009)	0.007** (0.003)	0.012*** (0.003)	0.001 (0.001)
Female	-0.022 (0.058)	-0.007 (0.020)	-0.018 (0.031)	-0.001 (0.013)	-0.021 (0.014)	-0.006 (0.004)
Lives in East Germany	0.006 (0.066)	-0.036* (0.020)	0.006 (0.032)	-0.016 (0.013)	0.012 (0.015)	0.005 (0.005)
Education	0.051** (0.022)	0.003 (0.008)	0.008 (0.012)	0.016*** (0.005)	0.017*** (0.005)	-0.001 (0.002)
Age	-0.004 (0.013)	-0.002 (0.004)	-0.010 (0.006)	-0.005** (0.002)	-0.007*** (0.003)	-0.000 (0.001)
Age squared	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000* (0.000)	-0.000 (0.000)
Unemployment	-0.014* (0.008)	-0.008* (0.005)	-0.012* (0.006)	-0.005 (0.004)	-0.005 (0.003)	-0.001 (0.001)
Disability	-0.083 (0.080)	-0.062** (0.022)	-0.005 (0.038)	-0.032* (0.015)	-0.003 (0.020)	0.000 (0.007)
German Nationality	-0.115 (0.107)	0.062** (0.024)	0.130*** (0.032)	0.038* (0.020)	0.082*** (0.014)	-0.003 (0.007)
Father self- employed	-0.015 (0.095)	-0.023 (0.030)	0.005 (0.049)	0.033 (0.021)	0.000 (0.022)	0.004 (0.008)
Log(household income)	-0.017 (0.056)	0.023 (0.019)	0.138*** (0.032)	0.055*** (0.013)	0.058*** (0.014)	0.012*** (0.004)
Observations	310	1,145	796	2,256	2,256	2,256

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

⁷ Because almost all individuals from our sample own savings account, home savings or a life insurance in the period 2000-2004, we cannot further restrict the sample with regard to these three investments for all six regressions. Furthermore, we do not expect high feedback effects of these relatively riskless investments on risk attitudes.

4.3 Relevance of controlling for reverse causality

In sections 4.1 and 4.2 we showed that risk attitudes affect risky investment choices, when controlling for reverse causality. But it has not yet been presented evidence to support the hypothesis of reverse causality in the first place. In what follows, we re-estimate several regressions with the unrestricted sample, i.e. we do not exclude individuals who owned the respective asset under consideration prior to 2005. We do this for the three alternative constructions of the variable for risk attitudes (“Financial risk attitude”, “Financial risk dummy”, “Financial risk grouping”). Results are depicted in tables 8 to 10 and correspond to those from tables 2, 4 and 5. The correlations between risk attitude and investment in bonds, stocks and company assets are considerably larger when using the unrestricted sample. In most of the cases, the coefficients for the unrestricted sample are more than twice as large as those of the restricted sample. The comparison suggests an upward bias caused by reverse causality.

Table 8
Financial risk and investments in 2005 to 2009: unrestricted sample.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.002 (0.002)	0.005* (0.003)	0.004 (0.003)	0.023*** (0.003)	0.057*** (0.003)	0.006*** (0.001)
Female	-0.021** (0.008)	-0.040*** (0.015)	-0.004 (0.014)	-0.004 (0.014)	0.016 (0.015)	0.003 (0.007)
Lives in East Germany	0.026*** (0.008)	0.036** (0.016)	0.023 (0.014)	-0.061*** (0.015)	-0.031* (0.016)	0.017** (0.008)
Education	0.012*** (0.003)	-0.007 (0.005)	-0.010** (0.005)	0.040*** (0.005)	0.059*** (0.005)	0.008*** (0.002)
Age	-0.008*** (0.002)	0.006** (0.003)	0.014*** (0.003)	-0.000 (0.003)	-0.006* (0.003)	0.000 (0.002)
Age squared	0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Unemployment	-0.011*** (0.002)	-0.030*** (0.005)	-0.024*** (0.004)	-0.019*** (0.005)	-0.026*** (0.005)	-0.006** (0.003)
Disability	-0.004 (0.012)	-0.014 (0.021)	-0.029 (0.019)	-0.029 (0.019)	-0.030 (0.022)	-0.020** (0.010)
German Nationality	0.087*** (0.025)	0.061* (0.035)	0.156*** (0.036)	0.140*** (0.031)	0.241*** (0.032)	0.009 (0.016)
Father self- employed	0.007 (0.011)	0.019 (0.020)	-0.006 (0.019)	0.052*** (0.019)	0.033 (0.021)	0.048*** (0.011)
Log(household income)	0.058*** (0.008)	0.145*** (0.014)	0.215*** (0.013)	0.179*** (0.014)	0.238*** (0.015)	0.067*** (0.007)
Observations	6,354	6,354	6,354	6,354	6,354	6,354

