Risk aversion vs. individualism: What drives risk taking in household finance?

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Abstract. Despite a considerable premium on equity with respect to riskfree assets, many households do not own stocks. We ask why the prevalence of stockholding is so limited. We focus on individual's attitudes towards risk and identify relevant factors that affect the willingness to take financial risks. Our empirical evidence contradicts standard portfolio theory, as it does not indicate a significant relationship between risk aversion and financial risk taking. However, our analysis supports the behavioral view that psychological factors rooted in national culture affect portfolio choice. Individualism, which is linked to overconfidence and overoptimism, has a significantly positive effect on financial risk taking. In micro data from Germany and Singapore, as well as in cross-country data, we find evidence consistent with low levels of individualism being an important factor in explaining the limited participation puzzle.

Keywords: Household Finance · Individualism · Risk Aversion · Risk Taking

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1 Introduction

Despite a considerable premium on equity with respect to riskfree assets, many households do not own stocks. In most countries, the majority of households holds no stocks even indirectly through mutual funds or retirement accounts. Exceptions are Sweden, the UK and the US, where stockholding participation amounts to over 40% of all households, but participation rates are below 20% in Germany, France, Italy, and Japan (Haliassos, 2006). We ask why the prevalence of stockholding is so limited. We focus on individual's attitudes towards risk and identify relevant factors that affect the willingness to take financial risks. We test directly whether the individual's subjectively measured rate of risk aversion influences the holding of risky assets. We further examine whether behavioral biases arising from cultural influences are helpful to explain attitudes towards risk taking in financial matters. In micro data from Germany and Singapore, as well as in cross-country data, we find evidence consistent with low levels of individualism being an important factor in explaining the limited participation puzzle.

Existing research has explored a variety of factors to explain risk taking behavior, and we are not the first to analyze the determinants of household willingness to take financial risks. However, the novel approach in this paper is to decompose the variation in risk attitudes across individuals into separate effects from risk aversion and cultural values.

Standard finance theory describes the choices that maximize household welfare. Investment in risky assets is rewarded by higher expected portfolio returns, and risk-averse households determine their best trade-off between risk and expected return. Under the standard axioms on decisions under uncertainty, any household will select that portfolio that maximizes the expected utility of their final consumption. An increase in risk aversion reduces the demand for risky assets (Gollier, 2002). In the following, we directly measure risk preferences of individuals through lottery questions and examine how these preferences correlate with the willingness to invest in risky assets.

Behavioral finance theory describes the choices that households actually make. Some households make decisions that are hard to reconcile with any standard

model, and observed portfolio composition often differs from predictions of the standard model. In fact, several studies reveal that non-standard models with behavioral factors explain why many individuals do not invest in stocks or other risky financial assets. Transaction and information costs, broadly interpreted, are suggested as the main reason for variations in stockholdings or the lack of stockholdings across individuals. The exact nature of these costs, however, is still not well understood (Christelis et al., 2010). In this paper we focus on cultural influences on human preferences as a potential explanation for limited willingness to take financial risks.

The study of household finance is challenging because household behavior is difficult to measure (Campbell, 2006). Our analysis uses detailed microeconomic datasets allowing us to control for a wide range of individual characteristics that may impact the willingness to take financial risks. Most importantly, we can directly infer a degree of risk aversion from hypothetical survey questions asking to compare different lotteries. Our data also contain information on cultural values that may be relevant for attitudes towards risk taking.

The contribution of our research is threefold. First, we are able to examine the immediate relationship between risk aversion and individual specific attitudes towards risk taking in financial matters. Though risk aversion has been recognized as a crucial determinant for financial risk taking, empirical studies seldom use information on an individual's rate of risk aversion, as such information is rarely available. Instead, most research relies on variables that proxy risk aversion through self-reported risk attitudes (see, for example, Haliassos and Bertraut, 1995; Keller and Siegrist, 2006; Barsky et al., 1997). We measure risk aversion directly through a set of hypothetical lottery questions. Second, we examine the relationship between cultural values and attitudes towards risk taking in financial matters. National culture has recently emerged as a powerful determinant in economic studies (Guiso et al., 2006). Hofstede (1983) defines culture as the "collective programming of the mind", indicating that culture is composed of certain values that shape attitudes and behavior. For that reason looking further and deeper into the individual, to the very things that define an individual's psychology, seems a fruitful approach to understand economic conduct (Durand et al.,

2008).Our dataset provides information on cultural values of the individual, so that we are able to test the immediate influence of culture on risk attitudes. Though the integration of cultural values into financial risk taking would certainly allow for interesting conclusions regarding participation in the stock market, this relationship remains unexplored in the current literature. Third, we extend our analysis to the country level. We not only examine whether culture exerts a direct influence on individual risk attitudes, but also investigate whether culture has an impact on actual economic outcomes. We therefore use cross-country data on cultural values and portfolio shares in equity. This analysis sheds light on the broader influence of culture, and provides an approach to identify a causal effect from national culture to economic outcomes.

