

Dohmen, Thomas et al.

Working Paper

Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey

DIW Discussion Papers, No. 511

Provided in Cooperation with:

German Institute for Economic Research (DIW Berlin)

Suggested Citation: Dohmen, Thomas et al. (2005) : Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey, DIW Discussion Papers, No. 511, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin

This Version is available at:

<http://hdl.handle.net/10419/18362>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Discussion Papers

511

Thomas Dohmen
Armin Falk
David Huffman
Uwe Sunde
Jürgen Schupp
Gert G. Wagner

Individual Risk Attitudes:
New Evidence from a Large, Representative,
Experimentally-Validated Survey

Berlin, September 2005



DIW Berlin

German Institute
for Economic Research

IMPRESSUM

© DIW Berlin, 2005

DIW Berlin
Deutsches Institut für Wirtschaftsforschung
Königin-Luise-Str. 5
14195 Berlin
Tel. +49 (30) 897 89-0
Fax +49 (30) 897 89-200
www.diw.de

ISSN print edition 1433-0210
ISSN electronic edition 1619-4535

All rights reserved.
Reproduction and distribution
in any form, also in parts,
requires the express written
permission of DIW Berlin.



Discussion Papers 511

Thomas Dohmen*
Armin Falk**
David Huffman*
Uwe Sunde**
Jürgen Schupp***
Gert G. Wagner****

**Individual Risk Attitudes:
New Evidence from a Large,
Representative, Experimentally-Validated Survey**

Berlin, September 2005

* IZA Bonn

** IZA Bonn and University of Bonn

*** DIW Berlin and IZA Bonn

**** DIW Berlin, Berlin University of Technology, Cornell University and IZA Bonn

ABSTRACT

Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey

This paper presents new evidence on the distribution of risk attitudes in the population, using a novel set of survey questions and a representative sample of roughly 22,000 individuals living in Germany. Using a question that asks about willingness to take risks on an 11-point scale, we find evidence of heterogeneity across individuals, and show that willingness to take risks is negatively related to age and being female, and positively related to height and parental education. We test the behavioral relevance of this survey measure by conducting a complementary field experiment, based on a representative sample of 450 subjects, and find that the measure is a good predictor of actual risk-taking behavior. We then use a more standard lottery question to measure risk preference, and find similar results regarding heterogeneity and determinants of risk preferences. The lottery question makes it possible to estimate the coefficient of relative risk aversion for each individual in the sample. Using five questions about willingness to take risks in specific domains — car driving, financial matters, sports and leisure, career, and health — the paper also studies the impact of context on risk attitudes, finding a strong but imperfect correlation across contexts. Using data on a collection of risky behaviors from different contexts, including traffic offenses, portfolio choice, smoking, occupational choice, participation in sports, and migration, the paper compares the predictive power of all of the risk measures. Strikingly, the general risk question predicts all behaviors whereas the standard lottery measure does not. The best overall predictor for any specific behavior is typically the corresponding context-specific measure. These findings call into the question the current preoccupation with lottery measures of risk preference, and point to variation in risk perceptions as an understudied determinant of risky behavior.

JEL Classification: D0, D1 D80, D81, C91, C93

Keywords: risk preferences, preference stability, experimental validation, field experiment, SOEP, gender differences, age, height, subjective well-being

Corresponding author:

Armin Falk
IZA
P.O. Box 7240
D-53072 Bonn
Germany
Email: falk@iza.org

1 Introduction

Risk and uncertainty are pervasive in economic life, playing a role in almost every important economic decision. As a result, understanding individual attitudes towards risk is intimately linked to the goal of predicting economic behavior. This paper uses new data and new methodology in an attempt to address some of the challenging questions surrounding this concept. In particular, do risk attitudes vary across individuals? If so, what are the determinants of individual differences? Are hypothetical measures of risk attitudes reliable predictors of actual risky behavior? What is the impact of context on willingness to take risks? Is there a single underlying preference that determines risk-taking in all contexts? How does the impact of personal characteristics vary with context? Can survey questions incorporating situation-appropriate context outperform standard, lottery-question measures of risk preference? How important are individual differences in risk perception for explaining behavior, as opposed to risk preference?

Our evidence is based on a sample of roughly 22,000 individuals, substantially larger than in previous studies of risk attitudes. The data are from the 2004 wave of the Socio-economic Panel (SOEP), which is carefully constructed to be representative of the German population. For each individual, the data provide a battery of new survey measures. The first measure asks about “willingness to take risks, in general” on an 11-point scale. The second is a more standard measure of risk preference, in which respondents indicate willingness to invest in a hypothetical lottery with explicit stakes and probabilities. Using responses to this question, it is possible to calculate a parameter describing the curvature of the individual’s utility function. There are also five additional questions, which use the same scale as the general risk question, but ask about willingness to take risks in specific contexts: car driving, financial matters, sports and leisure, career, and health. In a complementary field experiment, based on a representative sample of 450 individuals, we test the behavioral relevance of the general risk question, and find that it is a good predictor of risky choices with real money at stake. As a result of the experimental exercise, this measure and the other similar measures in the SOEP are uniquely valid instruments for inferring differences in actual risk-taking behavior.

The paper begins by presenting new evidence on the distribution of risk attitudes in the population, and the determinants of individual differences. Initially, we focus on

our most general measure, the general risk question, and construct a population-wide distribution of willingness to take risks. This distribution reveals substantial individual heterogeneity. Turning to possible determinants of these differences, we investigate the relationship between willingness to take risks and selected personal characteristics: gender, age, height, and parental background. We focus on these characteristics because they are plausibly exogenous and therefore allow causal interpretation. The analysis reveals several facts: (1) women are less willing to take risks than men, at all ages; (2) increasing age is associated with decreasing willingness to take risks; (3) taller individuals are more willing to take risks; (4) individuals with highly-educated parents are more willing to take risks. These effects are large and very robust, with the exception of parental education, which becomes insignificant in some specifications. This evidence on determinants has important implications. For example, differences in risk preferences could be one factor contributing to the well-known gender wage gap, gender-specific behavior in competitive environments (Gneezy *et al.*, 2003; Gneezy and Rustichini, 2004), and gender differences in career choice (Dohmen and Falk, 2005). The impact of age implies increased financial conservatism in ageing societies, and the height result points to a possible mechanism behind the higher earnings potential of taller individuals (Persico *et al.*, 2004). These four findings also suggest characteristics that can be used to partially control for risk attitudes in the absence of direct survey measures.

A chief advantage of survey questions is that they offer a direct measure of individual attitudes, avoiding the need to recover behavioral parameters by making restrictive identifying assumptions. Another advantage is the possibility of measuring attitudes for a very large sample, at relatively low cost, because the questions are hypothetical and do not involve real money. A potentially serious disadvantage of using hypothetical survey questions, however, is that they might not predict actual behavior. In this paper we offer a solution to this dilemma: the combination of a large survey with a field experiment designed to validate the survey measures.

The primary methodological point of the paper is that field experiments with a representative subject pool can be used to validate survey measures, in order to end up with both statistical power and confidence in the reliability of the measures. To test the validity of our survey measures, we conducted a field experiment in which participants had the opportunity to make risky choices with real money at stake, and also answered

the general risk question from the SOEP. We used a representative sample of 450 adults living in Germany as subjects, in order to match the sampling design of the survey. We find that answers to the general risk question are good predictors of actual risk-taking behavior in the experiment. With a high level of confidence we can therefore reject the null hypothesis that this survey measure is behaviorally irrelevant.

It is important to compare results based on the general risk question to results using a more standard lottery measure. The SOEP poses respondents with such a lottery, in the form of a hypothetical investment opportunity: respondents are asked how much of a windfall gain of 100,000 Euros they would invest in an asset that returns double, or half, of their investment, with equal probability. In comparison to the general risk measure, this question incorporates the relatively concrete context of a real-world financial decision. It also gives explicit stakes and probabilities, holding perceptions of the riskiness of the decision constant across individuals. By contrast, the general risk question potentially incorporates both risk preference and risk perception, i.e., individuals are free to think about curvature of utility when choosing a value on the response scale, but also to incorporate subjective beliefs about the stakes and probabilities typically involved in taking a risk “in general.” The amount invested in the hypothetical asset turns out to be strongly correlated with responses to the general risk question. The distribution of investment choices reveals heterogeneity across individuals, and gender, age, height and parental education all play a role in explaining differences in risk preferences. The effects of all of these exogenous factors are very robust and qualitatively similar to those observed using the general risk question.

Combining investment choices with information on individual wealth, it is also possible to infer a range for each individual’s Arrow-Pratt coefficient of relative risk aversion. We construct a distribution of interval midpoints in the population, and find support for the range of parameter values typically assumed in economic models. We also illustrate the first step needed to interpret responses to the general risk question in terms of ranges for parameter values: a mapping from responses on the general risk question to average amounts invested in the hypothetical asset, which then imply parameter ranges.

A fundamental question surrounding the notion of risk attitudes is the relevance of context. In economics it is standard to assume that a single, underlying risk preference governs risk taking in all domains of life. In line with this assumption, economists typically

use a lottery measure of risk preference, framed as a financial decision, as an indicator of risk attitudes in all other contexts, e.g., health. Some psychologists and economists, however, have questioned whether stable utility functions and risk preferences exist at all, given that risk attitudes appear to be highly malleable with respect to context in laboratory experiments (e.g., Slovic, 1964, 1972a and 1972b; Eckel and Grossman, forthcoming). An alternative interpretation of this evidence, of course, is that a stable risk preference does exist, but that individuals believe the typical risk in one context is greater than in another, and indicate different willingness to take risks accordingly (Weber *et al.*, 2002).

The five context-specific questions in the SOEP make it possible to study the impact of context, but for a much larger and more representative group of individuals than the typical laboratory experiment. Average willingness to take risks turns out to differ across contexts. However, the correlation across contexts is quite strong. Principal components analysis tells a similar story: one principal component explains the bulk of the variation, suggesting the presence of a single underlying trait, but each of the other components still explains a non-trivial amount of the variation. Overall, these findings support a middle position between the two extreme views. There is evidence for a single trait operating in all contexts, suggesting that the standard assumption is a reasonable approximation. On the other hand, something is varying across contexts. This could reflect some malleability in risk preferences, but is more likely to reflect differences in risk perception. In fact, risk perceptions are known to vary across individuals based on evidence from psychology.¹ Like the general risk question, the context-specific measures are able to capture differences in risk perception, e.g., beliefs regarding the relative danger of driving versus playing sports. The implication is that the standard approach – using lottery questions to predict behavior in all contexts – may be reasonable to the extent that it captures a stable risk preference, but also neglects a potentially important source of variation in context-specific willingness to take risks.

The final portion of the analysis compares the predictive power of all of the alternative risk measures, within and across different life contexts. We identify a collection of behavioral outcomes that spans the five contexts identified in the SOEP — portfolio

¹ For example, a number of studies have asked directly about risk perceptions and have documented a tendency for women to perceive dangerous events, such as nuclear war, industrial hazards, environmental degradation, and health problems due to alcohol abuse, as more likely to occur, in conditions where objective probabilities are difficult to determine (Silverman and Kumka, 1987; Stallen and Thomas, 1988; Flynn *et al.*, 1994; Spigner *et al.*, 1993).

choice, participation in sports, occupational choice, smoking, migration, subjective well-being, and traffic violations — and then compare how well different risk measures do at predicting these behaviors. The first finding is that any single measure is a significant predictor of several of the behaviors, providing further validation of their behavioral relevance. This validity across contexts also supports the standard assumption of a stable, underlying risk preference. Importantly, however, the only measure to predict all of the behaviors is the general risk question. In this sense the general risk question is the best all-around measure. By contrast, the hypothetical lottery does not predict smoking, migration, or self-employment and predicts public sector employment with the “wrong” sign. It is also striking that the best predictor of behavior in a given domain is typically the question incorporating context specific to that domain. For example, willingness to take risks in health matters is a better predictor of smoking than the hypothetical investment question, or the general risk question, or any other domain-specific question. A likely explanation for the better performance of the alternative measures is that they capture additional information about the individual, in terms of context-specific risk perceptions, e.g., the individual’s beliefs regarding the dangers of smoking. Overall, the evidence calls into question the use of lottery questions to predict risky behavior in all contexts. This approach is only optimal if risk preferences, and risk perceptions, remain constant across contexts, which seems inconsistent with our findings. The implication is that the standard conception is overly preoccupied with risk preference, and that measures capturing differences in risk perception, across individuals and contexts, are indispensable for the ultimate goal of predicting behavior.

In summary, the paper contributes new evidence on the determinants and measurement of individual risk attitudes. These conclusions are based on a substantially larger sample than in previous studies, and on survey measures that are shown to be behaviorally relevant in an accompanying field experiment. As such, the conclusions have a broader scope than in previous studies and can be interpreted in terms of behavior with more confidence. Previous studies using relatively large, representative samples include Guiso *et al.* (2002), Guiso and Paiella (2001), and Guiso and Paiella (2005), all of whom use a sample of 8,135 heads of households in the Italian Survey of Household Income and Wealth (SHIW) and measure risk preferences with an abstractly-framed, hypothetical lottery. Diaz-Serrano and O’Neill (2004) use the same sample but also add the next

wave from the survey, which includes roughly 3,000 additional individuals. Donkers *et al.* (2001) uses a sample of 4,000 individuals living in the Netherlands, one half of which is representative and the other half of which is drawn from the top 10 percent of the income distribution, and measures risk preferences with a series of abstract lotteries. Barsky *et al.* (1997) uses an especially large sample, 14,000 individuals living in the US, but this comes from the Health and Retirement Survey which is focused on individuals between 51 and 61 years of age. They measure risk preference using a hypothetical lottery involving different future income streams. Where it is relevant in the paper, we discuss the methodologies of these complementary studies in more detail.

There are a number of cases in which the evidence in this paper provides a powerful confirmation of previous findings, but others in which the findings contrast strongly with previous results. In particular, many previous studies have found a similar impact of gender on willingness to take risks (for a meta-analysis, see Byrnes *et al.*, 1999; for a review of experimental evidence on gender effects, see Eckel and Grossman, forthcoming). This paper documents the same gender difference on a larger scale, but in contrast to experimental evidence in Schubert *et al.* (1999), the effect is robust to the inclusion of concrete context in the question frame, e.g., as in the hypothetical investment scenario. In fact, the gender effect is present in all contexts, and at all ages, and is robust to controlling for wealth and other personal characteristics. In terms of the age effect, this paper is one of the few to study the full range of ages over adulthood, (exceptions include studies using the SHIW and Donkers *et al.*, 2001), and the first to investigate the impact of age in a variety of contexts. Few previous papers have investigated the impact of parental background on risk attitudes, with the exception of Guiso and Paiella (2001), and Guiso and Paiella (2005), who look at father's occupation (Hartog *et al.*, 2002, finds a similar impact of mother's education in a sample composed of accountants). To our knowledge, no previous paper has studied the relationship between height and risk attitudes.

The estimates of CRRA coefficients in this paper differ from previous studies in that they incorporate detailed information on individual wealth, and are based on a lottery with stakes that are large enough to be meaningful in terms of lifetime income (for other approaches see Guiso and Paiella, 2005; Barsky *et al.*, 1997; Donkers *et al.*, 2001). The analysis of risk attitudes across contexts has mainly been studied in psychology experiments with much smaller sample sizes. Previous studies have found that standard

measures of risk preference predict behaviors such as portfolio choice, smoking, and occupational choice. Our measures have similar predictive power, but our findings also point to the importance of context-specific risk perceptions in determining risky behavior. In particular, measures incorporating both risk preference and context-specific risk perceptions outperform a standard lottery measure of risk preference.

The organization of the paper is as follows. Section 2 describes the SOEP and the risk measures. Section 3 investigates individual heterogeneity and exogenous determinants of risk attitudes using the general risk question. Section 4 presents results on the behavioral relevance of the general risk question, based on the complementary field experiment. Section 5 compares the distribution and determinants of investment choices in the hypothetical lottery to results based on the general risk measure, and calculates individual risk coefficients. Section 6 assesses the stability of risk attitudes across different domains of life. Section 7 compares the predictive power of the different risk measures for a collection of behavioral outcomes. Section 8 concludes.

2 Data Description

The SOEP is a representative panel survey of the resident population of Germany (for a detailed description, see Wagner *et al.*, 1993, and Schupp and Wagner, 2002). The initial wave of the survey was conducted in 1984.² The SOEP surveys the head of each household in the sample, but also gives the full survey to all other household members over the age of 17. Respondents are asked for a wide range of personal and household information, and for their attitudes on assorted topics, including political and social issues. The survey also includes various subjective measures (e.g., life satisfaction) which are widely used and recognized for their quality (see, e.g., Ferrer-i-Carbonell and Frijters, 2004; Frijters *et al.*, 2004a and 2004b; van Praag and Ferrer-i-Carbonell, 2004). This paper is the first to use the new measures of risk attitudes added to the survey in the 2004 wave. The 2004 wave, which includes 22,019 individuals in 11,803 different households, is the focus of our analysis.

We analyze seven different questions from the SOEP which ask, in different ways,

² The panel was extended to include East Germany in 1990, after reunification. For more details on the SOEP, see www.diw.de/gsoep/.

about an individual's risk attitudes.³ The first question asks for attitude towards risk in general, allowing respondents to indicate their willingness to take risks on an eleven-point scale, with zero indicating complete unwillingness to take risks, and ten indicating complete willingness to take risks.⁴ The next five questions all use the same scale, and similar wording, but refer to risk attitudes in specific contexts: car driving, financial matters, leisure and sports, career, and health. All of these measures are characterized by ambiguity, in the sense that they leave it up to the respondent to imagine the typical probabilities, and stakes, involved in taking risks in a given domain.

The last risk question is different, in that it corresponds more closely to the lottery measures used in previous studies. The question presents respondents with the following choice:

Imagine you had won 100,000 Euros in a lottery. Almost immediately after you collect, you receive the following financial offer from a reputable bank, the conditions of which are as follows: There is the chance to double the money within two years. It is equally possible that you could lose half of the amount invested.

Respondents are then asked what fraction of the 100,000 Euros they would choose to invest, and are allowed six possible responses: 0, 20,000, 40,000, 60,000 80,000, or 100,000 Euros.⁵ This measure shares the common feature of other lottery measures in that it presents respondents with explicit stakes and probabilities, and thus holds risk perceptions constant across individuals. Because beliefs are held constant, differences in responses are more clearly attributable to risk preference alone, as compared to the six measures above, which potentially incorporate both risk preference and risk perceptions. Under certain assumptions, it is also possible to use responses to the hypothetical lottery to infer a parameter describing the curvature of the individual's utility function, corresponding to

³ There is also an eighth question asking about willingness to take risks when trusting strangers. This question appears to measure something different. For this reason we analyze responses to the trust question in detail in a separate paper, see Dohmen *et al.* (2005a).