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

Regressions in table 8 are based on the ordinary 11-point scale risk measure. As before, the willingness to take risks is highly correlated with holding bonds, stocks, or company assets. In table 9 we use the risk dummy. High risk takers are more likely to hold bonds, stocks, company assets, and home savings.

Table 9

Financial risk dummy and investments in 2005 to 2009: unrestricted sample.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk dummy	-0.004 (0.009)	0.027* (0.016)	0.014 (0.015)	0.068*** (0.016)	0.205*** (0.016)	0.022*** (0.008)
Female	-0.022*** (0.008)	-0.041*** (0.015)	-0.006 (0.014)	-0.015 (0.014)	-0.005 (0.015)	0.000 (0.007)
Lives in East Germany	0.026*** (0.008)	0.036** (0.016)	0.023 (0.014)	-0.061*** (0.015)	-0.031* (0.016)	0.017** (0.008)
Education	0.012*** (0.003)	-0.007 (0.005)	-0.010** (0.005)	0.042*** (0.005)	0.062*** (0.005)	0.008*** (0.002)
Age	-0.008*** (0.002)	0.006** (0.003)	0.014*** (0.003)	-0.000 (0.003)	-0.006* (0.003)	0.000 (0.002)
Age squared	0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Unemployment	-0.011*** (0.002)	-0.030*** (0.005)	-0.024*** (0.004)	-0.019*** (0.005)	-0.026*** (0.005)	-0.006** (0.003)
Disability	-0.004 (0.012)	-0.014 (0.021)	-0.030 (0.019)	-0.030 (0.019)	-0.031 (0.022)	-0.020** (0.010)
German Nationality	0.087*** (0.025)	0.062* (0.035)	0.157*** (0.036)	0.143*** (0.030)	0.247*** (0.031)	0.010 (0.015)
Father self- employed	0.008 (0.011)	0.019 (0.020)	-0.005 (0.019)	0.054*** (0.019)	0.036* (0.021)	0.050*** (0.012)
Log(household income)	0.059*** (0.008)	0.146*** (0.014)	0.216*** (0.013)	0.185*** (0.014)	0.247*** (0.015)	0.070*** (0.007)
Observations	6,354	6,354	6,354	6,354	6,354	6,354

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

Results depicted in table 10 are based on the risk grouping measure. Individuals belonging to the highest risk group are more likely to hold bonds, stocks, and company assets. The positive and significant coefficients for medium risk takers as well as the negative coefficients for high risk takers even suggest an inverted u-shape relationship between willingness to take risks and holding home savings or a life insurance.