Our models explain financial risk taking from subjectively measured variables capturing risk aversion and cultural values as well as socio-demographic characteristics. We do not address the issue of endogeneity of the latter variables. The underlying conceptual model of our analysis is rather simple: individual characteristics (gender, age, income, and wealth) are given, risk aversion and cultural values may vary within these characteristics. In particular, we do not investigate possible relationships between preference parameters on the one side and income and wealth on the other side. Instead, we focus on how risk taking in financial matters is driven by risk aversion or cultural values as well as individual characteristics.

The paper proceeds as follows. In Section 1 we link our study to the previous literature. Section 2 details the survey design. Section 3 contains the results. Section 4 provides evidence at the country level. Section 5 discusses our findings. Section 6 concludes.

2 Literature Review

The relationship between risk attitudes and the participation in the stock market is straightforward and well established in the literature. Several studies show that the probability of stockholding is smaller the larger the degree of risk tolerance (Shum and Faig, 2006; Puri and Robinson, 2007; Donkers and van Soest, 1999; Barsky et al., 1997). However, most of these analyses employ respondents' self-assessed risk attitudes as a proxy for risk aversion, and there is little research on

the extent to which actual measures of risk aversion influence the willingness to take financial risks.

Dimmock and Kouwenberg (2010) obtain direct measures of risk aversion through survey data involving hypothetical payoffs. Their evidence indicates that risk aversion is highly significant for the decision to participate in risky markets. Wärneryd (1996) measures risk aversion through a set of hypothetical lottery questions and examines the relationship to actual investments in risky assets. He finds that the fact that a household invests in more risky assets is quite well explained by risk aversion, but contrary to standard portfolio theory, the proportion of risky assets is less well explained. Similarly, Guiso et al. (2008) consider a set of risky lotteries to derive a measure of risk aversion and discover that risk aversion has little predictive power for financial risk taking. To this effect, Fellner and Maciejovsky (2007) note that observations of how people deal with risks in real life cast some doubts on the occurrence of risk aversion. They document that studies of decision making frequently uncover inconclusive evidence regarding the relation of risk attitudes and individual behavior. Empirical studies often find that actual risky choices deviate substantially from what maximization of expected utility presumed.

Economic models of standard portfolio theory suggest that generally all households should own stocks. A household should be willing to participate in the stock market because of the equity premium (Haliassos and Bertraut, 1995). Theoretical models typically derive household portfolio choice by maximizing an expected utility function conditional on household preferences. Among these, the household's rate of risk aversion is a crucial parameter. For instance, in the standard two-period Markowitz model of portfolio theory, the choice between risky and riskless assets depends on the individual's risk aversion parameter (Markowitz, 1952). Risk aversion is defined as a preference for a sure outcome over a prospect with an equal or greater expected value (Tversky and Kahnemann, 1981). Risk aversion is usually assumed as a stable personal trait. As theory predicts, households that are more risk averse should be less inclined to invest in risky assets (Guiso et al., 2003).

Hypothesis 1: Risk aversion is negatively related to the willingness to take financial risks.

Empirical studies document that equity market participation is much lower than what is implied by standard portfolio theory. It follows that limited participation in the stock market must be due to inadequacy of the standard assumptions (Campbell, 2006). Literature suggests several explanations for the reluctance of investment in markets for risky assets. The view that seems to have gained most support is that households face some actual or perceived fixed entry or participation costs that discourage investment in the stock market (Haliassos, 2006). The costs are eclectic and can be interpreted in distinct ways. One concept is to understand them broadly as transaction costs, ranging from trading costs to monitoring costs (Guiso et al., 2003). An alternative approach is to describe them as psychological factors that make equity ownership uncomfortable for some households. The exact nature of these costs is however not well understood and a matter of ongoing research (Campbell, 2006).

The empirical literature provides various findings consistent with the presence of psychological individual-specific factors that influence investment in risky assets. Puri and Robinson (2007) show that more optimistic individuals are more likely to participate in the equity market. Guiso et al. (2008) find that an individual's level of trust towards others is an effective measure to predict the level of stock market participation. Hong et al. (2004) contend that social households are more likely to invest in the stock market than non-social households. Georgarakos and Pasini (2011) demonstrate that trust and sociability have distinct and sizeable effects on stock market participation.