⁴ The exact wording of the question (translated from German) is as follows: 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? Please tick a box on the scale, where the value 0 means: 'unwilling to take risks' and the value 10 means: 'fully prepared to take risk'." German versions of all risk questions are available online, at www.diw.de/deutsch/sop/service/fragen/personen/2004.pdf.

⁵ The exact wording is as follows: "What share of your lottery winnings would you be prepared to invest in this financially risky, yet lucrative investment?"

the theoretical notion of risk preference.

3 Willingness to Take Risks in General

This section presents the distribution of willingness to take risks in the population, as measured by the general risk question, and then turns to the investigation of possible determinants of individual differences in risk attitudes.

3.1 Risk attitudes in a representative sample

Figure 1 describes the distribution of general risk attitudes in our sample. Each bar in the histogram indicates the fraction of individuals choosing a given number on the eleven point risk scale. The modal response is 5, but a substantial fraction of individuals answers in the range between 2 and 8. There is also a notable mass, roughly 7 percent of all individuals, who choose the extreme of 0, indicating a complete unwillingness to take risks. Only a very small fraction chooses the other extreme of 10.

3.2 Exogenous Factors: Gender, Age, Height and Parental Education

Given that risk attitudes are heterogeneous, it is important to understand the determinants of these individual differences. We investigate the impact of four personal characteristics on risk attitudes: gender, age, height, and parental background. We focus on these characteristics because they are plausibly exogenous to individual risk attitudes and behavior and thus allow us to give a causal interpretation to correlations and regression results.⁶

The lower panel of Figure 1 shows the difference between the fraction of women and the fraction of men choosing each value on the general risk scale. Clearly, women are more likely to choose low values on the scale and men are more likely to choose high values. The figure thus gives an initial indication that women are less willing to take risks than men, although this result is not yet conditioned on other potentially relevant characteristics.

Figure 2 displays the relationship between age and risk attitudes, with separate panels for men and women. The shaded bands indicate the proportion of individuals at each age who choose a given value on the 11-point risk scale. Starting at the bottom,

⁶ Note, however, the caveat that age could potentially be endogenous, for example if people who are less willing to take risks live longer.

the darkest shade shows the proportion choosing 0, indicating a complete unwillingness to take risks. Progressively lighter shades correspond to choices 1 to 4, and the white band corresponds to 5. Above the white band, progressively darker shades indicate choices 6 to 10.

Clearly, the proportion of individuals who are relatively unwilling to take risks, i.e., choose low values on the scale, increases strongly with age. For men, age appears to cause a steady increase in the likelihood that an individual is unwilling to take risks. For women, there is some indication that unwillingness to take risks increases more rapidly from the late teens to age thirty, and then remains flat, until it begins to increase again from the mid-fifties onwards. It is important to note that this relationship could reflect a direct effect of age on risk preferences, but could also be driven by cohort effects, i.e., society-wide changes in risk preferences over time, perhaps due to major historical events. The difference in age patterns for men and women makes it less credible that the change in risk attitudes is attributable to cohort effects, because major historical events are likely to affect both men and women at the same time, but it is difficult to definitively disentangle the two explanations with the data available.

Comparing the panels for men and women, it appears that women are less willing to take risks than men at all ages, although the gap narrows somewhat among the elderly. Another noteworthy feature of Figure 2 is that the differently shaded bands track each other quite closely over the entire age range. This suggests that aggregating the risk measure from eleven categories to a smaller number of categories is likely to preserve most of the information in the risk measure. This observation will lead us to adopt a simple, binary classification of risk attitudes in parts of the analysis later on.

Figure 3 presents histograms of responses to the general risk question by parental education. Other aspects of family background could be relevant for risk attitudes, e.g., parental income, but only parental education is available in the data.⁷ As a proxy for highly-educated parents, we use information on whether or not a parent passed the “*Abitur*,” an exam that comes at the end of university-track high school in Germany and is a prerequisite for attending university.⁸ The histograms in Figure 3 give some

⁷ It is likely that parental education captures some of the effect of parental wealth and income.

⁸ There are two types of high school in Germany, vocational and college-track. Only about 30 percent of students attend college-track high schools, and pass their *Abitur*, allowing them to attend college. Thus, completion of an *Abitur* exam is an indicator of relatively high academic achievement.

indication that family background does play a role in determining risk attitudes. The mass in the histograms for individuals with highly-educated parents, shown in the bottom panel, appears shifted to the right compared to histograms for individuals without highly-educated parents, shown in the upper panel, indicating a positive correlation between parental education and willingness to take risks.

Figure 4 presents histograms of responses to the general risk question by self-reported height, again with separate panels for men and women. The figure shows that taller individuals are more willing to take risks. This relationship is unconditional, and thus could reflect correlation with other factors, in particular parental education. Highly-educated parents might have higher income, provide better nutrition, and thus have taller children.⁹ On the other hand, the result could reflect a direct effect of height on willingness to take risks, perhaps through a channel discussed recently in Persico *et al.* (2004). They find that individuals who are tall in their teenage years earn higher wages later in life, even if they are the same height in adulthood. They hypothesize that this difference is due to the impact of height in adolescence on confidence and self-esteem. Our findings suggest one channel through which the greater confidence arising from height translates into positive economic outcomes: increased willingness to take risks.

3.3 The Joint Role of Exogenous Determinants

To determine whether these unconditional results are robust once we control for all four exogenous characteristics simultaneously, we turn to regression analysis. We estimate binary Probit models, where the dependent variable is equal to 1 if individuals are relatively willing to take risks, i.e., choose a value greater than 5 on the risk scale. Likewise, a person is classified as relatively unwilling to take risks if he or she chooses a value of 5 or lower on the risk scale. We prefer using this binary measure, despite the fact that it neglects some information contained in the ordinal structure, because it generates results that are intuitive and simple to interpret, and minimizes problems arising from individual-specific differences in the use of response scales.¹⁰ All estimation results report robust standard

⁹ Height is frequently used as an instrument for child nutrition and health in the development literature see, e.g., Schultz (2002).

¹⁰ We find similar results if we estimate Ordered Probit, or interval regression models, using a dependent variable that reflects the full range of answers from 0 to 10. Thus we feel confident reporting the simpler, more intuitive Probit results.

errors, corrected for possible correlation of the error term across individuals from the same household. The only sample restriction in the analysis is the omission of individuals who have missing values for any of the variables in the regression.

Table 1 summarizes our initial regressions. The baseline specification, presented in Column (1), uses the four exogenous characteristics discussed above as explanatory variables. The resulting coefficient estimates show that the unconditional results remain robust. Women are significantly less willing to take risks in general. The probability that someone is willing to take risks also decreases significantly with age. Unreported regressions that include age in splines with knots at 30 and 60 years reveal that the age effect is particularly strong for young and old ages, reflecting the patterns displayed in Figure 2.¹¹ The inclusion of splines leaves the estimates of the other coefficients virtually unchanged. Taller people are more likely to report that they are willing to take risks. Finally, having a mother or father who is highly educated, in the sense of having completed the *Abitur*, significantly increases the probability that the individual is willing to take risks. All of these effects are individually and jointly significant at the 1-percent level.¹²

Columns (2) to (9) check the robustness of our findings by including other control variables. The most important economic variables that need to be controlled for are measures for income and wealth. High income or wealth levels may increase the willingness to take risks because they cushion the impact of bad outcomes. Individual wealth information is taken from the 2002 wave of the SOEP, which contains detailed information on different assets and property values.¹³ Household wealth is constructed by summing the wealth information of all individuals in the household.¹⁴ The yearly or monthly income measures ask about income from a variety of sources, including retirement pensions, social assistance, capital and labor income. We use income information from the 2003 as well as from the 2004 wave. The former provides data on annual net income, while the latter has

¹¹ Results for spline regressions are available upon request.

¹² A likelihood-ratio test reveals that adding interaction terms between all independent variables improves the fit. The coefficients of interest in the unrestricted specification, however, are very similar to those from the restricted model, both qualitatively and quantitatively. We prefer the model reported in Column 1 of Table 1 for ease of presentation and interpretation, because, e.g., the coefficient on the interaction term between age and parental education might be driven by trends in educational achievement over time.

¹³ The regression includes log individual wealth if wealth is positive (non-zero) and the absolute value of individual wealth logged if wealth is negative (non-zero).

¹⁴ Adding household wealth increases the number of observations somewhat because of some missing values for the individual wealth variable.

data on current monthly gross income at the stage of the interview. A potential problem with adding these variables to the regression is that they may be endogenous, e.g., a high wealth level could lead to greater willingness to take risks, because it cushions the impact of bad outcomes, but a greater willingness to take risks could also lead to high wealth levels. Wealth and income are sufficiently important economic variables, however, that it is arguably important to know what happens to the baseline results when they are included in the regression.

A comparison of the results in Columns (2) to (7) to results in Column (1) shows that the coefficient estimates are very robust to including the additional income and wealth controls. The point estimates for gender, age, height and parental education are virtually unchanged, and remain equally statistically significant, regardless of which wealth or income measure is included in the regression. Although causal interpretations are inadvisable, it is noteworthy that the correlation between wealth or income and risk attitudes goes in the predicted direction, i.e., these coefficients are invariably positive and significant, indicating that wealthier individuals are more willing to take risks.

As an additional robustness check, Columns (8) and (9) control for wealth and income simultaneously, at the individual or household level, and also add a variety of other personal and household characteristics. These characteristics, which are all potentially endogenous, include among others: marital status, socialization in East or West Germany, nationality, employment status (white collar, blue collar, private or public sector, self-employed, non-participating), education, subjective health status, and religion. For the sake of brevity, the table does not report coefficient estimates for all of the additional controls. The precise specification and all coefficients are shown in Table A.1 in the Appendix. Once again, the point estimates and significance levels for gender, age, and height are virtually unchanged. The coefficients for parental education are less robust. Mother's education is still significant in Column (8), but becomes insignificant in Column (9) where household income and wealth are included simultaneously. Father's education is not significant in either column. This could reflect the correlation between parental education and wealth, as well as the strong correlation between father's education (and occupation) and children's occupational choice.

In summary, we find that women are less willing to take risks than men,¹⁵ increasing

¹⁵ Gender differences have often been studied using Oaxaca-Blinder decomposition techniques, which are

age leads to decreasing willingness to take risks, and increasing height leads to a greater willingness to take risks. These findings are robust in all specifications. Having a mother who completed the *Abitur* increases the likelihood that an individual is willing to take risks, although in one specification this effect is insignificant. The impact of father's education is less robust, with an insignificant effect in two specifications, but otherwise seems to cause an increased willingness to take risks.

4 Experimental Validation of Survey Measures

The previous section identified several exogenous factors that determine individual risk attitudes. Importantly, these conclusions were drawn from a very large and representative survey. The scope of the results is therefore considerably larger than that of the typical laboratory experiment, which uses a small and selective subject pool of undergraduate students. Even the recently conducted field experiment by Harrison *et al.* (2003) relies on a subject pool of only 253 subjects. While their study makes an important contribution to the literature by studying behavior of a non-student subject pool, their data do not allow an analysis as detailed as the one that is possible with data based on 22,000 individuals.

On the other hand, all results in the previous section are based on survey responses, not on actual behavior. A serious concern with the use of hypothetical questions is that they might not predict actual behavior. Put differently, it is unclear to what extent the general risk question is a reliable indicator for real risk taking behavior. Since survey responses are not incentive compatible, it may well be that respondents give inaccurate answers, perhaps due to strategic considerations, self-serving biases, or a lack of attention. In a related paper on social preferences, Glaeser *et al.* (2000) have shown that attitudinal trust questions do not predict actual trusting behavior in controlled and paid experiments. Overall, the evidence on the reliability of survey measures is an unresolved issue and there continues to be considerable debate over how accurate hypothetical questions really are, and in what circumstances they are likely to perform reasonably well (Camerer and

more flexible than regression analysis because they allow gender to interact with all observable characteristics. Specifically, the technique decomposes the difference in risk attitudes across gender into two different components, one due to differences in observable characteristics and the other due to differences in regression coefficients. Performing this decomposition we find that more than 60 percent of the gender gap is explained by differences in coefficients rather than characteristics, regardless of the specification or the reference group chosen. This provides a further confirmation that women are less willing to take risks, even if they have the same observable characteristics as men.

Hogarth, 1999; Kraus, 1995).

In light of this discussion, the researcher who is interested in an accurate and yet representative measurement of preferences faces a dilemma. Running an experiment with, say, 22,000 subjects is hardly a feasible option, given the substantial associated administrative and financial costs. Conducting surveys or experiments with only several hundred subjects, on the other hand, leaves the researcher either with uncertainty about the reliability of the data or a relatively small sample with limited statistical power. In this paper we suggest a solution to this dilemma: the combination of a large survey with field experiments designed to validate the survey measures. The primary methodological point of this paper is that experiments can be used to validate survey measures to end up with both statistical power and confidence in the reliability of the measures. In order to validate our survey risk measure, we ran a lottery experiment based on a representative sample of adult individuals living in Germany. Of course, it would also be possible to validate the measure in a lab experiment with undergraduates, a relatively easy and potentially less expensive option. Strictly speaking, however, this would only allow validation of the survey questions for this special subgroup of the total population, which is why we decided on our alternative design.

In our field experiment, the subjects are a random sample of the population drawn using the random walk method (Fowler, 1988).¹⁶ The survey-experiment was conducted by experienced and trained interviewers who interviewed subjects face-to-face at the subjects' homes. Both answers to the questionnaire and the decisions in the lottery experiment were typed into a computer (Computer Assisted Personal Interview (CAPI)). The study was run between June 9th and July 4th, 2005, and a total of 450 participants took part.

In our study, subjects first went through a detailed questionnaire, similar to the standard SOEP questionnaire. As part of the questionnaire we asked the general risk question analyzed in the previous section. After completion of the questionnaire, participants took part in a paid lottery experiment. In the experiment participants were shown a table with 20 rows. In each row they had to decide whether they preferred a safe option or playing a lottery. In the lottery they could win either 300 Euros or 0 Euros with 50 percent probability (1 Euro \sim \$ US 1.2). In each row the lottery was exactly the same but

¹⁶ For each of 179 randomly chosen primary sampling units (voting districts), one trained interviewer was given a randomly chosen starting address. Starting at that specific local address, the interviewer contacted every third household and had to motivate one adult person aged 16 or older to participate.

the safe option increased from row to row. In the first row the safe option was 0 Euros, in the second it was 10 Euros, and so on up to 190 Euros in row 20. After a participant had made a decision for each row, it was randomly determined which row became relevant for the participant's payoff. For example, if row 4 was randomly selected, the subject either received 40 Euros in case he had opted for the safe option in that row, or received the outcome from the lottery if he had chosen to play the lottery. This procedure guarantees that each decision was incentive compatible (see also Holt and Laury, 2002, who have used a similar procedure). Once a respondent preferred the safe option to playing the lottery, the interviewer confirmed that he would also prefer even higher safe payments to playing the lottery. If subjects have monotonous preferences, they prefer the lottery up to a certain level of the safe option, and then switch to preferring the safe option in all subsequent rows of the choice table. The switching point informs us about a subject's risk attitude. Since the expected value of the lottery is 150 Euros, weakly risk averse subjects should prefer safe options that are smaller than or equal to 150 Euros over the lottery. Only risk loving subjects should opt for the lottery when the offered safe option is greater than 150 Euros.

The stakes in this experiment are relatively high compared to typical lab experiments. However, not every subject in the experiment was paid. Subjects were informed that after the experiment a random device would determine whether they would be paid according to their decision, and that the chance of winning was $1/7$. Subjects were paid by check sent to them by mail.

Ideally subjects who take part in the experiment should be as similar as possible to the participants in the SOEP study, in particular with respect to the exogenous factors that explain individual risk attitudes. As the upper panel of Table 2 shows, they are in fact very similar. The fraction of females is 52.7 percent in the experiment and 51.9 percent in the SOEP data. Also, both mean age and median age of the participants are extremely similar. The same holds for height. The similarity reflects the true representative character of the experimental subject pool. Table 2 also shows that the mean and median response to the general risk question is very similar. While the mean (median) value in the experiment is 4.76 (5), it is 4.42 (5) for the people who are interviewed in the SOEP. In addition the answers to the general risk question are almost identically distributed (compare Figure 1

and Figure 5, upper panel).¹⁷

Figure 5 shows a histogram of subjects' choices in the experiment. About 78 percent of the participants are risk averse, in the sense that they prefer not to play the lottery, which has an expected value of 150 Euros, when offered a safe payment smaller than 150 Euros. About 13 percent are arguably risk neutral: 9 percent prefer a safe payment of 150 Euros to the lottery, but play the lottery at smaller alternative options, and 4 percent play the lottery when offered a safe payment equal to the expected value of the lottery but do not play the lottery when the safe payment exceeds the expected value of the lottery. About 9 percent of the subjects reveal risk loving preferences, preferring the lottery to safe amounts above 150 Euros.

Our main interest in this section is whether survey data can predict actual risk taking behavior in the lottery experiment. In other words, we want to study whether subjects who indicated a greater willingness to take risks in the general risk question also show a greater willingness to take risks in the lottery experiment. A first indication that this is indeed the case is given by the lower panel of Figure 5. The figure shows a scatter plot where the average certainty equivalents observed in the experiment, i.e. the average of the smallest safe options that the corresponding subjects preferred over the lottery, are plotted against the survey answers. The figure reveals a clearly positive relation.¹⁸ To test the predictive power of the general risk question more rigorously, we ran the regressions reported in the lower panel of Table 2. In the first model, we simply regress answers given to the general risk question on the value of the safe option at the switching point. The general risk coefficient is positive and significant at any conventional level indicating that the answers given in the survey do predict actual risk taking behavior. To check robustness, we add controls in Columns 2 and 3, which are essentially the same as the controls in Table 1. In Column 2 we add gender, age, and height as explanatory variables. In Column 3, we control for many additional individual characteristics such as wealth, debt, household income, marital status, number of dependent children, country of residence before unification, foreigner status, schooling degree, employment status, occupational choice, employment rank, public and private sector employment, life satisfaction, general

¹⁷ A Kolmogorov-Smirnov-test does not reject the null hypothesis that the answers to the survey risk questions in the two samples have the same distribution.