Table 10
Financial risk groups and investments in 2005 to 2009: unrestricted sample.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.002	0.039**	0.028**	0.062***	0.169***	0.005
Medium	(0.009)	(0.016)	(0.014)	(0.015)	(0.016)	(0.007)
Financial risk attitude	-0.013	-0.045	-0.012	0.131***	0.343***	0.061***
High	(0.016)	(0.028)	(0.027)	(0.027)	(0.022)	(0.017)
Female	-0.022***	-0.043***	-0.006	-0.011	0.003	0.002
	(0.008)	(0.015)	(0.014)	(0.014)	(0.015)	(0.007)
Lives in East Germany	0.026***	0.036**	0.023	-0.060***	-0.030*	0.017**
	(0.008)	(0.016)	(0.014)	(0.015)	(0.016)	(0.008)
Education	0.012***	-0.007	-0.010**	0.041***	0.061***	0.008***
	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
Age	-0.008***	0.006*	0.014***	-0.000	-0.006**	0.000
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Age squared	0.000***	-0.000***	-0.000***	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment	-0.011***	-0.030***	-0.024***	-0.020***	-0.027***	-0.006**
	(0.002)	(0.005)	(0.004)	(0.005)	(0.005)	(0.003)
Disability	-0.004	-0.014	-0.030	-0.031	-0.035	-0.021**
	(0.012)	(0.021)	(0.019)	(0.019)	(0.022)	(0.010)
German Nationality	0.087***	0.061*	0.157***	0.145***	0.253***	0.011
	(0.025)	(0.035)	(0.036)	(0.030)	(0.031)	(0.015)
Father self- employed	0.007	0.019	-0.006	0.052***	0.033	0.049***
	(0.011)	(0.020)	(0.019)	(0.019)	(0.021)	(0.012)
Log(household income)	0.059***	0.146***	0.216***	0.183***	0.243***	0.069***
	(0.008)	(0.014)	(0.013)	(0.014)	(0.015)	(0.007)
Observations	6,354	6,354	6,354	6,354	6,354	6,354

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are marginal effects from probit regressions. Robust standard errors are in brackets.

Covariates refer to the year 2004. Additional covariate not displayed: job position.

Finally, we incorporate a dummy variable indicating if an individual owned an asset between 2000 and 2004 in the unrestricted model. Thereby we interact the “having owned an asset” variable with risk attitudes. We do this for the ordinary risk measure. Results are depicted in table 11. For each financial asset, we implement a linear probability model. Coefficients (without interaction) now are conditional effects. That is, our coefficients of interest depict effects conditional on having no asset under consideration prior to 2005. In almost all specifications in table 11 (2, 3, 5, 6) having owned an asset prior to 2005 increases the impact of risk attitudes on holding the specific asset under consideration. The significant

and positive coefficients of the interaction variables (ownership of asset prior 2005 * risk attitude) again suggest that former asset holding has a feedback effect on risk attitudes.

Table 11
Interaction model: Financial risk and prior asset holding.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.013 (0.009)	-0.003 (0.003)	-0.009* (0.005)	0.014*** (0.003)	0.015*** (0.003)	0.002 (0.001)
Ownership asset 2004	0.493*** (0.033)	0.566*** (0.016)	0.462*** (0.019)	0.441*** (0.018)	0.480*** (0.016)	0.387*** (0.031)
O. asset 2004 * f. risk a.	-0.011 (0.009)	0.009** (0.004)	0.013** (0.005)	-0.003 (0.005)	0.013*** (0.004)	0.018** (0.007)
Female	-0.021*** (0.008)	-0.023** (0.011)	0.005 (0.010)	0.009 (0.011)	0.008 (0.011)	0.001 (0.007)
Lives in East Germany	0.027*** (0.008)	0.025** (0.012)	0.007 (0.011)	-0.033*** (0.012)	-0.024** (0.012)	0.007 (0.007)
Education	0.010*** (0.003)	-0.000 (0.004)	-0.003 (0.004)	0.024*** (0.004)	0.028*** (0.004)	0.005** (0.003)
Age	-0.005*** (0.002)	0.002 (0.002)	0.003 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.001)
Age squared	0.000*** (0.000)	-0.000** (0.000)	-0.000*** (0.000)	0.000* (0.000)	0.000 (0.000)	-0.000 (0.000)
Unemployment	-0.011*** (0.003)	-0.010*** (0.003)	-0.014*** (0.003)	-0.004* (0.003)	-0.006** (0.003)	-0.001 (0.001)
Disability	-0.002 (0.011)	-0.016 (0.015)	-0.016 (0.016)	-0.018 (0.016)	-0.013 (0.015)	-0.020*** (0.008)
German Nationality	0.090*** (0.028)	0.018 (0.025)	0.080*** (0.026)	0.040 (0.024)	0.096*** (0.022)	0.002 (0.018)
Father self- employed	0.007 (0.010)	0.004 (0.014)	-0.007 (0.014)	0.025 (0.016)	0.010 (0.014)	0.020* (0.010)
Log(household income)	0.042*** (0.008)	0.054*** (0.010)	0.113*** (0.010)	0.099*** (0.011)	0.095*** (0.010)	0.043*** (0.007)
Constant	-0.012 (0.074)	-0.268*** (0.085)	-0.575*** (0.086)	-0.810*** (0.088)	-0.734*** (0.083)	-0.270*** (0.055)
Results of F test Ho: coefficient on f. risk attitude + coefficient on f. risk attitude * o. asset 2004 = 0						
<i>F</i>	1.53	4.52	2.84	7.47	95.36	7.25
<i>Prob > F</i>	0.216	0.034	0.092	0.006	0.000	0.007
Observations	6,354	6,354	6,354	6,354	6,354	6,354
R-squared	0.228	0.431	0.407	0.311	0.431	0.388