Behavioral finance provides several explanations for the apparent irrationality of investors. Behavioral finance is concerned with psychological influences on individual investor behavior (Charness and Gneezy, 2010). Several studies acknowledge that investor portfolio diversity can be attributed to psychological factors (Shum and Faig, 2006). Intrinsic differences in how to view the world may lead to heterogeneity in beliefs (He and Shi, 2010). As financial decisions are often made in situations of high complexity and high uncertainty that lack formal rules for

decision making, many conclusions rely on intuition (Kahneman and Riepe, 1998). Intuitions play a crucial role in most decisions and may cause systematic errors in judgment, so called biases. Two of the most prominent biases discussed in the investment literature are overconfidence and optimism. The interplay of overconfidence and optimism causes individuals to overestimate their knowledge, to underestimate risks, and to exaggerate their ability to control events (Giordani and Söderlind, 2006). Both biases are substantially related to attitudes towards risk taking.

We refer to the concept of national culture as a way of capturing and measuring information about the psychology of investors. Culture is defined as customary beliefs and values that social groups transmit fairly unchanged from one generation to another. Cultural beliefs and values reflect a person's sense of what is good, right, fair, and just. Restricting the potential channel of cultural influence to values and beliefs provides an approach to identify a causal link from culture to economic behavior (Guiso et al., 2006).

Virtually all decision theorists agree that values and beliefs jointly influence the willingness to invest under uncertainty (Campbell, 2006). We focus on what psychologists refer to as "individualism". Individualism describes the relationship between the individual and the collectivity that prevails in a given society. In individualist societies the ties between individuals are loose, and everyone is expected to look after him- or herself. In the polar type, collectivist societies, people are integrated into strong groups that they are unquestioningly loyal to (Hofstede, 2001). Although individualism does not directly measure the behavioral biases of overoptimism and overconfidence, the psychology literature suggests a link between individualism and overconfidence as well as overoptimism. In more individualistic societies more decisions are made by the individual and these decisions are more likely to be driven by overconfidence (Chui et al., 2010).

Markus and Kitayama (1991) indicate that people in individualistic cultures think positively about their abilities. Van den Steen (2004) argues that when individuals are overoptimistic about their abilities, they tend to overestimate the precision of their predictions, whereas in collectivist cultures, people are concerned with be-

having properly and exert high self-monitoring. Church et al. (2006) discuss that high self-monitoring helps to reduce the cognitive bias caused by overoptimism. Odean (1998) demonstrates that overoptimism leads to a miscalibration in beliefs. Puri and Robinson (2007) find that optimism is significantly related to attitudes towards risk. Grinblatt and Keloharju (2009) contend that overconfidence might result in a miscalibration of beliefs, what implies a tendency to be excessively confident in one's estimate of a parameter, such as the future return of a stock. Glaser and Weber (2007) evidence that overconfident investors tend to believe that one has the skill to pick winning stocks with above-average returns. Pan and Statman (2009) maintain that highly overconfident people exhibit indeed more risk tolerance than less overconfident people.

Hypothesis 2: Individualism is positively related to the willingness to take financial risks.

Recent strands of the literature explore the link between financial risk taking and household socio-demographic characteristics. Gender, age, income, and wealth are probably the factors that affect household financial decisions the most. In general, women are found to be making more risk averse choices than men (see Barnea et al., 2010; Renneboog and Spaenjers, 2011). There is no consensus on the relationship with age. While the majority of empirical work observe no age differences in risk propensity (Guiso et al., 2008; Dimmock and Kouwenberg, 2010), some studies find that risk taking rises with age (Shum and Faig, 2006), whereas others suggest a declining risk taking (Campbell, 2006). Almost all studies consistently support a positive link between wealth and income and investment in risky assets (Guiso et al., 2008; Barnea et al., 2010; Campbell, 2006). We control for these variables in our regression analysis.

Risk and time preferences are underresearched in the context of household finance. Dimmock and Kouwenberg (2010) examine the link between such parameters and equity market participation. They reveal that, among an individual's risk preferences, loss aversion has a significantly negative impact. Time discount rates seem to be unrelated. We include variables for these preference parameters in our regression models as well.

3 Survey Design and Data Collection

We use a specifically designed survey to obtain the different types of individual data we need to test our hypotheses. Altogether, the questionnaire for the experiment consists of five main components. The main components of the survey are questions concerning the risk taking behavior of the individual following Puri and Robinson (2007) and different lotteries concerning risk preferences as well as questions on cultural values. In addition, the survey comprises demographic variables, a section covering the economic background of the respondent, and questions deriving time preferences.

As our paper seeks to explain financial risk taking, the willingness to invest in risky assets is our focal point of interest. Literature suggests many different measures for the riskiness of an individual's portfolios, and until today there is no consensus on the most appropriate question. We employ a question developed in Puri and Robinson (2007):

> "Which of the following statements comes closest to the amount of financial risk that you are willing to take when you save or make investments?"