¹⁸ For the calculation of the average value of the switching point we set the value of the safe option equal to 200 for the 31 participants who always prefer the lottery.

health status, smoking, and weight. The general risk coefficient becomes somewhat smaller but stays significant at the one percent level. In sum, the answers to the general risk attitude question predict actual behavior in the lottery quite well. With a high level of confidence we can therefore reject the hypothesis that our survey measure is behaviorally irrelevant.

5 A Lottery Measure of Risk Preference: The Hypothetical Investment Question

It is important to compare our findings based on the general risk measure to our more-standard, lottery measure of risk preference. In this section we return to the issues of heterogeneity and exogenous determinants of risk attitudes, but use investment choices in the hypothetical investment scenario as the measure of willingness to take risks. We also show how, under specific assumptions, responses to the investment question can be used to recover a parameter value describing the curvature of the individual's utility function.

5.1 Risk Attitudes in a Hypothetical Lottery

Respondents in the SOEP were asked how much of 100,000 Euros in lottery winnings they would choose to invest, in a hypothetical asset promising, with equal probability, to either halve or double their investment in two years time. The question offered respondents six possible investment amounts: 0, 20,000, 40,000, 60,000, 80,000, or 100,000 Euros. Importantly, these stakes are large enough to have a potentially significant impact on lifetime utility; 100,000 Euros is roughly five times the average annual net individual income of respondents in the sample (21,524 Euros). One feature of the question that deserves additional comment is the two-year lag between the time of investment and the hypothetical payoff. On the one hand this feature is necessary to create the context of a realistic investment. On the other hand there is a potential confound, because differences in the investment decision could reflect differences in time preference rather than risk preference. In Dohmen *et al.* (2005b) we analyze data from a field experiment, in which we elicit time preferences as well as questionnaire answers to the general risk question discussed above. It turns out that the correlation between elicited time preferences and stated risk preferences is not significantly different from zero. We therefore neglect the

potential confound of time preferences in the following analysis of the investment question.

Figure 6 shows the distribution of responses to the investment question in the sample. The histogram indicates that roughly 60 percent of the survey respondents chose not to invest in the hypothetical asset.¹⁹ The remaining 40 percent did choose to invest, with substantial variation in terms of the amount, although the fraction of individuals investing decreases as the investment amount becomes larger. Thus, similar to the general risk question, the hypothetical investment measure reveals substantial heterogeneity. In fact, the correlation between investment choices and responses to the general risk question is fairly strong, about 0.26, indicating a significant overlap in terms of what these questions measure.

In order to explore the determinants of individual differences in willingness to invest, we regress the amount invested in the lottery on exogenous factors and other controls. The resulting coefficient estimates are presented in Table 3. We do not adopt a binary measure for the dependent variable, as we did in the case of the general risk question, because it is more difficult to choose a sensible division of the scale. Also, we want our coefficient estimates to reflect the impact of exogenous factors on the amount of Euros invested.²⁰ We use an estimation procedure that accounts for the fact that the dependent variable is measured in intervals, and hence is left and right censored. A negative coefficient indicates a lower willingness to invest and therefore a lower willingness to take risks.

In Table 3, the right-hand side variables for Columns (1) to (9) correspond exactly to those used in the analysis of the general risk question, in Table 1. The baseline results, without income, wealth and additional controls, are shown in Column (1). The marginal effects indicate that women invest about 6000 Euros less in the risky asset than men. Each year of age tends to reduce the investment by about 350 Euros.²¹ Finally, each centimeter of height leads to about 200 Euros higher investment in the risky asset. These effects are substantial, and they are all highly significant. They are also qualitatively similar to the findings based on the general risk question. In contrast, the results for parental education

¹⁹ A similar share of the sample, roughly 68 percent, chose a value less than 6 on the general risk scale and were classified as relatively unwilling to take risks using the binary version of the general risk question.

²⁰ As a robustness check, we estimated the regressions using a binary measure as the dependent variable, indicating whether an individual invests a positive amount. We found very similar results in this case.

²¹ A specification with three splines with knots at 30 and 60 years reveals that age has no significant effect on investment for the youngest age category, significant and large effects of 300 and 640 Euros per year of age, respectively, for the two older age categories.

are somewhat different. Mother’s education has no explanatory power for investment choices, and father’s education exhibits a large and highly significant positive effect on willingness to invest. Adding additional controls in Columns (2) to (9) leaves these results qualitatively unchanged.

These findings are noteworthy given that the hypothetical investment question involves a relatively concrete context, in terms of a legitimate investment opportunity. For instance, the gender effect we find contrasts with Schubert *et al.* (1999), who conduct lottery experiments with undergraduates, and find that gender differences become insignificant when lotteries are given concrete framing as investment opportunities. In Section 6 we explore the issue of context in more detail.

5.2 Implied Coefficients of Risk Aversion

Responses to the hypothetical investment question provide cardinal information on individuals’ relative willingness to take risks, i.e., differences in investment choices can be measured in Euros. Under certain assumptions, this information can be combined with a measure of individual wealth and converted into a measure of the degree of curvature of the utility function.

We assume that the individual’s utility function is characterized by constant relative risk aversion, an assumption that is commonly made in many economic applications due to its tractability.²² Given this assumption, an individual’s utility has the form $u(x) = \frac{x^{1-\gamma}}{1-\gamma}$, which is a function of a wealth endowment (or consumption possibilities) x . The CRRA parameter γ describes the degree of relative risk aversion for an individual: the individual is risk loving if $\gamma < 0$, risk neutral if $\gamma = 0$, and risk averse if $\gamma > 0$.²³ Using an individual’s investment choice, and additional survey information on the individual’s wealth level before the investment, it is possible to compute an interval for the individual’s CRRA parameter.²⁴ Intuitively, the choice of a given investment implies that the expected utility from this option must be greater than or equal to the utility derived from any other option,

²² We choose this specification for reasons of tractability and because it is frequently used in the literature. Note, however, that empirical evidence suggests skepticism about the appropriateness of this functional form (see Gollier, 2001, p. 58).

²³ Note that $\lim_{\gamma \rightarrow 1} u(x) = \ln x$.

²⁴ Note that heterogeneity in the initial wealth level implies that individuals with the same answer to the investment question may have different CRRA intervals.

in particular the next largest, and next smallest possible investment choice. Expressing these two conditions in terms of the individual's utility function, and substituting the wealth level as an argument, it is possible to solve for upper and lower bound values for $\gamma > 0$ (see Barsky *et al.*, 1997, and Holt and Laury, 2002, for a similar approach). Given that the stakes in our hypothetical investment scenario are large enough to be meaningful in terms of lifetime consumption, and given that the calculation incorporates information on current wealth, the resulting parameter ranges can be interpreted as referring to the curvature of the lifetime utility function.²⁵

The top panel of Figure 7 shows the distribution of interval mid-points in the sample. The figure excludes individuals investing 0 Euros or 100,000 Euros. Individuals who invest nothing are clearly risk averse, but the interval for their CRRA coefficient cannot be displayed in the graph because it is not bounded from above. Conversely, individuals who invest 100,000 Euros are relatively risk-seeking, but the lower bound for their interval cannot be determined.²⁶ In the literature, values for the CRRA coefficient between 1 and 5 are typically perceived as reasonable, and values above 10 are considered unrealistic (for discussions on this point see Kocherlakota, 1996; Cecchetti *et al.*, 2000; Gollier, 2001, p. 31). The conditional distribution in Figure 7 is consistent with this perception: the bulk of the mass in the distribution is located between 1 and 10. There is, however, a non-negligible mass of midpoints in the range of higher values, up to about 20.²⁷

The middle panel of Figure 7 provides a different perspective on the data. It shows the cumulative distributions of lower and upper bounds for γ in the population (the cumulative for upper bounds is the lower line in the figure), excluding individuals who invest

²⁵ Unlike Barsky *et al.* (1997) or Holt and Laury (2002), our calculation takes into account current wealth levels (including the 100,000 Euros of hypothetical endowment). Guiso and Paiella (2005) take a different approach altogether. They derive a point estimate for the degree of absolute risk aversion using a local approximation of the utility function around imputed lifetime wealth. As noted by the authors, this approximation is only reasonable for an investment with relatively small stakes, like the one included in their survey. The much larger stakes in our hypothetical investment question make such an approximation inadvisable. Indeed, computations of CRRA coefficients for the SOEP sample using a local approximation of the utility function yield exceedingly high levels of risk aversion compared to the interval approach depicted in Figure 7. Donkers *et al.* (2001) also calculate preference parameters using lottery responses, but in a model derived from cumulative prospect theory rather than in the expected utility framework.

²⁶ Thus the investment question does not allow us to say whether individuals investing 100,00 are mildly risk averse, with a γ close to 0, or whether they are actually risk loving, with $\gamma < 0$.

²⁷ This is potentially explained by measurement error in wealth levels, the neglect of incomes in the computation, or the underestimation of the true expected value of the lottery because of probability-weighting.

0 or 100,000 Euros. For any given value of γ on the horizontal axis, the vertical difference between the two curves gives the fraction of individuals with an interval containing that value of γ . The figure confirms that most intervals contain a γ between 1 and 10. The bottom panel in the figure shows the cumulative distributions for upper and lower bounds of γ using the whole sample including non-investors and individuals investing the the full amount of 100,000 Euros. Since γ cannot be bounded from a above for the 61 percent of individuals investing zero, the cumulative distribution converges to 39 percent in the range of values for γ on the horizontal axis. Likewise, γ cannot be bounded from below for those who invest the full amount.

In principle, it would also be possible to construct a distribution of CRRA coefficients using the lottery choices in our field experiment, described in Section 4. However, the lottery measure is not as well-suited for this purpose, because the stakes are relatively small (300 Euros). As shown by Rabin (2000), the curvature of the lifetime utility function should be approximately linear for stakes in this range, assuming a typical wealth level.²⁸ In order to avoid inferring extreme parameter values from such lottery choices, it is typically necessary to assume an initial wealth level of zero (Watt *et al.*, 2002). This assumption need not be taken literally, but could instead capture the somewhat more realistic notion that the individual “ignores” current wealth when making their decisions. If we do assume a wealth level of zero, as is done by, e.g., Holt and Laury (2002) and Harrison *et al.* (2003), indifference between the lottery of winning 300 Euros or 0 Euros with equal probability $p = 0.5$ and a safe option of y implies $p \cdot \frac{300^{1-\gamma}}{1-\gamma} = \frac{y^{1-\gamma}}{1-\gamma}$, and therefore $\gamma = 1 - \frac{\ln p}{\ln y - \ln 300}$. This gives bounds for the interval containing γ . It is then possible to assign an interval to each of the switching points observed in the field experiment (displayed in Figure 5). The CRRA coefficients associated with each switching point, (y, γ) are $(0, \infty)$, $(10, 0.796)$, $(20, 0.744)$, $(30, 0.699)$, $(40, 0.656)$, $(50, 0.613)$, $(60, 0.569)$, $(70, 0.524)$, $(80, 0.476)$, $(90, 0.424)$, $(100, 0.369)$, $(110, 0.309)$, $(120, 0.244)$, $(130, 0.171)$, $(140, 0.091)$, $(150, 0)$, $(160, -0.103)$, $(170, -0.220)$, $(180, -0.357)$, $(190, -0.518)$.

It would be valuable to be able to interpret responses to the general risk question in terms of coefficient intervals. In this case researchers could take advantage of the relatively simple and easy-to-ask format of the general risk question without sacrificing the ability

²⁸ In fact, if we use the information on wealth and income included in the field experiment and calculate CRRA intervals as in the SOEP, we obtain extreme coefficient estimates (available upon request) by this procedure.

to gather information on preference parameters. We conclude this section by showing how the SOEP data can be used to construct the necessary mapping. Figure 8 shows the average amount invested in the risky asset for each possible answer to the general risk question, among all individuals and also separately for men and women. This is the information necessary for the first step in imputing ranges for the CRRA coefficient based on responses to the general risk question. To see how the imputation works, suppose an individual reports a willingness to take risks of 4 on the general risk scale. According to the figure, individuals with such a response invest on average 13,184 Euros in the hypothetical investment. Combining this information with data on the individual’s wealth endowment, say 25,000 Euros, straightforward computation leads to a CRRA coefficient for this person of around 4.5. Alternatively, suppose a man with a wealth endowment of 100,000 Euros reports a willingness to take risks of 7. On average, he would invest 22,716 Euros in the risky asset, implying a CRRA coefficient of about 4.1. Finally, the CRRA coefficient of a woman endowed with 30,000 Euros of wealth, choosing a value of 2 on the general risk scale, is predicted to be around around 7.55, using the information that women reporting a value of 2 invest on average 8,064 Euros into the hypothetical asset. The type of mapping illustrated in Figure 8 is thus a potentially useful tool, adding to the value of the general risk question for researchers who prefer the question’s easy-to-ask format but who are also interested in CRRA coefficients.

In summary, results on heterogeneity and determinants using the hypothetical lottery question are similar to those obtained using the general risk question. Given that the investment scenario holds risk perceptions constant, however, these effects are more clearly attributable to differences in risk preference.²⁹ These findings are also noteworthy because they persist even though the question incorporates concrete context, in the form of a legitimate investment opportunity. The estimates for CRRA parameters provide information about the distribution of risk preferences in the population, and the mapping provided at the end of the section potentially adds to the value of the general risk question.

²⁹ Note, however, previous evidence on gender differences in probability-weighting. For example, Fehr-Duda *et al.* (2004) conduct an experiment on risky choice, involving explicit stakes and probabilities, and find evidence for a gender difference in willingness to take risks that is due to different perceptions of how “large” or “small” the probabilities are. Donkers *et al.* (2001) also find evidence that individual heterogeneity is partly explained by differences in probability-weighting.

6 Risk Attitudes and Context

This section investigates the role of context in shaping risk attitudes. In economics it is standard to assume the existence of a single risk preference governing risk taking in all contexts. In line with this assumption, economists typically use a lottery measure of risk preference, framed as a financial decision, as an indicator of risk attitudes in all other contexts. By contrast, there is considerable controversy on this point in psychology. Based on laboratory experiments in which self-reported risk taking is only weakly correlated across different contexts, some studies conclude that a stable risk trait does not exist at all (see Slovic, 1972a and 1972b for a review). We contribute to this discussion in several ways. First, we study the impact of context on a much larger scale using a representative sample. Second, we measure the correlation of willingness to take risks across the different contexts identified in the SOEP: general, car driving, financial matters, sports and leisure, health, and career. Little or no correlation would provide evidence against the standard assumption; a strong correlation would suggest the existence of a stable risk preference. We then explore the determinants of willingness to take risks in specific contexts. Evidence that the same factors determine risk attitudes across contexts would also lend support to the notion of a stable risk preference.

6.1 Correlation Across Domains

The first section of Table 4 reports mean responses for each domain-specific question and the general risk question.³⁰ Context appears to matter for self-reported willingness to take risks. The ranking in willingness to take risks, from greatest to least, is as follows: general, career, sports and leisure, car driving, health, and financial matters. The same ranking holds for both men and women. Notably, women are less willing to take risks than men in every domain.

The next section in the table shows simple pairwise correlations between individuals' risk attitudes in different contexts. Risk attitudes are not perfectly correlated across domains, but the correlations are large, typically in the neighborhood of 0.5, and all are highly significant. Another way of assessing the stability of risk attitudes is to check

³⁰ The different numbers of observations across domains reflects different non-response rates. These differences may arise because individuals feel certain questions do not apply to them, e.g., a 90-year-old without a driver's license is free to leave blank the question about taking risks while driving a car.

what fraction of individuals is relatively willing to take risks (choose a value greater than 5) for all of the six different measures. It turns out that 51 percent of individuals are willing to take risks in all six domains and more than 1 third are willing in at least five domains. The relatively large correlation across contexts, and the stability of an individual's disposition towards risk across domains, strongly suggest the presence of a stable, underlying risk preference. The consistency across domains is not perfect, and could indicate some malleability of risk preferences, but it seems more likely that this variation reflects the risk perception component of the measures, e.g. a tendency for most people to view car driving as more risky than sports and thus state a relatively lower willingness to take risks in car driving.³¹

The lower portion of Table 4 reports similar statistics, but using binary versions of each question. These are constructed in the same way as the binary version of the general risk question used in Section 3: for each domain, the indicator is equal to 1 for responses higher than 5 on the question scale and 0 otherwise. The means of these binary risk measures can be interpreted as the fraction of individuals in each domain who are relatively willing to take risks. The correlations across domains using the binary measures range from 0.24 to 0.47 and are highly significant.

Principal components analysis using the general risk question and the five domain-specific questions tells a similar story. About 60 percent of the variation in individual risk attitudes is explained by one principal component, consistent with the existence of a single underlying trait determining willingness to take risks.³² Nevertheless, each of the other five components explains at least five percent of the variation, which again suggests that there is some additional content captured by the domain-specific measures.

³¹ Given that the questions ask about "willingness to take risks," it is possible that individuals could think of the same gamble, in utility terms, across contexts, in which case any variation at all in willingness to take risks would be inconsistent with stable risk preferences. It seems more likely, however, that individuals imagine the typical risk they expect to encounter in each context, based on their subjective beliefs, and state their willingness to take this risk. In this case, the pattern we observe would reflect a stable risk preference but varying risk perceptions.

³² The eigenvalue associated with this component equals 3.61 while the eigenvalues associated with all other components are smaller than 0.57. When only one component is retained, none of the off-diagonal elements of the residual correlation matrix exceeds |0.11|.

6.2 Determinants of Risk Attitudes in Different Domains

Table 5 explores the determinants of individual risk attitudes in each of the five domains identified in the SOEP. For ease of comparison, the first column reports results for the general risk domain, shown previously in Table 1. The remaining columns report marginal effect estimates from Probit regressions, where the dependent variables are the binary versions of each domain-specific question.³³ These binary measures are the same as the ones reported in the lower section of Table 4 above, with a 1 indicating that an individual is relatively willing to take risks (i.e., chooses a value greater than 5 on the response scale).

From Columns (2) to (9) it is apparent that the impact of the exogenous factors is, for the most part, qualitatively similar across contexts. Women are significantly less willing to take risks than men in all domains.³⁴ Gender differences are most pronounced for general risk attitudes and risk attitudes in car driving, and least pronounced in the domains of financial matters and health. Age decreases the probability that an individual is willing to take risks in all five domains, but has a particularly large impact in the domain of sports and leisure, and a relatively small impact in financial matters. The table also shows that taller persons are more willing to take risks, in all domains. The height effect is particularly strong for general risk attitudes, the career domain, and in the domain of sports and leisure.³⁵ The relationship between parental education and risk attitudes is less consistent across domains. Overall, having a parent who has completed the *Abitur* increases willingness to take risks. A more highly-educated mother is associated with a higher willingness to take risks in all domains, except for car driving and health. This holds similarly for subjects with more highly-educated fathers. Adding additional controls to the regressions has no impact on the qualitative results, and most effects remain significant. Regressions with all controls are reported in Table A.1 in the Appendix.³⁶

In summary, our findings suggest the existence of a stable, underlying risk prefer-

³³ The results are robust if we instead run linear probability models (OLS) or ordered probits, using the 11-point scale measures rather than binary measures as dependent variables.