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are from OLS regressions. Robust standard errors are in brackets. Covariates refer to the year 2004. Additional covariate not displayed: job position.

4.4 Controlling for time period

The analysis so far is based on the elicitation of risk attitudes in 2004. In the SOEP survey financial risk attitudes were measured a second time in 2009. Since these risk preferences might be affected by some overall factors as the financial crisis, we based our main analysis on the risk measurement elicited in 2004. However, to check whether the results are systematically driven by the particular time period of the analysis, we rerun the last analysis for 2009. In accordance to the unrestricted model of subsection 4.3 we generate a dummy variable indicating if an individual held an asset in 2010, 2011 or 2012. And, we allow individuals holding the respective asset before obtaining information about their risk attitudes. As mentioned before, risk attitudes are measured in 2009. We interact risk attitudes with a variable indicating whether an individual already owned an asset before 2010. Regression results for the second time period are depicted in table 12. Again, results suggest, that having owned an asset prior to 2010 increases the impact of risk attitudes on holding the specific asset under consideration. This especially holds for stocks: The significant and positive coefficients of the interaction variables suggest that former holding of risky assets has a feedback effect on risk attitudes.

Table 12
Interaction model: Financial risk 2009 and prior asset holding.

VARIABLES	(1) Savings account	(2) Home savings	(3) Life insurance	(4) Bonds	(5) Stocks	(6) Company assets
Financial risk attitude	0.001 (0.005)	-0.002 (0.002)	-0.004** (0.002)	0.002 (0.001)	0.003** (0.001)	0.000 (0.001)
Ownership asset 2009	0.724*** (0.015)	0.794*** (0.008)	0.714*** (0.010)	0.559*** (0.012)	0.695*** (0.010)	0.655*** (0.020)
O. asset 2009 * f. risk a.	-0.004 (0.005)	0.004 (0.003)	0.007** (0.003)	0.015*** (0.004)	0.019*** (0.003)	0.002 (0.005)
Female	0.002 (0.005)	0.000 (0.006)	-0.003 (0.006)	0.014** (0.007)	0.014** (0.006)	0.004 (0.004)
Lives in East Germany	0.007 (0.006)	0.008 (0.007)	0.007 (0.007)	-0.021*** (0.007)	-0.031*** (0.007)	0.006 (0.004)
Education	0.001 (0.002)	-0.004** (0.002)	0.006*** (0.002)	0.003 (0.003)	0.013*** (0.002)	-0.001 (0.002)
Age	0.001 (0.001)	0.003** (0.001)	0.007*** (0.001)	0.002 (0.001)	0.002 (0.001)	0.001 (0.001)
Age squared	-0.000 (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Unemployment	-0.006*** (0.001)	-0.004*** (0.001)	-0.007*** (0.002)	0.000 (0.001)	-0.002 (0.001)	-0.001 (0.001)
Disability	-0.003 (0.008)	-0.003 (0.008)	0.016* (0.009)	0.018* (0.010)	-0.002 (0.009)	0.000 (0.004)
German Nationality	0.050*** (0.019)	0.028 (0.017)	0.029 (0.019)	0.003 (0.015)	0.024* (0.014)	0.022** (0.010)
Father self- employed	0.003 (0.008)	0.002 (0.008)	-0.007 (0.009)	0.015 (0.010)	0.008 (0.009)	0.015** (0.006)
Log(household income)	0.043*** (0.006)	0.037*** (0.006)	0.063*** (0.006)	0.063*** (0.007)	0.047*** (0.006)	0.035*** (0.004)
Constant	-0.259*** (0.051)	-0.269*** (0.052)	-0.544*** (0.057)	-0.544*** (0.055)	-0.417*** (0.052)	-0.272*** (0.033)
Results of F test Ho: coefficient on f. risk attitude + coefficient on f. risk attitude * o. asset 2009 = 0						
<i>F</i>	3.24	0.87	2.08	23.34	91.23	0.24
<i>Prob > F</i>	0.072	0.351	0.149	0.000	0.000	0.622
Observations	10,872	10,872	10,872	10,872	10,872	10,872
R-squared	0.426	0.675	0.604	0.463	0.630	0.603