Respondents were allowed to choose between the following four answers:

(4) "Take substantial financial risks expecting to earn above average returns"
(3) "Take above average financial risks expecting to earn above average returns"
(2) "Take average financial risks expecting to earn average returns"
(1) "Not willing to take any financial risks"

We define the numerical answer to this question as variable RISKY, implicating that the higher the value of this variable, the riskier is the individual's behavior concerning portfolio choice.

Concerning risk preferences, we use the main ideas and questions of Prospect Theory that has been developed by Kahneman and Tversky in the late 1970s.
In Prospect Theory, risk preferences can be explained by three different parameters, risk aversion α, probability bias γ, and loss aversion λ. These parameters are

part of the commonly used value function by Kahneman and Tversky, which has been verified empirically.

$$v(x) := \begin{cases} x^{\alpha^+}, & x \geq 0 \\ -\lambda(-x)^{\alpha^-}, & x < 0 \end{cases} \quad (1)$$

Prospect Theory expresses outcomes as positive and negative deviations from a neutral reference outcome. In the above formula, the reference point is assigned a value of zero. Furthermore, v is the value of an amount of money x, which can be positive or negative. In the positive part, the individual gains x, while he loses x in the negative part. Risk aversion towards gains as well as risk seeking towards losses are both presented by the parameter α, since many empirical studies found the two parameters α^+ and α^- in formula (1) to be almost equal. As another characteristic of the value function, individuals respond to losses more extremely than to gains. Therefore Kahneman and Tversky introduce the loss aversion parameter λ, which is usually greater than 1. The Appendix details the exact derivation of the variables for risk and time preferences.

The parameters are derived through a set of hypothetical lottery questions. Clearly a key issue for our paper is the reliability of the measures for individual preferences. Some economists are sceptical about the use of subjective survey questions in general. As survey questions are not incentive compatible, individuals might respond randomly to survey questions, which would distort the induced measures (Dominitz and Manski, 1997). Yet we are eager that our measure of risk aversion captures risk preferences accurately. First, the validity of the survey based measures is examined and confirmed in laboratory experiments using paid lottery choices (Dohmen et al., 2011). Second, for several questions, there are simple, logical relationships that must hold between the responses. We find that only very few questionnaires of our sample violate these relations (Dimmock and Kouwenberg, 2010). Third, the questions used in our survey have been asked in numerous prior studies and are well accepted in the behavioral literature (Thaler, 1981). Finally, the responses and derived preference parameter are quantitatively similar to a large number of other empirical studies (Tversky and Kahneman, 1992).

We classify culture according to Hofstede by using the four original cultural dimensions uncertainty avoidance, power distance, individualism, and masculinity. Despite the criticism regarding Hofstede's work (Sivakumar and Nakata, 2001), academic research has relied extensively on his framework to analyze the impact of culture (Kirkman et al., 2006).

- Uncertainty avoidance deals with a society's tolerance for uncertainty and ambiguity and refers to its search for truth.
- Power distance is the extent to which different societies handle human inequality differently.
- Individualism describes the relationship between the individual and the collectivity that prevails in a given society.
- Masculinity refers to the distribution of roles between genders.

The questions used to calculate the respective indices can be found in Hofstede (2001). Each cultural dimension is calculated using the numerical answer to four different questions or statements. We follow the calculation formulas suggested in Hofstede (2001) to derive the specific values for each cultural dimension from the survey questions.

Since the economic background of the respondent may have an influence on his financial decisions we ask questions concerning wealth and monthly income. A description of these and other demographic control variables can be found in Table 1.

<<Insert Table 1 about here >>

A total of 449 economic students participated in the surveys, which were conducted in Germany and Singapore. We use data from two culturally distinct but equally developed countries, to ensure sufficient cultural variance in the sample without introducing too much heterogeneity in the economic background variables. The respondents answered the questions during the first or the last part of university lectures. The German questionnaire has been translated into English for the Singaporean survey and checked by re-translation for translation mistakes that

could influence the results. In order to adjust the questionnaire for differences in the currency, the cashflows have been converted using the Purchase Power Parity between Germany and Singapore. We used students with an economic background, because this group of individuals is easy to reach and is able to understand the tasks involving lotteries. Additionally, a group like this is homogenous and therefore comparable across countries, as requested in Hofstede (2001). For the final regressions, we only included those respondents who answered more than 50 % of the questions without inconsistencies. Table 2 illustrates the main summary statistics of our data.

<< Insert Table 2 about here >>

4 Results

To empirically capture the relationship between an individual's willingness to invest in risky assets and the individual's risk preferences as well as cultural values, we estimate individual-level ordinary least squares regression models.