³⁴ A Oaxaca-Blinder decomposition reveals that across domains, more than 60 to 70 percent of this difference is driven by differences in the risk coefficients, rather than different observable characteristics. This result is robust when adding the full set of controls.

³⁵ In OLS regressions, with the 11-point measure as dependent variables, height matters even more in the career domain than in the general or sports and leisure domains.

³⁶ The coefficient estimates are virtually identical in specifications using age splines with knots at 30 and 60 years of age, and are available upon request.

ence. One source of evidence is the strong correlation of risk attitudes across contexts, and the finding that a single principal component explains the bulk the variation in risk attitudes. Another piece of evidence is the fact that risk attitudes have similar determinants in all contexts, in the form of the four exogenous factors. There is some variation in risk attitudes with respect to context, but this seems likely to reflect variation in risk perceptions across contexts. Differences in risk perception could also potentially explain why the exogenous factors have effects of varying magnitudes across contexts, but a more detailed investigation of why, e.g., the gender effect is stronger in some contexts than others could be an interesting subject for future research.

7 The Predictive Power of the Survey Risk Measures

So far we have primarily concentrated on the heterogeneity and determinants of individual risk attitudes. In this final portion of the analysis we take a different perspective and ask whether the survey measures are capable of predicting actual risk taking behavior. Previously we demonstrated the ability of the general risk measure to predict real-stakes lottery choices in a field experiment, but in this section we study a broader range of risky behaviors, encompassing a variety of important economic and social contexts, and test the validity of all seven risk measures. In so doing, we hope to answer two questions. First, do all of the survey instruments reliably predict risky behavior, despite the fact that they are not incentive compatible and are therefore potentially behaviorally irrelevant? The answer to this question is of great importance both from a methodological and a practical point of view. Second, how do the different risk measures compare in terms of predictive power? In particular, how do the alternative measures fare, compared to the more standard measure of risk preference, and how do context-specific measures perform within and outside of their corresponding context? For example, is smoking best predicted by a health related risk question or is it equally well explained by a general risk or hypothetical lottery question? In the past economists have typically used only a single question, most often a hypothetical lottery question, to predict risk taking behavior in all contexts. Barsky *et al.* (1997) and Guiso and Paiella (2005), e.g., study the impact of risk attitudes on risky behaviors, but use only a single measure of risk attitudes, corresponding closely to our hypothetical investment measure. We test the relative predictive power of all of our seven risk measures

and in so doing learn something about the potential value-added of using the general risk question, and domain-specific risk measures, versus using the more standard hypothetical lottery measure. One caveat to the analysis in this section is that some of the behaviors may in fact be endogenous with respect to risk attitudes. For instance, smoking affects overall health and reduces mean life expectancy, which affects lifetime income and could thus potentially change risk attitudes. However, even taking the most conservative stance and refraining from causal interpretation entirely, assessing whether the measures are significantly correlated with behavior is interesting in its own right.

To address our questions, we use a collection of behaviors reported by the SOEP participants that spans different risk domains, i.e., willingness to take risks in general, in car driving, in financial matters, in sports and leisure, career, and health. The specific behaviors include portfolio choices, participation in sports, occupational choice, smoking, migration, life satisfaction and traffic offenses. All of these risky behaviors are measured as binary variables and are displayed in Table 6, with the exception of life satisfaction, which is measured on an 11-point scale, and traffic offenses, which are analyzed separately. As a proxy for portfolio choice we use information about household stock holdings, shown in Column 1. The variable “Investment in Stocks” is equal to 1 if at least one household member holds stocks, shares or stock options and zero otherwise. Since the question about stock holdings is typically answered by the household head, we use observations on risk preferences of household heads in Column (1) only. In the context of sports, the variable “Active Sports” takes a value of 1 if an individual actively participates in any sports (at least once per month). The variables “Employment in Public Sector” and “Self-Employment” are binary variables equal to 1 in the case of public sector employment or self-employment, respectively. These two career choices are interesting because public sector employment is relatively risk-free, in terms of income variability and job security, whereas self-employment is a relatively risky career. To study risk-taking behavior in the domain of health, we use information about whether the SOEP participant smokes or not. The corresponding variable is equal to 1 if the respondent smokes. Migration is another interesting risky behavior. The fall of the Iron Curtain in 1989 offers a natural experiment for studying the determinants of migration behavior for East and West Germany. The relatively attractive economic situation in West Germany was clearly an important factor in migration decisions following reunification, but risk attitudes are also likely to have

played a significant role, given that moving between East and West Germany was associated with substantial uncertainty regarding labor-market prospects, social acceptance, etc. The variables “Mobility from East to West” and “Mobility from West to East” are binary variables taking the value of 1 if the respondent has moved (after the year 1989) from East to West, or from West to East, respectively. A final outcome that might be associated with general risk attitudes is “Overall Life Satisfaction”, which is measured on an 11-point scale in the SOEP (higher values represent higher life satisfaction).

Each reported coefficient estimate shown in Table 6 is based on a separate regression of the respective behavior on this particular risk measure and a set of controls. Coefficient estimates for the controls are not reported but are available on request. In every regression the controls include gender, age, height, and parental education, as in Column (1) of Table 1, but also log household wealth, log household debt, and the log of current gross monthly household income. In addition, we control for the number of household members older than 18 in the regression for stock holdings, shown in Column (1), because the likelihood that at least one person in the household holds risky assets increases with household size. In Columns (6) to (8) we add additional controls as explained in the notes to Table 6. All risk measures are coded as binary measures, so that coefficients are comparable, including the hypothetical investment question: The variable “Positive Amount Invested in Hypothetical Asset” is equal to “0” if individuals invest nothing in the asset and “1” if they invest a positive amount.³⁷ For the outcomes in Columns (1) to (7), which are measured as binary variables, we ran Probit regressions. For each behavioral outcome Table 6 displays the Probit marginal effects estimates, evaluated at the means of independent variables. The coefficients of the binary risk measures reflect the discrete change in the probability. OLS estimates are displayed in Column (8). In addition, we report the standard errors of the coefficients (in brackets) as well as the log likelihoods (in parentheses). For example, the three entries in the upper left corner in Column (1) say that the willingness to take risks in general is significantly correlated with investments in stocks, the marginal effect being 0.035. The standard error of the coefficient is 0.011 and the log likelihood for this regression is -4708.9.

Several important observations can be made from Table 6. First, all measures predict

³⁷ Our qualitative results do not depend on the use of a binary measure for the hypothetical asset. For instance, the measure still does not predict smoking, self-employment, or mobility if we instead use the full range of investment choices as the independent variable.

at least some of the behaviors, providing further confirmation of their behavioral validity. This holds in particular for the general risk measure (first row). This measure is the only measure that predicts all behaviors significantly and with the expected sign. Notably, it predicts considerably better than the hypothetical lottery question (second row), which is not significantly correlated with the decision to be self-employed, to smoke, or to migrate. Second, each context-specific risk question predicts behavior in its respective domain, and is by far the best predictor in this domain. This can be seen by comparing the size of the coefficients and the log likelihoods of the different regressions.

Investment in stocks, shown in Column (1), is positively correlated with several risk measures, as expected given the relative riskiness of this kind of financial investment. The best predictor is the domain-specific risk question on “Financial Matters:” the marginal effect for this measure is the largest, and the log likelihood for this regression is larger than for any other regression based on a different risk measure. Being active in sports is strongly correlated with several risk measures but the measure of risk taking in “Sports and Leisure” is the best predictor (see Column (2)).

In Columns (3) and (4) we investigate the relationship between risk attitudes and career choice. Given the high degree of job security and the low income variability associated with public employment, we would expect that relatively risk-averse people are attracted by the public sector. In fact, the coefficients on willingness to take risks in general, and in career, are significant and negative, consistent with this prediction. It is noteworthy that the coefficient of the hypothetical investment question, shown in the second row, is significantly *positive*. In our view this is a rather implausible result, highlighting potential limits of using hypothetical lottery questions for predicting context specific behavior. Turning to self-employment we would expect the opposite relationship with risk attitudes. The coefficient estimates in Column (4) confirm this expectation, showing that self-employment is positively correlated with willingness to take risks in the career context, as well as with willingness to take risks in general and in financial matters. The career specific measure, however, is the overall best predictor of self-employment.

In Column (5) we turn to risky health behavior in the form of smoking. Willingness to take risks in general has a strong positive impact on the propensity to smoke, but willingness to take risks in the domain of health has an even greater impact, as indicated by the larger marginal effect and the higher log likelihood. The case of smoking is of

particular interest given that smoking has been used as an instrument for risk attitudes, in cases where direct measures of risk attitude were not available (e.g., Feinberg, 1977). In light of results in Column (5), however, smoking can only be considered a very imperfect substitute for more direct measures of risk attitudes. While smoking is strongly associated with the willingness to take risks in the health domain, or in general, it is less correlated or not correlated at all with risk attitudes in other domains such as financial matters or sports and leisure.

The regressions in Columns (6) and (7) investigate the impact of risk attitudes on the decision to move, from East to West Germany or from West to East Germany after 1989, respectively. Column (6) shows that people who are more willing to take risks in general were more likely to move from East to West. The same is true for migrants who moved from the West to the East. Interestingly, none of the other measures is significantly positively correlated with migration.

In the final column of Table 6 we explore the relationship between life satisfaction, measured on an 11-point scale, and risk attitudes. We find a strong positive association between life satisfaction and willingness to take risks in general, and to a lesser extent, with several other risk measures. A causal interpretation for this finding is anything but straightforward, however. We speculate that there is an underlying personality trait that is simultaneously responsible for risk taking and life satisfaction. It is likely that people who are relatively self-confident and who are less inclined to worry are also more willing to take risks and more likely to be satisfied with their life.³⁸

In additional (unreported) regressions we also tested the relative predictive power of the different risk measures by regressing a given behavioral outcome on all of the measures simultaneously. The results are very similar to the ones we have discussed in Table 6, in the sense that the corresponding domain specific risk question is the best predictor of investment in stocks, participation in sports, employment in public sector, self-employment, and smoking, and willingness to take risks in general is the best predictor

³⁸ In line with previous studies we find that women tend to be more satisfied with their life (for an overview, see Frey and Stutzer (2002)). Similar to Frijters *et al.* (2004a), who find a causal impact of income on life satisfaction in Germany, wealth and income both have a positive and significant impact on happiness. Similarly, Frijters *et al.* (2004b) find that individuals living in East Germany before the reunification are less satisfied with their life in general. The coefficient for having lived in the GDR in 1989, which we included in these regressions, is -0.475 with a standard error of [0.043], indicating that their result holds even when controlling for differences in risk attitudes.

of migration decisions and overall life satisfaction.

The SOEP does not provide a measure of risky behavior in the domain of car driving. In order to test whether answers to the survey questions have predictive power for behavior in this domain, we constructed Figure 9. The figure shows the relationship between risk attitudes and risk taking in the domain of car driving, as measured by driving offenses. The top and bottom panels show separate results for men and women. The shaded bands in each panel reflect responses by SOEP participants to the question about their willingness to take risks when driving a car. Each band indicates the fraction of individuals, at a given age, who are relatively willing to take risks: the darkest band corresponds to a value of 10, completely willing to take risks, and progressively lighter bands indicate lower willingness to take risks. The figure also plots data on all registered driving offenses in Germany during the year 2002 (the most recent year for which data are publicly available), by age category.³⁹ The figure plots three different lines for driving offense rates: the lowest shows the un-weighted rates of driving offenses by age category; the middle line shows the same rates weighted by the fraction of individuals holding a driver's license in each age group; the highest line shows rates of driving offenses weighted by automobile usage rates in each age category.⁴⁰

The figure reveals a strong correspondence between the distribution of risk attitudes by age and gender and traffic offense rates (both weighted and un-weighted). The larger the fraction of risk tolerant individuals in a gender age group, the higher is the rate of registered traffic offenses for that gender age group. This correspondence suggests a link between risk attitudes in the domain of car driving and actual risk taking behavior. It is noteworthy that the relationship between traffic offenses and risk attitudes in other domains, including

³⁹ A driving offense is registered if authorities impose an administrative fine of at least 40 Euros, or impose a driving ban, or if a court passes sentence because of a punishable act committed in road traffic, or if a driving license authority makes a legally binding decision to refuse or withdraw a driving license (this includes measures provided for by the "points system" or within the scope of the probationary driving license.)

⁴⁰ The German Federal Bureau of Motor Vehicles and Drivers (Kraftfahrtbundesamt) provides the sum of entries in the German Central Register of Traffic Offenders in the year 2002 aggregated by gender age groups on its webpage at www.kba.de/Abt3_neu/Verkehrsverstoesse/Personen_im_VZR/a-Haupt_Personen_im_VZR.htm. In order to calculate the un-weighted traffic offense rate, we divided the number of registered traffic offenses for a gender age group by the total population in the same gender age group in the year 2002. The population statistics were provided by the Federal Statistical Office. Finally, car usage weights and license weights are calculated based on information contained in the study "Mobilität in Deutschland" (Mobility in Germany) which was authorized by the German Institute for Economic Research (DIW) and conducted in 2002. For further information visit <http://www.kontiv2002.de/engl/index.htm>.

risk attitudes in general (not shown), is less strong than the relationship between traffic offenses and risk attitudes measured specifically in the domain of car driving. This points once more to the predictive value of domain-specific risk questions. In particular, the low willingness to take risks in car driving among those younger than 20, compared to car drivers in their twenties, is a unique feature of risk attitudes in the domain of car driving, and it coincides with a lower traffic offense rate for this age group compared to that of slightly older drivers (see Figure 9). A plausible explanation for the relatively low willingness to take risks and the relatively low rate of traffic offenses for 18 to 20 year old is the existence of a two-year probationary period, starting at the date when the license is obtained.⁴¹ During this period, the penalty for a registered traffic offense is particularly severe, the toughest consequence being loss of the driver's license.

In summary we find that each one of our seven risk measures predicts several behaviors. We can therefore reject the hypothesis that the measures are behaviorally irrelevant. This is especially true for the general risk question, which is the only measure to predict all of the behaviors. The fact that this measure is capable of predicting risky behaviors across very different domains of life suggests once more the existence of an underlying risk trait that is not specific to a particular domain. Interestingly, the general risk question seems to capture this trait much better than the hypothetical risk question. This latter measure not only fails to predict important behaviors but in some cases appears to make the wrong prediction. In this sense, we also qualify the conclusions derived by Barsky *et al.* (1997) and Guiso and Paiella (2005), who find a significant correlation between a set of behaviors similar to the ones we study and a risk measure similar to our hypothetical investment question. Even though we think our results support the assumption of a stable underlying risk preference, our analysis also shows that individual risk perceptions vary significantly across domains. In order to predict domain-specific risk taking behavior, it is therefore indispensable to use domain-specific risk questions. Using, e.g., simple lottery questions can only be considered an inadequate substitute for measures using situation-appropriate context.

⁴¹ Most young Germans start driving when they turn 18, the legal minimum driving age in Germany. The Federal Bureau of Motor Vehicles and Drivers states on its website that the purpose of the two-year probationary period is to counteract the combination of high-willingness to take risks in general with the lack of experience among younger drivers.

8 Conclusion

The aim of this paper is to improve understanding and measurement of individual risk attitudes. We use a new set of survey measures, collected for a representative sample of 22,000 individuals. We also use representative data from a complementary field experiment designed to test the behavioral relevance of these measures. Based on our analysis we can report nine main findings.

The first finding is that the distribution of willingness to take risks exhibits substantial heterogeneity across individuals. Second, these individual differences are partially explained by differences in four exogenous factors: willingness to take risks is negatively related to age and being female and positively related to height and parental education. A third important finding follows from the main methodological contribution of the paper: the survey measures are shown to be behaviorally relevant, in the sense that they predict actual risk-taking behavior in our field experiment. Fourth, estimates of the coefficient of relative risk aversion for the sample provide support for the range of parameter values typically assumed in economic models. A fifth finding is that risk attitudes are strongly but imperfectly correlated across different life contexts. This provides some support for the standard assumption of a single underlying trait, but also points to a value-added from asking context-specific questions, in order to capture variation in risk perceptions. The sixth finding is that gender, age, parental education, and height have a qualitatively similar impact on risk attitudes in most contexts, but that the magnitude differs across contexts. A seventh finding is that the survey measures can predict a wide range of important behavioral outcomes, including portfolio choice, occupational choice, smoking, and migration. An eighth finding is that the general risk question is the best all-around predictor of these behaviors, outperforming a lottery measure or domain-specific measures. Ninth, the best predictor of behavior within a given context is typically a question incorporating the corresponding context, as opposed to a lottery measure or measures incorporating other contexts.

In addition to adding to knowledge about risk attitudes, some of these findings have potentially important policy implications. A robust and pervasive gender difference in risk attitudes could play some role in explaining different labor market outcomes, and investment behavior, observed for men and women. An age profile for risk attitudes could

also have important ramifications, at the macroeconomic level. Demographic changes leading to a large population of elderly are predicted to lead to a more conservative pool of investors and voters, which could substantially influence macroeconomic performance and political outcomes, increase the resistance to reforms, and delay necessary but risky policy adjustments. Although we find that risk preferences are relatively stable across situations, an age profile also raises questions about the stability of risk preferences over time. A role for parental education in shaping the risk attitudes of children highlights a potentially important role of education policy. The impact of height on risk attitudes suggests a mechanism behind the documented relationship between height and labor market earnings.

Our findings leave open a number of intriguing avenues for future research, in particular research on the mechanisms behind the determinants of risk attitudes. One possible mechanism is socialization. The impact of gender and parental education could reflect different approaches towards child rearing or different norms to which the individual is exposed. Differences in risk attitudes over the life cycle could also be socially constructed, e.g., risky behavior in driving, sports, and health could be condoned at an early age but frowned upon later in life. Alternatively, the mechanism could be biological or evolutionary. Risk attitudes, like many traits, may be partially determined by genetics. Even changes in risk attitudes with age could have a biological or developmental explanation. Clearly it is important to disentangle these two explanations because of their different implications regarding the malleability of individual risk attitudes.