Notes: *** indicate significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

Coefficients in all columns are from OLS regressions. Robust standard errors are in brackets. Covariates refer to the year 2009. Additional covariate not displayed: job position.

5. Conclusion and implications

Risk attitudes affect individual behavior in a wide range of activities. In this paper we are able to examine empirically whether the decision of holding a specific asset is influenced by objectively measurable risk attitudes *before* this decision is made. Thereby, we reduce a potential feedback effect of asset holding on risk attitudes. We show that individuals with a higher willingness to take risks are indeed more likely to hold bonds, stocks, and company assets. When grouping individuals into risk groups our results even reveal that high risk takers are also less likely to own a life insurance. Owning a savings account or home savings are not correlated with the attitude towards taking risks. Comparing the results with those for a sample where individuals are allowed to hold assets before measuring risk attitudes reveals that the coefficients of the risk measure are upward biased when not controlling for reverse causality.

Individual risk aversion appears to be characterized by unexplained heterogeneity. Demographic characteristics have limited capability in predicting actions based on willingness to take risks. Our findings suggest that financial market participation shapes individuals attitudes about accepting risks. Results also imply that individuals sort themselves into financial assets according to their risk aversion. However, this selection reinforces the effect of risk aversion on asset choice. Generally our results point to an important role of prior asset holding for understanding risk aversion and portfolio decisions taken by individuals. This may hold also in other contexts.

References

- Andersen, Steffen; Harrison, Glenn W.; Lau, Morten I. and Rutström, E. Elisabet, 2008. “Lost in State Space: Are Preferences Stable?” *International Economic Review* 49:3, 1091-1112.
- Barasinska, Nataliya; Schäfer, Dorothea and Stephan, Andreas, 2012. “Individual Risk Attitudes and the Composition of Financial Portfolios: Evidence from German Household Portfolios.” *Quarterly Review of Economics and Finance* 52:1, 1-14.
- Barsky, Robert B.; Juster, F. Thomas, Kimball, Miles S. and Shapiro, Matthew D., 1997. “Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study.” *Quarterly Journal of Economics* 112:2, 537-579.
- Bowles, Samuel, 1998. “Endogenous Preferences: The Cultural Consequences of Markets and other Economic Institutions.” *Journal of Economic Literature* 36:1, 75–111.
- Buccioli, Alessandro and Miniaci, Raffaele, 2011. “Household Portfolios and Implicit Risk Preference.” *Review of Economics and Statistics* 93:4, 1235-1250.
- Bucher-Koenen, Tabea and Lusardi, Annamaria, 2011. “Financial Literacy and Retirement Planning in Germany.” *Journal of Pension Economics* 10:4, 565-584.
- Dohmen, Thomas; Falk, Armin; Huffman, David; Sunde, Uwe; Schupp, Jürgen and Wagner, Gert G., 2011. “Individual Risk Attitudes: Measurement, Determinants and Behavioral Consequences.” *Journal of the European Economic Association* 9:3, 522-550.
- Friend, Irwin and Blume, Marshall E., 1975. “The Demand for Risky Assets.” *American Economic Review* 65:5, 900-922.
- Harrison, Glenn W., Johnson, Eric, McInnes, Melayne M., and Rutström, E. Elisabet, 2005. “Temporal Stability of Estimates of Risk Aversion.” *Applied Financial Economics Letters* 1:1, 31-35.