The regression results for Hypothesis 1 can be found in Table 3. The dependent variable is RISKY, the behavior of an individual in terms of riskiness of portfolio choice. The independent variables are the risk aversion α and demographic variables such as sex and age and economic variables such as monthly income and wealth. Additionally, we control for other risk and time preferences. The table reports the ordinary least square estimates. Since data availability for some control variables is limited, we include the control variables separately and in groups.

We find positive estimates between risk aversion α and RISKY in the regression models as well, but in none of all regressions this relationship is significant. This finding contradicts standard portfolio theory and adds to the increasing evidence that risk aversion has only very low explanatory power for individual decision making (Fellner and Maciejovsky, 2007; Guiso et al., 2008).

<< Insert Table 3 about here >>

The regression results for Hypothesis 2 can be found in Table 4. The dependent variable remains RISKY, capturing individual attitudes towards investment risk. The independent variables are the cultural dimension of individualism as well as the remaining three Hofstede cultural dimensions uncertainty avoidance, power distance, and masculinity, to avoid an omitted variables bias. We again include demographic variables such as sex and age and economic variables such as monthly income and wealth. We also include risk preferences and time preferences. The table reports ordinary least square estimates.

We find a strong relationship between individualism and RISKY. Controlling for different variables, individualism has a significantly positive effect on an individual's willingness to invest in risky assets. The coefficient of individualism in our basic regression is 0.0028, which implies that, all else equal, a one-standard-deviation increase in individualism would induce a $0.0028 \cdot 57.2 = 0.1602$ increase in RISKY. In percentage terms, relative to the mean of RISKY, this corresponds to a $0.1602 : 2.09 = 8\%$ increase, which is economically significant. Our analysis supports the behavioral view that psychological biases induced by individualism are effective predictors of financial risk taking. Individualism is linked to overconfidence and optimism and increases the willingness to invest in risky financial assets.

<< Insert Table 4 about here >>

5 Discussion

Until now, we have only examined the effect of differences in cultural values across individuals. We documented that individualism is positively related to attitudes towards risk. Do these differences in individual preferences have an impact on economic outcomes across countries? What is the average implication of a low level of individualism in a country? According to our reasoning above, investors will be more reluctant to invest in risky assets when the level of individualism is low. Hence we expect that countries with low individualism have low equity holdings. We now turn to country-level data on the use of equities to test this prediction.

We obtain data on portfolio shares invested in equity from EIU WorldData. For each country, we calculate the ratio of equity assets to total assets held by the household sector in 2008. Equity assets consist of claims to residual value of incorporated enterprises, after claims of all creditors, and include mutual fund holdings. Hofstede (2001) provides data on the cultural dimensions.

To capture wealth and age effects, we include median household income (median nominal disposable income earned by households per annum) and the dependency ratio (the ratio of the population under age 15 and over age 64 to the population ages 15 to 64) in our regression analysis. We get both variables from EIU WorldData as well. We also control for the average level of trust in a country, as Guiso et al. (2008) show that a general lack of trust can have a negative effect on stock market participation. The data are from the World Values Survey. Besides, we include stock market capitalization to GDP as a control variable, to ensure that our results are not simply driven by the general development of financial markets. This variable comes from Beck and Demirgüç-Kunt (2009).

We test our hypothesis by regressing the portfolio shares of equities in each country on the cultural dimensions and control variables. We standardize the independent variables so that the coefficient estimates can be directly compared within and across regressions. The first column in Table 5 reports the results. As predicted, individualism has a positive effect on stock market participation and is statistically significant. Since the independent variables have been standardized for our regressions, the estimates are easy to interpret in economic terms. The dependent variable for investments in equities has a mean of 0.31, and individualism has a coefficient estimate of 0.0963. This estimate implies that, all else equal, a one-standard-deviation increase in individualism would induce a 0.0963 ∶ 0.31 = 31% increase in the measure for equity shares, relative to the mean value.

The coefficient of individualism has the highest absolute value, suggesting that cultural variables are as important as economic variables in understanding cross-country differences in portfolio structures. All the variables together can explain 20% of the cross-country variability in the rate of investments in equity. Our cul-

tural analysis also sheds light on the stock market participation rates quoted at the beginning. Sweden, the UK and the US, where participation rates are notably high, have very high levels of individualism.

Concerns arise over the possibility of endogeneity. Does culture affect the economic outcome only through the channel presumed in the regression? We opt for an instrumental variable approach that establishes an exogenous source of variation in culture to address this issue.