References

- BARSKY, R. B., T. F. JUSTER, M. S. KIMBALL, AND M. D. SHAPIRO (1997): "Preference Parameters and Individual Heterogeneity: An Experimental Approach in the Health and Retirement Study," *Quarterly Journal of Economics*, 112(2), 537–579.
- BYRNES, J., D. MILLER, AND W. SCHAFER (1999): "Gender Differences in Risk Taking: A Meta-Analysis," *Psychological Bulletin*, 125, 367–383.
- CAMERER, C., AND R. HOGARTH (1999): "The Effects of Financial Incentives in Experiments: A Review and Capital-Labor-Production Framework," *Journal of Risk and Uncertainty*, 19(1), 7–42.
- CECCHETTI, S. G., P. SANG LAM, AND N. C. MARK (2000): "Asset Pricing with Distorted Beliefs: Are Equity Returns Too Good to be True?," *American Economic Review*, 90(4), 787–805.
- DIAZ-SERRANO, L., AND D. O'NEILL (2004): "The Relationship Between Unemployment and Risk-Aversion," IZA Discussion Paper No. 1214.
- DOHMEN, T., AND A. FALK (2005): "Sorting, Incentives, and Performance," IZA Working Paper.
- DOHMEN, T., A. FALK, D. HUFFMAN, AND U. SUNDE (2005a): "Explaining Trust: Disentangling the Roles of Beliefs and Risk Preference," IZA Working Paper.
- (2005b): "Constructing the Representative Agent," IZA Working Paper.
- DONKERS, B., B. MELENBERG, AND A. V. SOEST (2001): "Estimating Risk Attitudes Using Lotteries: A Large Sample Approach," *Journal of Risk and Uncertainty*, 22(2), 165–195.
- ECKEL, C., AND P. GROSSMAN (forthcoming): in *Handbook of Experimental Results* North-Holland. Elsevier Science.
- FEHR-DUDA, H., M. DE GENNARO, AND R. SCHUBERT (2004): "Gender, Financial Risk, and Probability Weights," Institute for Economic Research Working Paper, University of Zurich.
- FEINBERG, R. (1977): "Risk-aversion, Risk and the Duration of Unemployment," *Review of Economics and Statistics*, 59(3), 264–271.
- FERRER-I CARBONELL, A., AND P. FRIJTERS (2004): "How Important is Methodology for the Estimates of the Determinants of Happiness?," *Economic Journal*, 114, 641–659.
- FLYNN, J., P. SLOVIC, AND C. MERTZ (1994): "Gender, Race, and Perception of Environmental Health Risks," *Risk Analysis*, 14, 1101–1108.
- FOWLER, F. (1988): *Survey Research Methods*. Newbury Park, London.
- FREY, B. S., AND A. STUTZER (2002): *Happiness and Economics: How the Economy and Institutions Affect Well-Being*. Princeton University Press, Princeton and Oxford, 1st edn.

- FRIJTERS, P., J. P. HAIKEN-DeNEw, AND M. A. SHIELDS (2004a): “Money Does Matter! Evidence from Increasing Real Incomes and Life Satisfaction in East Germany Following Reunification,” *American Economic Review*, 94(3), 730 – 740.
- (2004b): “Investigating the Patterns and Determinants of Life Satisfaction in Germany following Reunification,” *Journal of Human Resources*, 39(3), 649–674.
- GLAESER, E. L., D. I. LAIBSON, J. A. SCHEINKMAN, AND C. SOUTTER (2000): “Measuring Trust,” *Quarterly Journal of Economics*, 115(3), 811–846.
- GNEEZY, U., M. NIEDERLE, AND A. RUSTICHINI (2003): “Performance in Competitive Environments: Gender Differences,” *Quarterly Journal of Economics*, 118(3), 1049–1074.
- GNEEZY, U., AND A. RUSTICHINI (2004): “Gender and Competition at a Young Age,” *American Economic Review Papers and Proceedings*, 94(2), 377–381.
- GOLLIER, C. (2001): *The Economics of Risk and Time*. MIT Press, Cambridge, Massachusetts, 1st edn.
- GUIso, L., T. JAPPELLI, AND L. PISTAFERRI (2002): “An Empirical Analysis of Earnings and Employment Risk,” *Journal of Business and Economic Statistics*, 20(2), 241–253.
- GUIso, L., AND M. PAIELLA (2001): “Risk-Aversion, Wealth, and Background Risk,” CEPR Discussion Paper No. 2728.
- (2005): “The Role of Risk Aversion in Predicting Individual Behavior,” Bank of Italy Economic Working Paper No. 546.
- HARRISON, G., M. I. LAU, E. E. RUTSTROM, AND M. B. WILLIAMS (2003): “Eliciting Risk and Time Preferences Using Field Experiments: Some Methodological Issues,” CEPR Discussion Paper 2003-20.
- HARTOG, J., A. FERRER-I CARBONELL, AND N. JONKER (2002): “Linking Measured Risk Aversion to Individual Characteristics,” *Kyklos*, 55(1), 3–26.
- HOLT, C., AND S. K. LAURY (2002): “Risk Aversion and Incentive Effects,” *American Economic Review*, 92(5), 1644–1655.
- KOCHERLAKOTA, N. R. (1996): “The Equity Premium: It’s Still a Puzzle,” *Journal of Economic Literature*, 34(1), 42–71.
- KRAUS, S. J. (1995): “Attitudes and the Prediction of Behavior: A Meta-Analysis of the Empirical Literature,” *Personality and Social Psychology Bulletin*, 21(1), 58–75.
- PERSICO, N., A. POSTLEWAITE, AND D. SILVERMAN (2004): “The Effect of Adolescence Experience on Labor Market Outcomes: The Case of Height,” *Journal of Political Economy*, 112(5), 1019–1053.
- RABIN, M. (2000): “Risk Aversion and Expected Utility Theory: A Calibration Theorem,” *Econometrica*, 68(5), 1281–1292.
- SCHUBERT, R., M. BROWN, M. GYSLER, AND H. BRACHINGER (1999): “Financial Decision-Making: Are Women Really More Risk-Averse?,” *American Economic Review Papers and Proceedings*, 89(2), 381–385.

- SCHULTZ, T. P. (2002): “Wage Gains Associated with Height as a Form of Health Human Capital,” *American Economic Review*, 92(2), 349–353.
- SCHUPP, J., AND G. G. WAGNER (2002): “Maintenance of and Innovation in Long-Term Panel Studies The Case of the German Socio-Economic Panel (GSOEP),” *Allgemeines Statistisches Archiv*, 86(2), 163–175.
- SILVERMAN, J., AND D. KUMKA (1987): “Gender Differences in Attitudes Towards Nuclear War and Disarmament,” *Sex Roles*, 16, 189–203.
- SLOVIC, P. (1964): “Assessment of Risk Taking Behavior,” *Psychological Bulletin*, 61(3), 220–233.
- (1972a): “Information Processing, Situation Specificity, and the Generality of Risk-Taking Behavior,” *Journal of Personality and Social Psychology*, 22, 128–134.
- (1972b): “Psychological Study of Human Judgment: Implications for Investment Decision Making,” *Journal of Finance*, 27, 777–799.
- SPIGNER, C., W. HAWKINS, AND W. LORENS (1993): “Gender Differences in Perception of Risk Associated with Alcohol and Drug Use Among College Students,” *Women and Health*, 20, 87–97.
- STALLEN, P., AND A. THOMAS (1988): “Public Concern About Industrial Hazards,” *Risk Analysis*, 8, 237–245.
- VAN PRAAG, B. M. S., AND A. FERRER-I CARBONELL (2004): *Happiness Quantified - A Satisfaction Calculus Approach*. Oxford University Press, Oxford.
- WAGNER, G. G., R. V. BURKHAUSER, AND F. BEHRINGER (1993): “The English Language Public Use File of the German Socio-Economic Panel,” *The Journal of Human Resources*, 28(2), 429–433.
- WATT, R., M. RABIN, AND R. H. THALER (2002): “Comments,” *Journal of Economic Perspectives*, 16(2), 227–230.
- WEBER, E., A. R. BLAIS, AND N. BETZ (2002): “A Domain-Specific Risk-Attitude Scale: Measuring Risk Perceptions and Risk Behaviors,” *Journal of Behavioral Decision Making*, 15, 263–290.

Tables

Table 1: Primary Determinants of General Risk Attitudes

	Dependent Variable: Willingness to Take Risks in General (Binary Measure)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-0.111*** [0.009]	-0.105*** [0.010]	-0.112*** [0.009]	-0.099*** [0.010]	-0.110*** [0.009]	-0.104*** [0.009]	-0.110*** [0.009]	-0.093*** [0.011]	-0.104*** [0.011]
Age (in years)	-0.005*** [0.000]	-0.005*** [0.000]	-0.005*** [0.000]	-0.005*** [0.000]	-0.005*** [0.000]	-0.005*** [0.000]	-0.005*** [0.000]	-0.003*** [0.000]	-0.003*** [0.000]
Height (in cm)	0.005*** [0.001]	0.004*** [0.001]	0.004*** [0.001]	0.004*** [0.001]	0.004*** [0.001]	0.004*** [0.001]	0.004*** [0.001]	0.003*** [0.001]	0.003*** [0.001]
<i>Abitur</i> Mother	0.062*** [0.016]	0.071*** [0.018]	0.063*** [0.016]	0.071*** [0.017]	0.062*** [0.016]	0.065*** [0.016]	0.062*** [0.016]	0.038*** [0.018]	0.027 [0.017]
<i>Abitur</i> Father	0.036*** [0.012]	0.034*** [0.013]	0.032*** [0.012]	0.033*** [0.012]	0.035*** [0.012]	0.036*** [0.012]	0.034*** [0.012]	-0.011 [0.013]	-0.005 [0.013]
log(Individual Wealth in 2002)	No	Yes	No	No	No	No	No	Yes	No
log(Household Wealth in 2002)	No	No	Yes	No	No	No	No	No	Yes
log(Individual Income 2003)	No	No	No	Yes	No	No	No	No	No
log(Household Income 2003)	No	No	No	No	Yes	No	No	No	No
log(Individual Income 2004)	No	No	No	No	No	Yes	No	Yes	No
log(Household Income 2004)	No	No	No	No	No	No	Yes	No	Yes
Other Controls	No	No	No	No	No	No	No	Yes	Yes
Pseudo-R ²	0.063	0.063	0.065	0.067	0.063	0.065	0.064	0.096	0.095
log Pseudo-Likelihood	-11,483	-10,111	-11,466	-10,804	-11,480	-11,466	-11,477	-9,118	-9,816
Observations	19,438	17,313	19,438	18,425	19,438	19,438	19,438	16,284	17,435

Probit marginal effects estimates. The dependent variable is a binary measure for general risk attitudes, where “0” indicates unwillingness to take risks (answers 0-5 in the original data) and “1” indicates willingness to take risks (answers 6-10 in the original data). *Abitur* (high school degree) includes *Fachabitur* (topic related high school degree). The *Abitur* exam is completed at the end of university-track high-schools in Germany; passing the exam is a pre-requisite for attending university. The other controls in Columns (8) and (9) include demographic, professional and other self-reported information. For detailed results see Table A.1 in the appendix. Wealth and income controls are in logs. Logged absolute values of negative wealth are added as a separate control variable in the respective specifications. Income data for 2003 reflect annual net income. Income data for 2004 are based on answers to questions about *current monthly gross income* at the stage of the interview. We also used the net monthly income measure that is available as a generated variable in the SOEP; the results (not reported here) are essentially the same. Robust standard errors in brackets allow for clustering at the household level; ***, **, * indicate significance at 1-, 5-, and 10-percent level, respectively.

Table 2: Validation of Survey Risk Measure in a Field Experiment

	Subjects in Experiment		SOEP Respondents			
	Mean	std. dev.	Median	Mean	std. dev.	Median
Fraction Female	0.527	0.50	0.519	0.519	0.50	
Age (in years)	47.77	18.40	47	47.17	17.43	46
Height (in cm)	171.73	9.09	172	171.39	9.27	170
General Risk Attitude (Survey Response)	4.76	2.54	5	4.42	2.38	5
Observations	450	450	450	21,875	21,875	21,875

(a) Comparison of SOEP and Experimental Sample

	Dependent Variable: Value of Safe Option at Switch Point		
	(1)	(2)	(3)
Willingness to Take Risk in General	5.614*** [1.082]	4.447*** [1.109]	3.792*** [1.447]
Controls for Gender, Age, Height	No	Yes	Yes
Other Controls	No	No	Yes
Constant	57.097*** [5.836]	-68.309 [70.621]	-33.005 [127.048]
R-squared	0.06	0.09	0.25
Observations	450	450	313

(b) Predicting Lottery Choices with Survey Measure Risk Attitudes

OLS estimates. The dependent variable is the value of the safe option at the switching point. Other controls include controls for marital status, number of children, location of residence in 1989, nationality, student status, education achievement, occupational status interacted with public sector employment, overall health status, weight, net household income and overall life satisfaction, compare also Table A.1. Robust standard errors in brackets; ***, **, * indicate significance at 1-, 5-, and 10-percent level, respectively.

Table 3: Primary Determinants of Investment in the Hypothetical Investment Scenario

	Dependent Variable: Amount Invested in the Hypothetical Asset								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-5,997.97*** [811.62]	-6,620.92*** [863.35]	-6,129.53*** [812.56]	-5,284.08*** [844.80]	-5,934.56*** [811.27]	-5,374.38*** [819.96]	-5,936.38*** [811.22]	-6,597.82*** [978.35]	-6,793.28*** [936.11]
Age (in years)	-352.65*** [20.51]	-434.98*** [24.36]	-370.28*** [20.74]	-382.99*** [21.51]	-350.95*** [20.52]	-375.71*** [21.10]	-350.70*** [20.51]	-233.77*** [46.46]	-200.19*** [44.42]
Height (in cm)	204.98*** [48.85]	145.92*** [52.40]	185.50*** [49.02]	179.28*** [49.97]	203.00*** [48.86]	192.87*** [48.96]	203.26*** [48.88]	102.51* [59.93]	105.15* [57.73]
<i>Abitur</i> Mother	1,420.56 [1,291.08]	1,877.67 [1,424.45]	1,419.86 [1,292.13]	1,908.26 [1,331.49]	1,425.26 [1,291.64]	1,654.49 [1,288.58]	1,410.83 [1,291.07]	-144.79 [1,508.10]	89.58 [1,434.26]
<i>Abitur</i> Father	6,521.58*** [986.43]	6,184.77*** [1,056.29]	6,151.38*** [989.30]	6,578.94*** [1,009.60]	6,425.64*** [986.86]	6,529.94*** [984.78]	6,381.49*** [986.86]	2,429.78*** [1,128.95]	2,595.48*** [1,085.43]
log(Individual Wealth in 2002)	No	Yes	No	No	No	No	No	Yes	No
log(Household Wealth in 2002)	No	No	Yes	No	No	No	No	No	Yes
log(Individual Income 2003)	No	No	No	Yes	No	No	No	No	No
log(Household Income 2003)	No	No	No	No	Yes	No	No	No	Yes
log(Individual Income 2004)	No	No	No	No	No	Yes	No	Yes	No
log(Household Income 2004)	No	No	No	No	No	No	Yes	No	No
Other Controls	No	No	No	No	No	No	No	Yes	Yes
log sigma	10.49*** [0.011]	10.49*** [0.012]	10.48*** [0.011]	10.48*** [0.011]	10.49*** [0.011]	10.49*** [0.011]	10.49*** [0.011]	10.48*** [0.012]	10.48*** [0.012]
log Pseudo-Likelihood	-21,875	-19,342	-21,862	-20,687	-21,870	-21,857	-21,870	-17,929	-19,197
Observations	19,419	17,295	19,419	18,411	19,419	19,419	19,419	16,264	17,417

Interval regression coefficient estimates. The dependent variable is the amount invested in the risky asset. Respondents can choose from 6 categories, ranging from 0 to 100,000. *Abitur* (high school degree) includes *Fachabitur* (topic related high school degree). The *Abitur* exam is completed at the end of university-track high-schools in Germany; passing the exam is a pre-requisite for attending university. The other controls in Columns (2) to (9) include demographic, professional and other self-reported information. For detailed results see Table A.1 in the appendix. Wealth and income controls are in logs. Logged absolute values of negative wealth are added as a separate control variable in the respective specifications. Income data for 2003 reflect annual net income. Income data for 2004 are based on answers to questions about *current monthly gross income* at the stage of the interview. We also used the net monthly income measure that is available as a generated variable in the SOEP; the results (not reported here) are essentially the same. Robust standard errors in brackets allow for clustering at the household level; ***, **, * indicate significance at 1-, 5-, and 10-percent level, respectively.

Table 4: Correlations Between Risk Attitudes in Different Domains of Life

	General	Car Driving	Financial Matters	Sports/Leisure	Career	Health
Mean	4.420	2.927	2.406	3.486	3.605	2.934
Mean (Men)	4.909	3.523	2.882	3.961	4.039	3.317
Mean (Women)	3.967	2.346	1.963	3.044	3.190	2.580
General	1.000					
Car Driving	0.490	1.000				
Financial Matters	0.506	0.520	1.000			
Sports/Leisure	0.563	0.542	0.503	1.000		
Career	0.609	0.507	0.498	0.605	1.000	
Health	0.474	0.503	0.458	0.522	0.531	1.000
Mean	0.321	0.177	0.098	0.227	0.253	0.154
Mean (Men)	0.405	0.239	0.148	0.295	0.314	0.194
Mean (Women)	0.243	0.116	0.051	0.164	0.194	0.116
General	1.000					
Car Driving	0.323	1.000				
Financial Matters	0.315	0.295	1.000			
Sports/Leisure	0.394	0.350	0.265	1.000		
Career	0.471	0.304	0.289	0.414	1.000	
Health	0.297	0.311	0.235	0.345	0.340	1.000
Observations	21,875	20,598	21,685	21,568	19,896	21,862

Correlations in the upper panel are based on the original measures with 11 response alternatives (entries 0-10). Correlations in the lower panel are based on a binary measure for general risk attitudes, where “0” indicates unwillingness to take risks (answers 0-5 in the original data) and “1” indicates willingness to take risks (answers 6-10 in the original data).