- Heaton, John and Lucas, Deborah, 2000. "Portfolio Choice in the Presence of Background Risk." *The Economic Journal* 110: 460, 1-26.
- Kapteyn, Arie and Teppa, Federica, 2011. "Subjective Measures of Risk Aversion, Fixed Costs, and Portfolio Choice." *Journal of Economic Psychology* 32:4, 564-580.
- Kimball, Miles S., Sahm, Claudia R. and Shapiro, Matthew D., 2008. "Imputing risk tolerance from survey responses." *Journal of the American Statistical Association* 103:483, 1028-1038.
- Malmendier, Ulrike and Nagel, Stefan, 2011. "Depression Babies: Do Macroeconomic Experiences Affect Risk Taking?" *The Quarterly Journal of Economics* 126:1, 373-416.
- Riley, William B. and Chow, K. Viktor, 1992. "Asset Allocation and Individual Risk Aversion." *Financial Analysts Journal* 48:6, 32-37.
- Siegel, Frederick W. and Hoban, James P., 1982. "Relative Risk Aversion Revisited." *Review of Economics and Statistics* 64:3, 481-487.
- Ucbasaran, Deniz, Wright Mike, and Westhead Paul, 2008. "Opportunity Identification and Pursuit: Does an Entrepreneur's Human Capital Matter?" *Small Business Economics* 30:2, 153-173.
- Van Rooij, Maarten; Lusardi, Annamaria and Alessie, Rob, 2011. "Financial Literacy and Stock Market Participation." *Journal of Financial Economics* 101:2, 449-272.
- Weber, Elke U., Blais, Ann-Renee and Betz, Nancy E. 2002. "A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors." *Journal of Behavioral Decision Making* 15:4, 263-290.
- Westhead, Paul and Wright, Mike, 1998. "Novice, Serial and Portfolio Founders: Are They Different?" *Journal of Business Venturing* 13:3, 173-204.

APPENDIX

Table A.1 Data description

Label	Description
Ownership of the following investment forms (between 2005 and 2009)	
Savings account	Dummy = 1 if individual owns a savings account between 2005 and 2009, but not between 2000 and 2004
Home savings	Dummy = 1 if individual owns a savings contract for building a home between 2005 and 2009, but not between 2000 and 2004
Life insurance	Dummy = 1 if individual owns a life insurance between 2005 and 2009, but not between 2000 and 2004
Bonds	Dummy = 1 if individual owns fixed interest securities (e.g. saving bonds, mortgage bonds, federal savings bonds) between 2005 and 2009, but not between 2000 and 2004
Stocks	Dummy = 1 if individual owns other securities (e.g. stocks, funds, equity warrant) between 2005 and 2009, but not between 2000 and 2004
Company assets	Dummy = 1 if individual owns company assets (for individuals own company, other companies, agricultural assets) between 2005 and 2009, but not between 2000 and 2004
Financial risk attitude	Willingness to take risks in financial matters in 2004 (11 point scale)
Female	Dummy = 1 if female
Lives in East Germany	Dummy = 1 if individual lives in Eastern Germany in 2004
Education	Education level in 2004 based on ISCED classification
Age	Age of the individual in 2004
Age squared	Age squared
Unemployment	Years of unemployment experience in 2004
Disability	Dummy = 1 if individuals is handicapped/physically challenged
German Nationality	Dummy= 1 if individual is from Germany
Father self-employed	Dummy = 1 if individual's father was self-employed when she/he was 15 years of age
Log(household income)	Monthly net income of household
Occupational position	
Unemployed	Dummy = 1 if individual is unemployed
Non-working	Dummy = 1 if individual is not working (retirees, apprentices, etc.)
Unskilled Blue Collar / Helping Family Member	Dummy = 1 if individual is an unskilled worker or a helping family member
Skilled Blue Collar / Blue Collar Craftsman	Dummy = 1 if individual is a skilled worker or a craftsman
Self-employed	Dummy = 1 if individual is self-employed
White Collar	Dummy = 1 if individual is an employee
Civil Servant	Dummy = 1 if individual is a civil servant