Our instrument for the cultural dimensions of individualism is derived by analyzing the language spoken in a country. A large body of work maintains that culture and language are inseparable and mutually constitute one another. Though a detailed discussion of this literature is beyond the scope of this paper, there is substantial evidence that language affects people's social beliefs and value judgments (Whorf, 1956; Sapir, 1970). Culture and language may be connected through the conception of the person, which is coded in the use of person-indexing pronouns, such as "I" and "you" in English. Major differences arise from the question of "whether to use a pronoun" and "which pronoun to use".
The cultural dimension of individualism concerns the relationship between the individual and the collective. Kashima and Kashima (1998) relate this dimension to the linguistic practice of pronoun drop, in particular the omission of the first-person singular pronoun ("I" in English). In some languages (like English, for example) it is mandatory to include a subject pronoun in most sentences, while it is not required in other languages (in Spanish, for example) where these pronouns can be dropped. An explicit use of "I" emphasizes the speaker's person, whereas a language that allows pronouns to be dropped reduces its prominence. Kashima and Kashima (1998) examine major languages and code a language as "2" if it almost always requires a first-person singular pronoun in an independent clause and as "1" otherwise, and label the variable as pronoun drop. Therefore, we expect a positive relationship between pronoun drop and individualism ($\rho = 0.83$, $p = 0.00$).

In the two-stage least squares instrumental approach, our first step is to treat individualism as a dependent variable and use pronoun drop as the instrumental ex-

planatory variable. In the second step, we then insert the predicted values of individualism back in our regression with the portfolio shares of equities as the dependent variable, together with other explanatory variables that appear in the regression. The results are shown in the second column of Table 5. The coefficient of individualism using this instrumental variable approach is considerably bigger than the coefficient using the ordinary least squares approach, suggesting that endogeneity is not a major concern. The statistical significance of individualism remains about the same.

<< Insert Table 5 about here >>

6 Conclusion

In this paper we link individual and cultural preferences to willingness to invest in risky assets. We collect data using a survey that allows us to test (1) standard portfolio theory that risk aversion is negatively related to financial risk taking (2) whether individualism, which is linked to overconfidence and overoptimism, affects financial risk taking (3) how cultural preferences translate into economic outcomes at the country level. Our empirical evidence contradicts standard portfolio theory, as it does not indicate a significant relationship between risk aversion and risk taking in financial matters. However, our analysis supports the behavioral view that psychological factors rooted in culture can affect portfolio choice. Individualism has a significantly positive effect on financial risk attitudes. The last extension shows that cultural values are also important predictors for investment in equities across countries.

As most developed countries are facing an increased population aging, households need to accumulate assets on their own in order to finance retirement (Bilias, 2010). Despite a noticeable premium on investments in equity, worldwide participation in equity markets is still limited. Financial economists need to advance solutions to reduce the incidence of these investment mistakes (Campbell, 2006). Any policy interventions aimed at fostering investment can be more effectively designed if there is a proper understanding of the underlying factors (Badunenko et al. 2009).

Appendix

To elicit risk preferences, we employ a simple task for every parameter with three sub questions. The main assignment for risk aversion towards gains had the following form:

> "For each lottery comparison, please state the amount of Z for which you are indifferent between both lotteries.
> Lottery A: 50 % chance to gain 20 €, 50 % chance to gain 200 €
> Lottery B: 50 % chance to gain Z €, 50 % chance to gain nothing
> Z should be _____ €, such that lottery A is as attractive as lottery B."

Using Prospect Theory by Kahneman and Tversky and three different lotteries of the form (x_n, 0,5; y_n, 0,5) und (z_n, 0,5; 0, 0,5) withx_n, y_n> 0, we calculate the risk aversion towards gains:

$$\pi(0{,}5) \cdot v(x_n) + \pi(0{,}5) \cdot v(y_n) = \pi(0{,}5) \cdot v(z_n) + \pi(0{,}5) \cdot v(0) \qquad (2)$$

With v(0) = 0 it follows:

$$v(x_n) + v(y_n) = v(z_n) \qquad (3)$$

Now the function $v(x_n)$ has to be adjusted. For every value of the parameter α (exogenously given) the sum of the differences between the calculated value and the real value given through the questionnaire is calculated. The value of α, for which this sum is minimal, is the optimal value of the parameter. The higher the value of α, the smaller is the risk aversion towards gains, since the shape of the function is getting more concave with smaller α. For α = 1 the investor is neutral towards risk.