Table 5: Primary Determinants of Risk Attitudes in Different Domains of Life

	Dependent Variable: Willingness to Take Risks (Binary Measure) in:					
	General	Car Driving	Financial Matters	Sports/Leisure	Career	Health
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.111*** [0.009]	-0.091*** [0.008]	-0.078*** [0.006]	-0.095*** [0.008]	-0.082*** [0.009]	-0.062*** [0.007]
Age (in years)	-0.005*** [0.000]	-0.004*** [0.000]	-0.001*** [0.000]	-0.007*** [0.000]	-0.005*** [0.000]	-0.003*** [0.000]
Height (in cm)	0.005*** [0.001]	0.002*** [0.000]	0.001*** [0.000]	0.003*** [0.000]	0.003*** [0.001]	0.001*** [0.000]
<i>Abitur</i> Mother	0.063*** [0.016]	0.02 [0.012]	0.029*** [0.010]	0.041*** [0.013]	0.047*** [0.015]	0.014 [0.011]
<i>Abitur</i> Father	0.035*** [0.012]	-0.004 [0.009]	0.015** [0.007]	0.065*** [0.011]	0.034*** [0.011]	0.017* [0.009]
Pseudo-R ²	0.064	0.074	0.062	0.114	0.058	0.042
log Pseudo-Likelihood	-11,471	-7,935	-5,816	-9,185	-9,475	-7,988
Observations	19,438	18,313	19,274	19,186	17,683	19,431

Probit marginal effects estimates. The dependent variables are binary measures of the willingness to take risks in different domains, where “0” indicates unwillingness to take risks (answers 0-5 in the original data) and “1” indicates willingness to take risks (answers 6-10 in the original data). *Abitur* (high school degree) includes *Fachabitur* (topic related high school degree). The exam is completed at the end of university-track high-schools in Germany; passing the exam is a pre-requisite for attending university. Controls for interview month are included. Robust standard errors in brackets allow for clustering at the household level; ***, **, * indicate significance at 1-, 5-, and 10-percent level, respectively.

Table 6: The Relevance of Heterogeneity in Risk Measures: Primary Determinants of Behavior in Different Domains

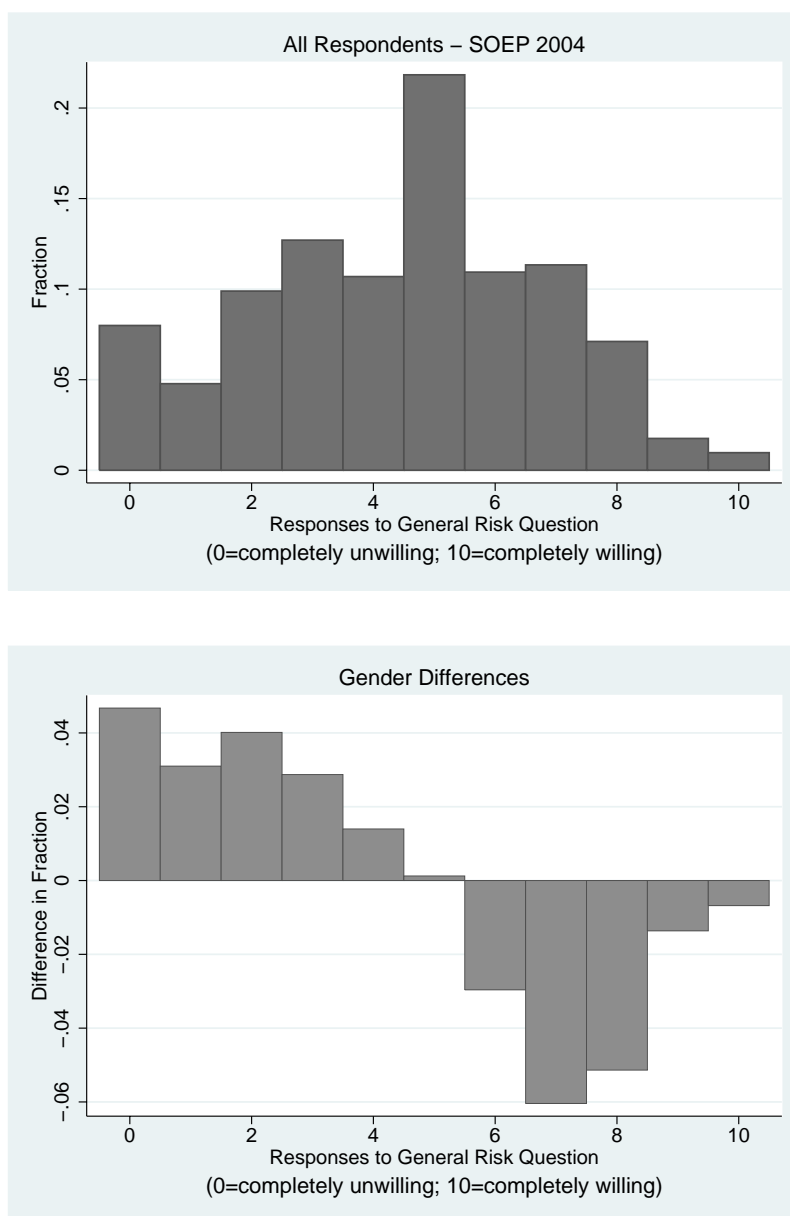
Dependent Variable:	Investment in Stocks (1) [†]	Active Sports (2)	Employment in Public Sector (3)	Selfemployed (4)	Smoking (5)	Mobility from East to West (6) [‡]	Mobility from West to East (7) [‡]	Overall Life Satisfaction (8) [*]
Willingness to Take Risks (binary measure) in General	0.035*** [0.011] (-4708.9)	0.083*** [0.009] (-8726.2)	-0.014** [0.007] (-6361.1)	0.006*** [0.002] (-1446.4)	0.052*** [0.008] (-9333.2)	0.018* [0.011] (-848.7)	0.006** [0.003] (-437.8)	0.350*** [0.035] (0.111)
Positive Amount Invested in Hypothetical Asset	0.085*** [0.011] (-4683.1)	0.086*** [0.008] (-8716.1)	0.016** [0.007] (-6360.2)	-0.001 [0.002] (-1450.7)	-0.003 [0.008] (-9354.2)	0.001 [0.010] (-850.2)	-0.001 [0.002] (-441.9)	0.128*** [0.034] (0.105)
Willingness to Take Risks (binary measure) in Car Driving	0.01 [0.014] (-4713.4)	0.038*** [0.011] (-8768.8)	-0.009 [0.008] (-6362.7)	0.001 [0.003] (-1450.7)	0.036*** [0.010] (-9347.3)	-0.014 [0.012] (-849.6)	-0.002 [0.002] (-441.4)	0.141*** [0.042] (0.105)
Financial Matters	0.244*** [0.018] (-4618.2)	0.079*** [0.013] (-8756.9)	0.003 [0.011] (-6363.3)	0.007** [0.003] (-1448.2)	-0.018 [0.012] (-9353.1)	-0.002 [0.018] (-850.2)	-0.001 [0.003] (-441.9)	0.222*** [0.051] (0.105)
Sports and Leisure	0.060*** [0.013] (-4703.0)	0.184*** [0.009] (-8579.2)	0.01 [0.008] (-6362.6)	0.003 [0.003] (-1450.0)	0.001 [0.009] (-9354.3)	0.005 [0.013] (-850.1)	0.004 [0.003] (-440.6)	0.247*** [0.041] (0.106)
Career	0.053*** [0.013] (-4704.2)	0.084*** [0.009] (-8731.7)	-0.012* [0.007] (-6361.9)	0.018*** [0.003] (-1421.3)	0.034*** [0.009] (-9346.2)	-0.018* [0.011] (-848.8)	0.002 [0.002] (-441.7)	0.196*** [0.039] (0.106)
Health	0.014 [0.014] (-4713.2)	0.033*** [0.011] (-8770.5)	0.012 [0.009] (-6362.4)	0.002 [0.003] (-1450.6)	0.128*** [0.011] (-9276.4)	-0.014 [0.013] (-849.7)	-0.003 [0.002] (-441.2)	0.057 [0.046] (0.104)
Observations	8610	16066	13925	13925	16120	2971	8211	11804

Dependent variables in Columns (1) to (7) are binary variables. The dependent variable in Column (8) measures life satisfaction on an 11-point scale from 0 (absolutely not satisfied with life in general) to 10 (completely satisfied with life in general). Investment in stocks in Column (1) includes investment in stock options. Explanatory variables are binary measures of willingness to take risks in different domains, where “0” indicates unwillingness to take risks (answers 0-5 in the original data) and “1” indicates willingness to take risks (answers 6-10 in the original data). Positive Amount Invested in Hypothetical Asset is also a binary measure taking on the value “0” if individuals respond no positive investment, and “1” otherwise.

Probit marginal effects estimates, evaluated at the means of independent variables, are displayed in Columns (1) to (7), i.e., coefficients of the binary risk measures reflect the discrete change in the probability. OLS estimates are displayed in Column (8). Each reported coefficient estimate of a binary risk measure is based on a separate regression of the respective dependent variable on this particular risk measure and a set of controls, whose coefficient estimates are not reported. This set includes the same controls for gender, age, height, and parental education as in Table 1, as well as controls for log household wealth, log household debt, and the log of current gross monthly household income in every regression. Additional controls: [†] Number of Adults in household; [‡] German national, Retired, School degree, *Abitur*; * Lived in GDR in 1989, Lived Abroad in 1989, Location in 1989 missing. Robust standard errors that allow for clustering at the household level are reported in brackets below the coefficient estimates, while log pseudolikelihood of the respective regression model are reported in parentheses in Columns (1) to (7) and R^2 statistics are in parentheses in beneath the the coefficient estimates in Column (8); ***, **, * indicate significance at 1-, 5-, and 10-percent level, respectively.

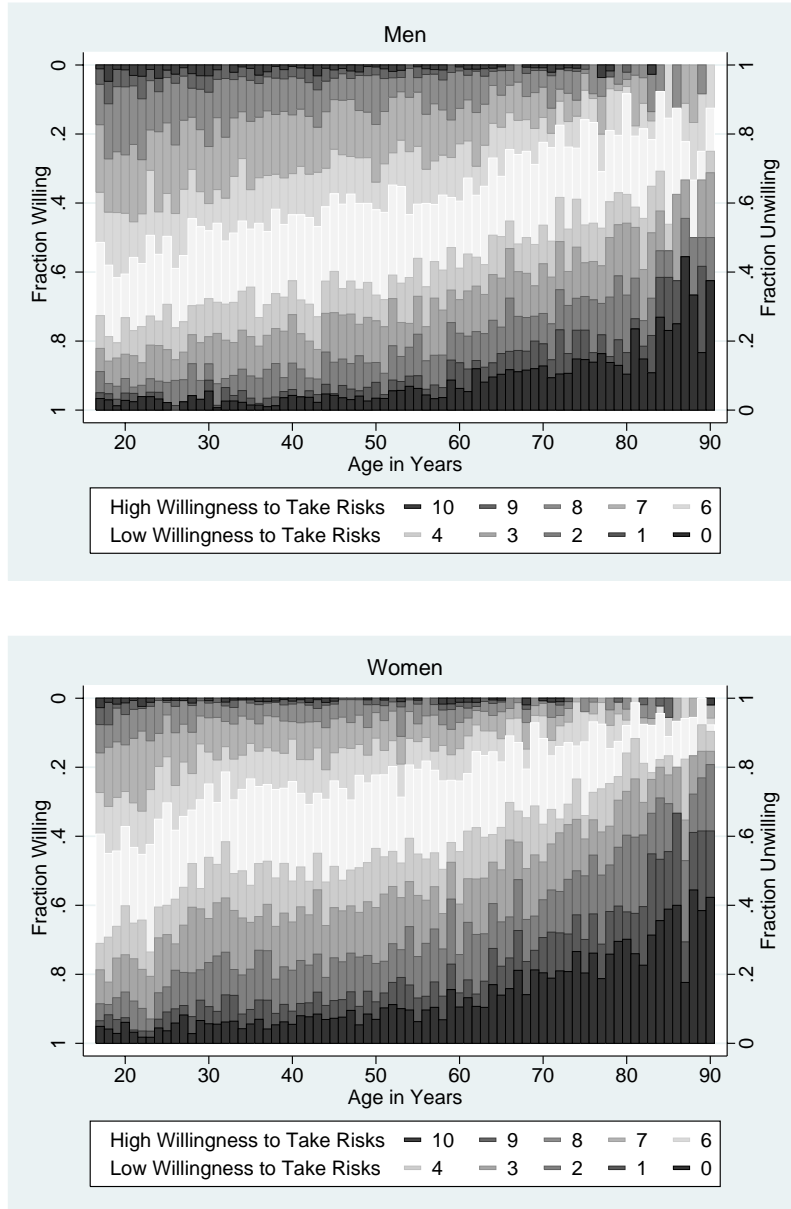
Figures

Figure 1: Willingness to Take Risks in General



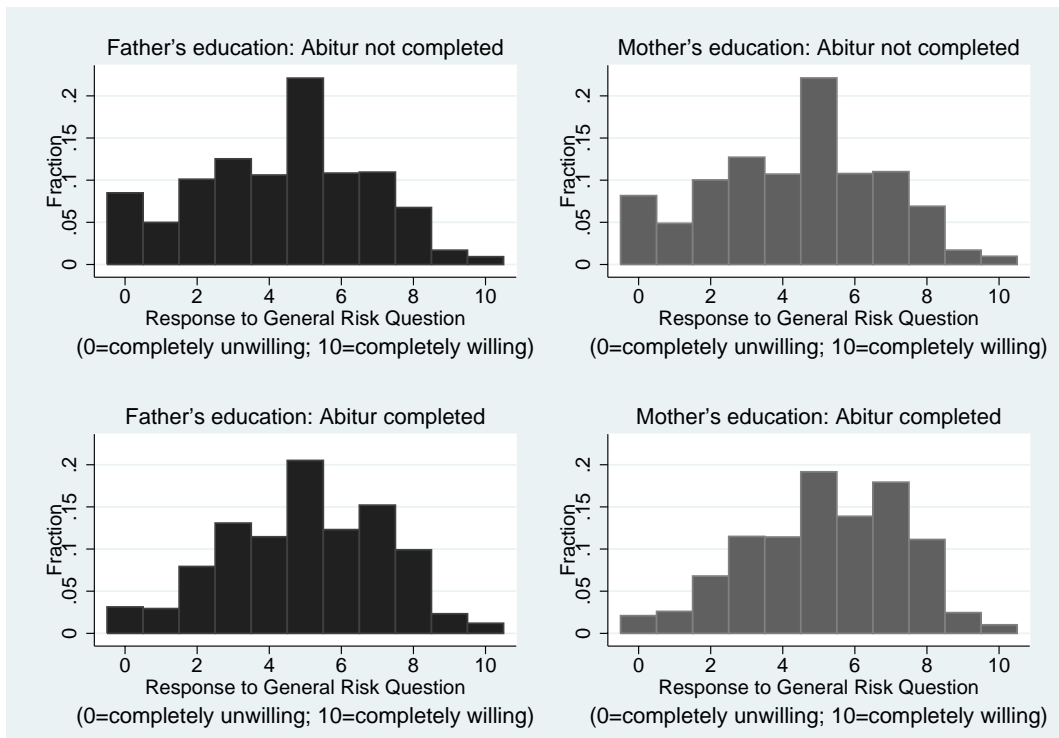
Notes: The top panel shows a histogram of responses to the question about general risk attitudes (measured on an eleven-point scale). The bottom panel shows the difference between the fraction of females and the fraction of males choosing each response category. A positive difference for a given category indicates that relatively more females choose that category.

Figure 2: Willingness to Take Risks in General, by Age and Gender



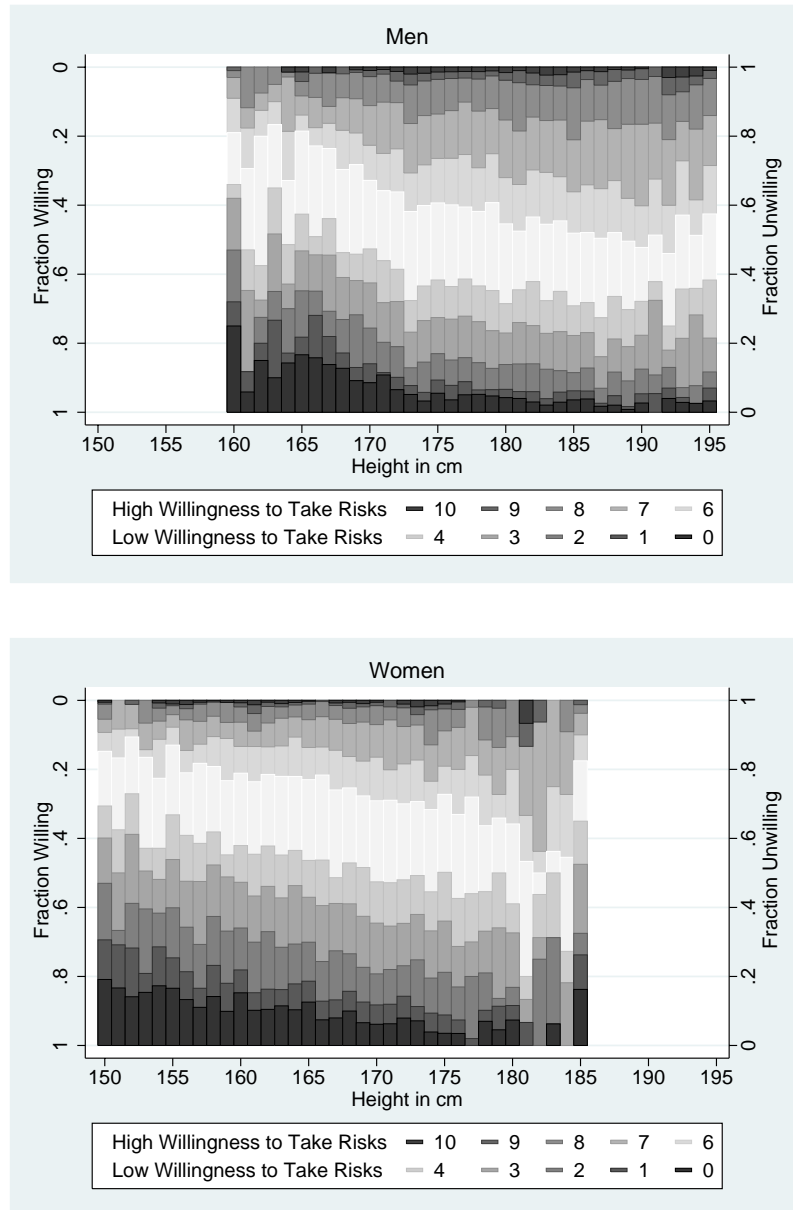
Notes: Each shaded band gives the fraction of individuals choosing a particular number on the eleven-point response scale for the question about general risk attitudes. The dark band at the bottom corresponds to a choice of zero, with progressively lighter shades indicating 1 through 4. The white band is the fraction choosing 5, and the progressively darker shades represent fractions choosing 6 through 10.

Figure 3: Willingness to Take Risks in General, by Parental Education



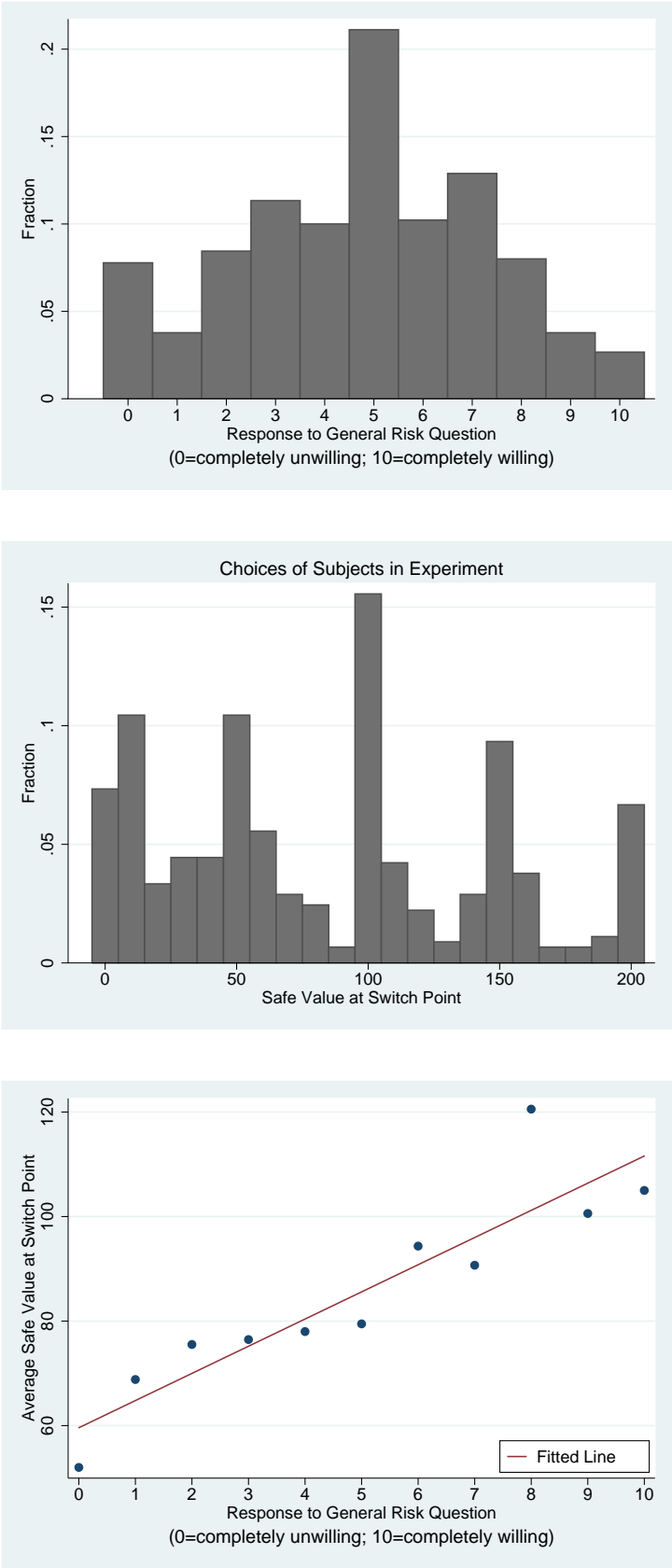
Notes: Each panel shows, for the indicated sub-sample, the histogram of responses to the question about general risk attitudes (measured on an eleven-point scale). *Abitur* (high school degree) includes *Fachabitur* (topic related high school degree). The *Abitur* exam is completed at the end of university-track high-schools in Germany; passing the exam is a pre-requisite for attending university.

Figure 4: Willingness to Take Risks in General, by Height and Gender



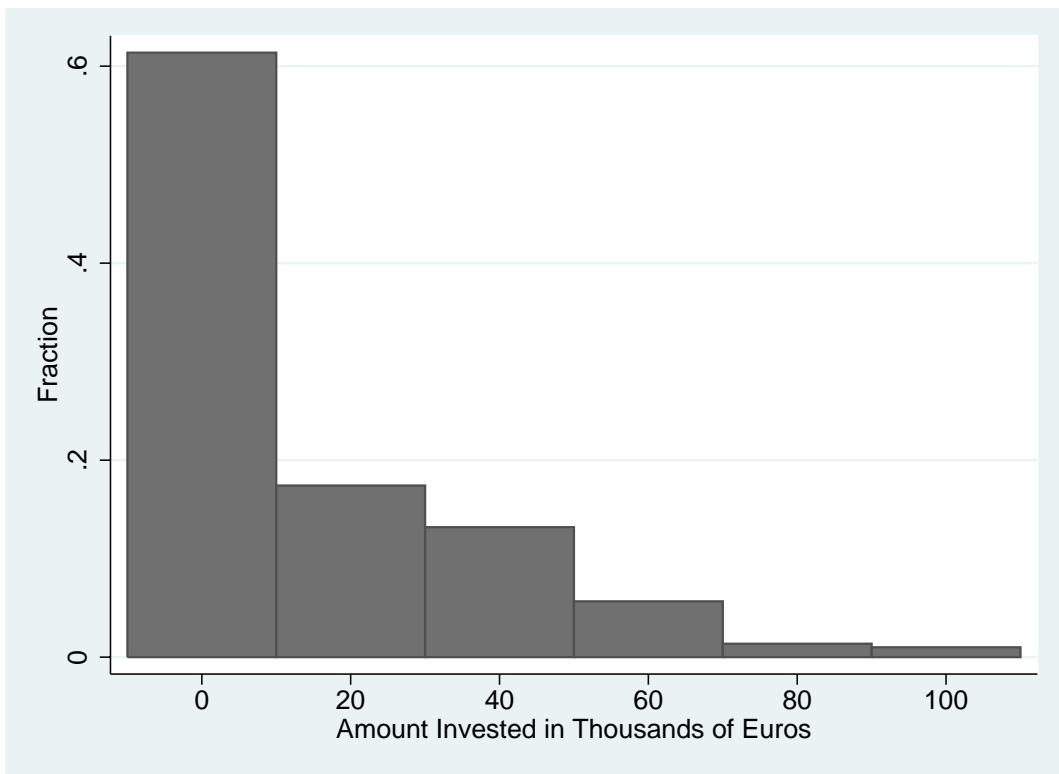
Notes: Each shaded band gives the fraction of individuals choosing a particular number on the eleven-point response scale for the question about general risk attitudes. The dark band at the bottom corresponds to a choice of zero, with progressively lighter shades indicating 1 through 4. The white band is the fraction choosing 5, and the progressively darker shades represent fractions choosing 6 through 10. In order to deal with small cell size, we pooled men taller than 195 cm with those being 195 cm tall, and men smaller than 160 cm with those being 160 cm tall. Similarly, we pooled women smaller than 150 cm with women who are 150 cm tall and women taller than 185 cm with those of being 185 cm tall.

Figure 5: Responses to General Risk Question and Lottery Choices in Field Experiment



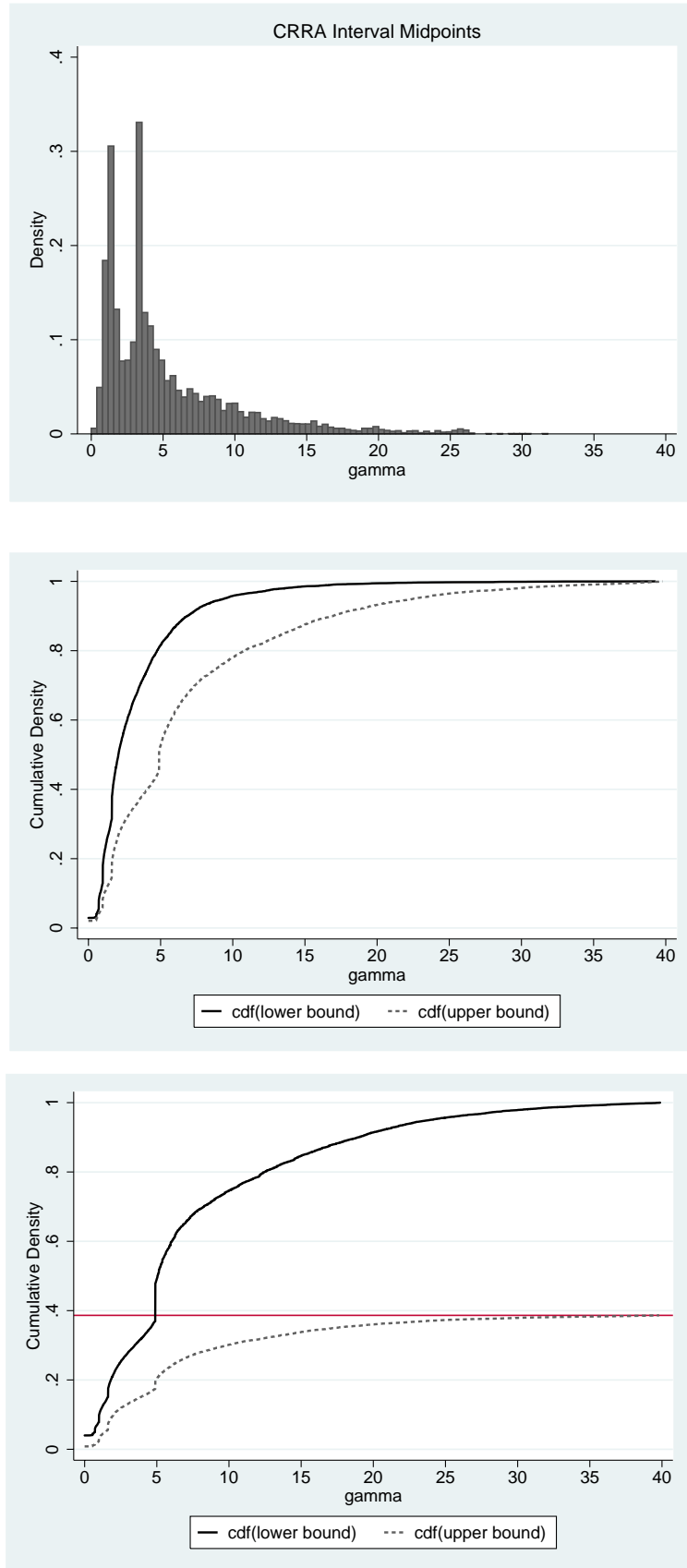
Notes: The upper panel of the figure shows the distribution of responses of subjects in the field experiment to the SOEP survey question about risks attitudes in general. The central panel shows the distribution of the safe option at the switching points in the field experiment. The lower panel shows the average value of the safe option at the switching point of respondents in a given response category.

Figure 6: Willingness to Invest in Hypothetical Asset



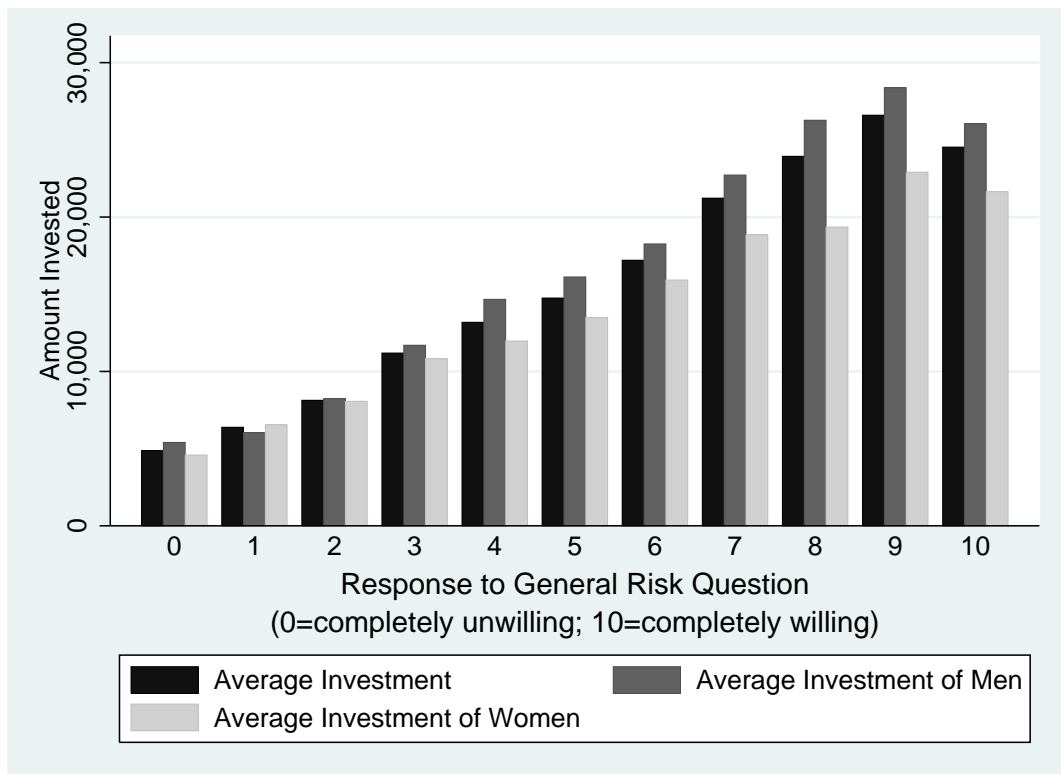
Notes: The figure shows a histogram of amounts invested in the hypothetical investment scenario. For details see text.

Figure 7: Distribution of Implied CRRA Coefficients



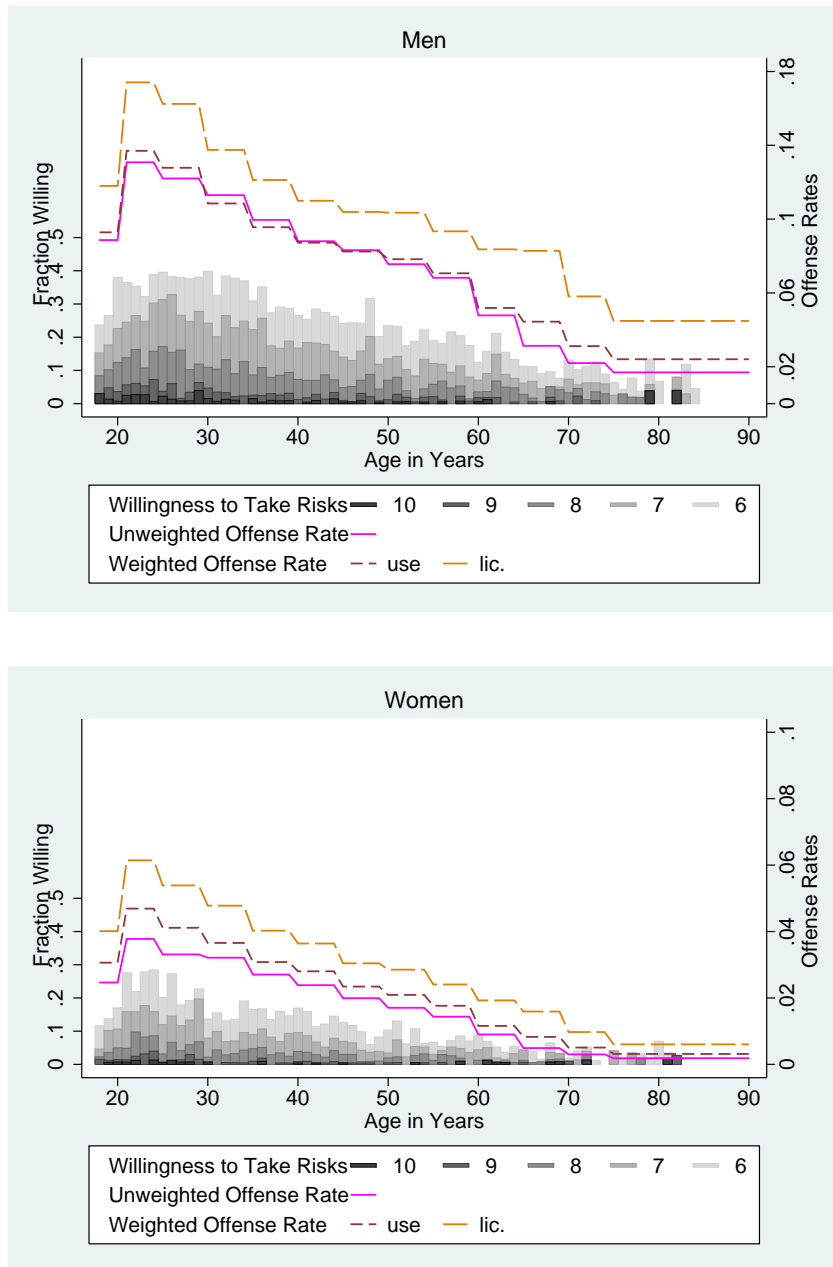
Notes: The top panel shows a histogram of interval midpoints of the CRRA parameter γ , which are derived from amounts invested in the hypothetical investment scenario. See text for details about computation. The middle panel shows the cumulative distribution function of the interval bounds of CRRA coefficients for individuals that choose interior investments in the hypothetical investment scenario. The lower panel shows the cumulative distribution function of the interval bounds of CRRA coefficients for all respondents of the the hypothetical investment scenario, including the 61 percent of respondents choosing to invest nothing and the 1 percent of respondents choosing to invest the entire lottery prize.

Figure 8: Predicted Investment in Hypothetical Asset



Notes: The figure shows average investment amounts for a given self-reported general risk attitude on a scale from 0 to 10.

Figure 9: Registered Traffic Offences and Willingness to Take Risks in Driving



Notes: The figure plots the fraction of risk lovers and traffic offense rates by age groups for men (upper panel) and women (lower panel). Each shaded band gives the fraction of individuals of a birth year cohort choosing a number between 6 and ten on the eleven-point response scale for the question about risk attitudes in driving a car. Progressively darker shades represent fractions choosing 6 through 10. The lines plot the rates of registered traffic offenses in the year 2002, the latest year for which data is available at the German Federal Bureau of Motor Vehicles and Drivers (Kraftfahrtbundesamt). Weighted offense rates are calculated based on information about car usage and driver's license ownership.

Data Sources: Risk attitudes are obtained from the SOEP, own calculations. The number of entries in the German Central Register of Traffic Offenders in the year 2002 (aggregated by gender age groups) are obtained from the Federal Bureau of Motor Vehicles and Drivers at www.kba.de/Abt3_neu/Verkehrsverstoesse/Personen_im_VZR/a_Haupt_Personen_im_VZR.htm Data on population by gender cohorts in 2002 was provided by the Federal Statistical Office. Finally, usage weights and license weights are calculated based on information contained in the study "Mobilität in Deutschland" (Mobility in Germany) which was authorized by the German Institute for Economic Research (DIW) and conducted in 2002. For further information visit <http://www.kontiv2002.de/engl/index.htm>.