Since we assume $\alpha^+ = \alpha^-$, the risk aversion parameter α is set equal to the risk seeking towards gains parameter and we can use three subsequent questions of the form (x_n, 0,5; $-y_n$, 0,5) und ($-z_n$, 0,5; 0, 0,5) with $x_n = y_n$ to calculate λ, the loss aversion.

$$v(x_n) + v(-y_n) = v(-z_n) \tag{4}$$

$${x_n}^{\alpha^+} - \lambda {y_n}^{\alpha^-} = -\lambda {z_n}^{\alpha^-} \tag{5}$$

$$\lambda = \frac{x^{\alpha^+}}{{y_n}^{\alpha^-} - {z_n}^{\alpha^-}} \tag{6}$$

For the calculation of the probability γ bias we use a well known formula that has been introduced by Kahneman and Tversky:

$$\pi_\gamma(p_n) = \frac{{p_n}^\gamma}{(({p_n}^\gamma + (1 - p_n)^\gamma)^{\frac{1}{\gamma}}} \tag{7}$$

The treatment of probabilities differs between Expected Utility Theory and Prospect Theory. In Expected Utility Theory, the utility of an uncertain outcome is weighted by its probability. In Prospect Theory, the probability is replaced by a decision weight π(p), that is not a probability. We use questions of the form (x_n, p_n; 0, 1 – p_n) and ask the respondents for the certainty equivalent z_n. With $v(0)=0$ it follows:

$$\pi(p_n) \cdot v(x_n) + \pi(1 - p_n) \cdot v(0) = v(z_n) \tag{8}$$

$$\pi(p_n) = \frac{v(z_n)}{v(x_n)} \tag{9}$$

Since v(x) is known, $\pi(p_n)$ can be deferred by variation of p_n, using the same procedure that has been used for the calculation of risk aversion α.

Concerning time preferences we use the theory of the quasi-hyperbolic discount-model. Following this model, that has been confirmed in a large number of experiments, individuals tend to prefer smaller, but earlier rewards instead of larger, but later rewards. The function discount factor over time does not follow the shape of exponential discounting (which would be the result of discounting with interest) but a hyperbolic shape. Mathematically quasi-hyperbolic discounting can be described as:

$$u(x_o, x_1, \dots, x_T) = u(x_o) + \sum_{t=1}^{T} \beta \cdot \delta^t \cdot u(x_t) \tag{10}$$

where u is the benefit for the individual, β and δ are constants between 0 and 1, t is the delay of the reward. The parameter β is called the presentbias, because this factor describes the time preference of the individual between this period and the next period. A larger β implies a less present bias. The other parameter δ is called long-term discount factor and describes the time preference between any two future periods.

For the calculation of these parameters the following two questions were used:

> "Please consider the following alternatives:
> Payment A: A payment of 100 € now
> Payment B: A payment of F € in one year (ten years)
> F_{1year} ($F_{10years}$) should be _____ €, such that payment A is as attractive as payment B."

Both parameters can be inferred from the individual's responses F_{1year} and $F_{10years}$:

$$\delta = \left(\frac{F_{1year}}{F_{10years}}\right)^{\frac{1}{9}}, \tag{11}$$

$$\beta = \frac{100}{\delta \cdot F_{1year}}. \tag{12}$$

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Table 1. Variables and sources.

Variable	*Description*
Variables from the individual dataset (collected in surveys)	
RISKY	Respondent's answer to the question: Which of the statements on this page comes closest to the amount of financial risk that you are willing to take when you save or make investments?" [(4) Take substantial financial risks expecting to earn above average returns; (3) Take above average financial risks expecting to earn above average returns; (2) Take average financial risks expecting to earn average returns; (1)Not willing to take any financial risks]
risk aversion α	Risk preferences parameter from Prospect Theory according to Kahneman and Tversky (1981). See Appendix for a detailed derivation.
loss aversion λ	Risk preferences parameter from Prospect Theory according to Kahneman and Tversky (1981). See Appendix for a detailed derivation.
probability bias γ	Risk preferences parameter from Prospect Theory according to Kahneman and Tversky (1981). See Appendix for a detailed derivation.
presentbias β	Time preferences parameter according to the Quasi-hyperbolic discount model. See Appendix for a detailed derivation.
long-term discount factor δ	Time preferences parameter according to the Quasi-hyperbolic discount model. See Appendix for a detailed derivation.
uncertainty avoidance	Hofstede Uncertainty Avoidance Index following Hofstede (2001).
power distance	Power Distance Index following Hofstede (2001).
individualism	Hofstede Individualism Index following Hofstede (2001).
masculinity	Hofstede Masculinity Index following Hofstede (2001).
sex (d)	Gender. [(1) male, (0) female].
age	Age of the respondent.
ln(monthincome)	Logarithm of the respondent's monthly disposal.
ln(wealth)	Logarithm of the respondent's actual total wealth.
Variables from the cross-country dataset (source in parantheses)	
equities	The ratio of equity assets to total assets held by the household sector. Equity assets consist of claims to residual value of incorporated enterprises, after claims of all creditors, and include mutual fund holdings. Data for 2008. (EIU WorldData)
uncertainty avoidance	Hofstede Uncertainty Avoidance Index. (Hofstede, 2001)
power distance	Hofstede Power Distance Index. (Hofstede, 2001)
individualism	Hofstede Individualism Index. (Hofstede, 2001)
masculinity	Hofstede Masculinity Index. (Hofstede, 2001)
market capitalization	Value of listed shares to GDP. Data is averaged over 2000 to 2008. (Beck and Demirgüç-Kunt, 2009)
median income	Median nominal disposable income earned by households per annum. Data for 2008. (EIU WorldData)
trust	Average level of trust in a country. (World Values Survey)
dependency ratio	The dependency ratio is the sum of the ratio of the population under age 15 to the population ages 15 to 64 and the ratio of the population over age 64 to the population ages 15 to 64. (EIU WorldData)

Notes: The table lists the descriptions of variables for the regressions.