A Appendix

Table A.1: Determinants of Risk Attitudes

	Dependent Variable:						
	General	Willingness to take Risks in the Domain of: Car Driving	Financial Matters	Sports & Leisure	Career	Health	Hypothetical Investment Choice
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.104*** [0.011]	-0.088*** [0.008]	-0.083*** [0.006]	-0.107*** [0.009]	-0.087*** [0.010]	-0.053*** [0.008]	-6,793.28*** [936.11]
Age (in years)	-0.003*** [0.000]	-0.004*** [0.000]	-0.001*** [0.000]	-0.005*** [0.000]	-0.004*** [0.000]	-0.002*** [0.000]	-200.19*** [44.42]
<i>Abitur</i> Mother	0.003*** [0.001]	0.001* [0.000]	0.001** [0.000]	0.003*** [0.001]	0.001** [0.001]	0.000 [0.000]	105.15* [57.73]
<i>Abitur</i> Father	0.027 [0.017]	0.015 [0.013]	0.024** [0.010]	0.011 [0.014]	0.013 [0.015]	0.004 [0.012]	89.58 [1,434.26]
Height (in cm)	-0.005 [0.013]	-0.011 [0.009]	-0.005 [0.006]	0.017 [0.011]	-0.011 [0.012]	0.002 [0.009]	2,595.48** [1,085.43]
Married	-0.022* [0.013]	-0.01 [0.010]	-0.020*** [0.008]	-0.031*** [0.011]	-0.040*** [0.013]	-0.026*** [0.010]	-2,968.57** [1,205.55]
Divorced	0.019 [0.018]	0.010 [0.014]	-0.013 [0.009]	0.000 [0.015]	0.015 [0.017]	0.001 [0.013]	-1,996.36 [1,636.44]
Widowed	-0.021 [0.022]	-0.018 [0.020]	-0.008 [0.013]	-0.032* [0.019]	-0.049** [0.021]	-0.022 [0.015]	-2,105.16 [2,095.39]
1 Child born after 1987	-0.005 [0.012]	0.003 [0.009]	0.015** [0.007]	-0.020** [0.010]	0.022* [0.012]	-0.001 [0.009]	537.16 [1,147.58]
2 Children born after 1987	-0.012 [0.014]	0.002 [0.010]	0.011 [0.008]	-0.024** [0.011]	0.003 [0.013]	-0.006 [0.010]	321.65 [1,299.30]
3 Children born after 1987	-0.060*** [0.022]	-0.037** [0.015]	-0.016 [0.012]	-0.074*** [0.015]	-0.024 [0.021]	-0.033** [0.015]	-301.98 [2,190.34]
> 3 Children born after 1987	0.067 [0.051]	-0.061** [0.025]	-0.021 [0.019]	-0.009 [0.036]	-0.024 [0.042]	0.008 [0.036]	4,956.97 [4,487.15]
Catholic	-0.017* [0.010]	-0.003 [0.008]	0.000 [0.005]	-0.012 [0.008]	-0.008 [0.009]	-0.005 [0.007]	11.45 [910.44]
Other Christian confession	-0.085*** [0.025]	-0.007 [0.021]	0.006 [0.016]	-0.050** [0.020]	-0.059*** [0.022]	-0.013 [0.020]	-1,287.84 [2,729.86]
Not religious	-0.035 [0.024]	-0.021 [0.018]	-0.013 [0.012]	-0.053*** [0.018]	-0.032 [0.023]	-0.041*** [0.015]	-4,742.86* [2,700.84]
No confession	0.052*** [0.011]	0.024*** [0.008]	0.005 [0.006]	0.021** [0.009]	0.030*** [0.010]	0.012 [0.008]	-975.35 [976.78]
Missing Religion	0.004 [0.049]	-0.026 [0.041]	-0.032 [0.021]	-0.051 [0.039]	0.004 [0.052]	0.024 [0.041]	-1,714.75 [4,639.67]
Lived in GDR in 1989	0.026 [0.020]	0.008 [0.015]	-0.004 [0.011]	-0.030* [0.016]	-0.002 [0.018]	-0.008 [0.014]	-1,344.11 [1,807.18]
Lived abroad in 1989	0.016 [0.022]	-0.011 [0.016]	0.021 [0.014]	-0.035** [0.016]	0.024 [0.021]	0.017 [0.016]	-2,622.57 [2,058.15]
Residence in 1989 missing	0.063 [0.120]	-0.102** [0.048]		0.096 [0.110]	0.026 [0.107]	0.139 [0.104]	2,904.00 [7,592.96]
Lives in East Germany in 2004	-0.009 [0.019]	-0.012 [0.014]	-0.005 [0.011]	0.02 [0.017]	0.036* [0.019]	0.002 [0.014]	-1,944.15 [1,801.72]
German Nationality	-0.005 [0.019]	0.003 [0.014]	-0.019 [0.012]	0.01 [0.016]	0.006 [0.018]	0.000 [0.014]	-3,826.93** [1,879.63]
School Degree	0.022 [0.027]	0.026 [0.022]	0.012 [0.015]	0.029 [0.023]	0.047* [0.026]	0.011 [0.020]	3,975.51 [3,248.04]
<i>Abitur</i>	0.043*** [0.010]	0.021*** [0.008]	0.028*** [0.006]	0.031*** [0.009]	0.038*** [0.010]	0.027*** [0.008]	3,674.81*** [873.17]
Subjective Health Status	-0.013*** [0.005]	0.004 [0.004]	0.005* [0.003]	-0.015*** [0.004]	-0.002 [0.005]	0.008** [0.003]	-1,793.54*** [436.00]
Smoker	0.063*** [0.009]	0.019*** [0.007]	-0.006 [0.004]	0.012* [0.007]	0.037*** [0.008]	0.081*** [0.007]	940.04 [784.99]
Weight (in kg)	0.000 [0.000]	0.001** [0.000]	-0.000** [0.000]	-0.001*** [0.000]	0.000 [0.000]	0.001*** [0.000]	-66.20** [28.12]
Enrolled in School	0.029 [0.064]	-0.064** [0.030]	-0.039* [0.023]	0.008 [0.048]	-0.072* [0.043]	-0.026 [0.035]	-3,929.09 [5,594.65]
Enrolled in College/University	-0.034 [0.027]	-0.048*** [0.016]	-0.039*** [0.009]	0.034 [0.025]	-0.040* [0.023]	-0.022 [0.017]	1,300.17 [2,591.62]

Table A.1: continued: Determinants of Risk Attitudes

	Dependent Variable:						Hypothetical Investment Choice (7)
	General (1)	Willingness to take Risks in the Domain of: Car Driving (2)	Financial Matters (3)	Sports & Leisure (4)	Career (5)	Health (6)	
Public Sector:							
Unskilled Blue Collar	-0.212*** [0.037]	-0.107*** [0.026]	0.025 [0.046]	0.001 [0.059]	-0.118*** [0.041]	-0.027 [0.041]	-8,956.93 [6,945.98]
Skilled Blue Collar	-0.180*** [0.033]	-0.065** [0.026]	-0.032* [0.019]	-0.089*** [0.030]	-0.160*** [0.023]	-0.058** [0.024]	-2,679.29 [4,835.20]
Blue Collar Craftsman	-0.129*** [0.033]	-0.067*** [0.022]	0.000 [0.024]	-0.022 [0.034]	-0.138*** [0.023]	-0.042* [0.024]	-3,029.66 [4,254.87]
Blue Collar Foreman	-0.193** [0.081]		-0.026 [0.057]	-0.027 [0.105]	-0.180*** [0.052]		6,953.86 [15,391.39]
Blue Collar Master	-0.044 [0.136]	-0.052 [0.078]	-0.029 [0.056]	0.141 [0.131]	-0.126 [0.077]	-0.024 [0.083]	4,120.91 [9,582.80]
Unskilled White Collar	-0.195* [0.113]	0.18 [0.240]		-0.039 [0.137]		0.212 [0.245]	-6,902.71 [15,937.23]
Skilled White Collar	-0.07 [0.052]	-0.077** [0.031]	-0.035 [0.026]	-0.051 [0.043]	-0.118*** [0.036]	-0.008 [0.039]	-6,711.54 [5,336.95]
White Collar Technician	-0.053 [0.034]	-0.011 [0.026]	-0.032** [0.015]	-0.017 [0.030]	-0.084*** [0.026]	-0.046** [0.020]	-1,577.79 [3,200.12]
White Collar Master	-0.093*** [0.021]	-0.009 [0.018]	0.004 [0.014]	0.018 [0.022]	-0.084*** [0.018]	-0.032** [0.015]	-1,991.13 [2,281.49]
Highly-Skilled White Collar	-0.045 [0.028]	-0.050*** [0.017]	0.013 [0.017]	0.026 [0.027]	-0.036 [0.024]	-0.011 [0.019]	3,119.11 [2,590.29]
White Collar Management	0.019 [0.097]	0.026 [0.073]	0.167* [0.088]	0.016 [0.076]	0.037 [0.088]	0.022 [0.069]	-11,739.48 [8,388.50]
Civil Servant	0.189 [0.134]	0.024 [0.089]	-0.017 [0.048]	0.290** [0.129]	0.114 [0.121]	0.227* [0.125]	13,758.21 [12,358.40]
Civil Servant Intermediate	-0.058* [0.034]	-0.013 [0.026]	-0.021 [0.016]	0.061* [0.035]	-0.057** [0.028]	-0.027 [0.022]	-3,109.50 [3,515.81]
Civil Servant High	-0.049* [0.028]	-0.037** [0.019]	-0.008 [0.015]	0.024 [0.027]	-0.055** [0.024]	-0.018 [0.019]	1,315.78 [2,668.61]
Civil Servant Executive	-0.05 [0.031]	-0.063*** [0.019]	-0.009 [0.016]	0.058* [0.033]	-0.015 [0.029]	-0.043** [0.019]	4,120.07 [3,031.33]
Private Sector:							
Unskilled Blue Collar	-0.111*** [0.020]	-0.019 [0.017]	-0.026** [0.010]	-0.027 [0.019]	-0.132*** [0.014]	-0.043*** [0.014]	-5,751.52** [2,389.73]
Skilled Blue Collar	-0.134*** [0.027]	-0.043* [0.023]	-0.012 [0.019]	-0.052* [0.027]	-0.116*** [0.022]	-0.040* [0.021]	-2,761.51 [3,464.72]
Blue Collar Craftsman	-0.093*** [0.020]	-0.044*** [0.014]	-0.020** [0.010]	-0.030* [0.018]	-0.123*** [0.014]	-0.060*** [0.012]	-2,796.78 [2,231.24]
Blue Collar Foreman	-0.065* [0.038]	-0.002 [0.029]	-0.013 [0.019]	0.009 [0.035]	-0.028 [0.034]	-0.027 [0.026]	-3,852.31 [4,037.80]
Blue Collar Master	-0.008 [0.056]	-0.019 [0.036]	-0.032 [0.020]	-0.003 [0.046]	0.045 [0.054]	-0.022 [0.034]	4,053.64 [5,641.84]
Unskilled White Collar	0.019 [0.081]	-0.011 [0.053]	-0.001 [0.038]	-0.041 [0.057]	-0.056 [0.058]	-0.037 [0.045]	3,038.84 [6,165.43]
White Collar Technician	-0.044* [0.025]	-0.021 [0.018]	-0.013 [0.013]	-0.002 [0.023]	-0.088*** [0.019]	-0.046*** [0.014]	-2,469.55 [2,513.45]
Highly-Skilled White Collar	-0.069*** [0.019]	-0.023 [0.015]	0.005 [0.012]	0.012 [0.019]	-0.053*** [0.017]	-0.038*** [0.013]	1,639.23 [2,018.03]
White Collar Master	-0.011 [0.023]	0.013 [0.018]	0.026* [0.015]	0.042* [0.022]	0.012 [0.021]	-0.011 [0.016]	4,103.48* [2,135.24]
White Collar Management	0.126*** [0.040]	0.058* [0.030]	0.081*** [0.027]	0.071** [0.034]	0.139*** [0.039]	-0.001 [0.024]	3,763.05 [3,298.69]
Self-employment:							
Professional Services	0.038 [0.032]	0.002 [0.023]	0.042** [0.021]	0.055* [0.029]	0.124*** [0.033]	-0.024 [0.019]	3,412.22 [2,874.27]
Other Self-employment	0.086** [0.034]	-0.010 [0.022]	0.029 [0.020]	0.017 [0.028]	0.090*** [0.032]	-0.043** [0.017]	-44.33 [2,984.52]
Agriculture	-0.078 [0.062]	-0.058 [0.042]	-0.049** [0.021]	0.016 [0.077]	0.111 [0.078]	-0.027 [0.045]	-23,432.24*** [8,440.01]

Table A.1: continued: Determinants of Risk Attitudes

	Dependent Variable:						
	General	Willingness to take Risks in the Domain of:	Financial	Sports & Leisure	Career	Health	Hypothetical Investment Choice
	(1)	Car Driving (2)	Matters (3)	(4)	(5)	(6)	(7)
Trainees/Apprentices							
Apprentice (technical)	0.017 [0.037]	-0.045** [0.020]	-0.027** [0.014]	0.023 [0.030]	-0.084*** [0.024]	-0.022 [0.021]	-2,897.21 [3,288.50]
Apprentice (clerical)	-0.036 [0.040]	-0.049** [0.023]	-0.030* [0.015]	0.007 [0.033]	-0.060* [0.031]	-0.033 [0.024]	3,310.49 [3,576.41]
Intern/Trainee	0.062 [0.086]	0.019 [0.059]	0.061 [0.056]	-0.011 [0.058]	0.007 [0.070]	0.020 [0.057]	7,425.67 [6,326.91]
Other	0.024 [0.059]	-0.041 [0.031]	-0.045*** [0.014]	0.023 [0.046]	-0.077** [0.038]	-0.001 [0.037]	-4,815.38 [4,923.30]
Unemployed	-0.049** [0.021]	-0.050*** [0.014]	-0.024*** [0.010]	-0.025 [0.018]	-0.063*** [0.012]	-0.057*** [0.018]	-4,938.20** [2,222.47]
Non-Participating	-0.098*** [0.019]	-0.080*** [0.012]	-0.017 [0.011]	-0.014 [0.019]	-0.110*** [0.015]	-0.062*** [0.011]	-5,261.98** [2,089.65]
Retired (Pension)	-0.120*** [0.020]	-0.065*** [0.014]	-0.026** [0.011]	-0.022 [0.019]	-0.115*** [0.017]	-0.059*** [0.014]	-5,613.56*** [2,116.17]
Log(Household Wealth in 2002)	0.002** [0.001]	0.002** [0.001]	0.002*** [0.001]	0.002** [0.001]	0.002 [0.001]	0.000 [0.001]	164.53* [94.87]
Log(Household Debt in 2002)	0.008*** [0.002]	0.002 [0.002]	0.003** [0.001]	0.005*** [0.002]	0.005*** [0.002]	0.001 [0.001]	92.91 [206.41]
Log(Household Income 2004)	0.004* [0.002]	0.002 [0.002]	0.001 [0.001]	0.001 [0.002]	-0.001 [0.002]	0.004*** [0.001]	121.28 [205.74]
Life Satisfaction	0.028*** [0.002]	0.011*** [0.002]	0.009*** [0.001]	0.014*** [0.002]	0.014*** [0.002]	0.006*** [0.002]	516.80** [228.76]
Month of Interview:							
January	-0.076 [0.083]	-0.004 [0.065]	-0.023 [0.033]	-0.081 [0.059]	-0.036 [0.089]	-0.007 [0.069]	15,047.38 [12,974.33]
February	-0.054 [0.083]	0.007 [0.066]	-0.018 [0.033]	-0.062 [0.059]	-0.018 [0.090]	-0.003 [0.069]	15,069.07 [12,979.48]
March	-0.078 [0.079]	0.001 [0.066]	-0.022 [0.031]	-0.069 [0.055]	-0.028 [0.088]	-0.007 [0.068]	18,048.17 [12,983.84]
April	-0.034 [0.083]	0.019 [0.071]	-0.017 [0.031]	-0.035 [0.059]	-0.005 [0.092]	0.012 [0.074]	16,883.39 [13,039.52]
May	-0.085 [0.075]	-0.020 [0.061]	-0.029 [0.026]	-0.066 [0.051]	-0.042 [0.084]	-0.025 [0.062]	13,296.42 [13,065.10]
June	-0.092 [0.074]	-0.006 [0.066]	-0.035 [0.024]	-0.075 [0.048]	-0.055 [0.081]	-0.024 [0.063]	17,848.73 [13,094.10]
July	-0.095 [0.073]	-0.037 [0.056]	-0.024 [0.028]	-0.059 [0.053]	-0.024 [0.088]	-0.007 [0.069]	15,390.35 [13,145.25]
August	-0.048 [0.085]	-0.040 [0.056]	-0.024 [0.030]	-0.070 [0.050]	-0.011 [0.094]	-0.033 [0.060]	16,334.55 [13,266.70]
September	-0.055 [0.091]	-0.078* [0.046]	-0.040 [0.025]	0.000 [0.075]	0.032 [0.113]	-0.039 [0.061]	19,959.06 [13,859.30]
Constant							-23,905.91 [16,850.44]
Pseudo- R^2	0.095	0.102	0.100	0.127	0.103	0.066	
Pseudo Log Likelihood	-9,817	-6,892	-4,945	-7,745	-7,983	-6,770	-19,197
Observations	17,435	1,6540	17,337	17,198	15,872	17,423	17,417

Probit marginal effects estimates. The dependent variables are binary measures of willingness to take risks in different domains, where “0” indicates unwillingness to take risks (answers 0-5 in the original data) and “1” indicates willingness to take risks (answers 6-10 in the original data). *Abitur* (high school degree) includes *Fachabitur* (topic related high school degree). The *Abitur* exam is completed at the end of university-track high-schools in Germany; passing the exam is a pre-requisite for attending university. Wealth and income controls are in logs. Logged absolute values of negative wealth are added as separate control. The income data for 2004 are based on answers to questions about *current gross monthly income sources* at the time of the interview. We also used the net monthly income measure that is available as a generated variable in the SOEP; the results (not reported here) are essentially the same. Robust standard errors in brackets allow for clustering at the household level; ***, **, * indicate significance at 1-, 5-, and 10-percent level, respectively.