Table 2. Summary statistics.

Variable	*N*	*Mean*	*Median*	*S.D.*	*Min*	*Max*
Summary statistics for individual dataset						
RISKY	444	2.09	2.00	0.78	1.00	4.00
risk aversion α	318	0.59	0.55	0.27	0.06	1.00
loss aversion λ	250	1.66	1.00	1.83	1.00	22.99
probability bias γ	318	0.61	0.54	0.35	0.00	3.25
presentbias β	434	0.65	0.69	0.33	0.00	1.66
long-term discount factor δ	434	0.85	0.86	0.09	0.30	1.05
uncertainty avoidance	420	65.50	65.00	59.15	-105.00	215.00
power distance	405	-8.06	-5.00	41.47	-140.00	130.00
individualism	443	48.71	50.00	57.20	-400.00	205.00
masculinity	435	76.94	80.00	91.27	-370.00	370.00
sex	447	0.71	1.00	0.46	0.00	1.00
age	431	22.43	22.00	2.16	19.00	33.00
ln(monthincome)	352	6.26	6.21	0.67	3.00	9.21
ln(wealth)	251	8.72	8.85	1.40	3.91	12.90
Summary statistics for cross-country dataset						
equities	34	0.31	0.26	0.18	0.00	0.66
power distance	34	57.56	59.00	20.40	22.00	104.00
individualism	34	49.71	47.00	25.01	13.00	91.00
masculinity	34	49.62	51.00	19.09	5.00	95.00
uncertainty avoidance	34	64.41	64.50	21.34	29.00	95.00
market capitalization	34	0.93	0.68	0.78	0.13	4.01
median income	34	32228	24465	24842	2570	83730
trust	34	0.24	0.19	0.14	0.04	0.58
dependency ratio	34	0.48	0.49	0.06	0.34	0.58

Notes: The first panel of this table presents descriptive statistics for the variables at the individual level. The second panel of this table reports descriptive statistics for the variables at the country level.S.D. indicates the standard deviation.

Table 3. Regression results for Hypothesis 1.

independent variable	*dependent variable: RISKY*				
constant	0.4805 (0.8303)	1.1024 (0.8949)	0.1582 (0.8358)	0.7828 (0.8993)	0.9371 (1.0676)
sex	0.1571 (0.1395)	0.1989 (0.1561)	0.0741 (0.1435)	0.1226 (0.1591)	0.1295 (0.1437)
age	0.0142 (0.0293)	0.0167 (0.0332)	0.0115 (0.0290)	0.0183 (0.0328)	0.0123 (0.0298)
ln(monthincome)	0.1696* (0.0915)	0.0637 (0.1024)	0.2056 (0.0921)**	0.0870 (0.1019)	0.1572* (0.0941)
ln(wealth)	0.0093 (0.0430)	-0.0280 (0.0482)	0.0042 (0.0426)	-0.0382 (0.0479)	0.0167 (0.0450)
risk aversion α	0.1310 (0.2387)	0.4272 (0.2814)	0.1685 (0.2370)	0.4468 (0.2783)	0.1715 (0.2462)
loss aversion λ		0.0383 (0.0328)		0.0305 (0.0326)	
probability bias γ			0.3773** (0.1774)	0.4758** (0.2398)	
presentbias β					0.2456 (0.205)
long-term discount factor δ					-0.6618 (0.7162)
R^2	0.0377	0.0420	0.0624	0.0710	0.0538
adjusted R^2	0.0099	0.0033	0.0297	0.0194	0.0139
number of observations	173	127	172	126	166
F-statistic	1.3569	0.9277	1.9075	1.3758	1.3481
p-value	0.2430	0.4775	0.0822	0.2211	0.2308
standard error	0.8177	0.7637	0.8095	0.7550	0.8181

Notes: *** indicates the coefficient is different from 0 at the 1 % level, ** at the 5 % level, and * at the 10 % level. Standard errors in parentheses.

Table 4. Regression results for Hypothesis 2.

independent variable	*dependent variable: RISKY*				
constant	0.8547 (0.7861)	1.7406* (1.0099)	1.6723* (0.9885)	1.4485 (1.0052)	1.3788 (0.9619)
sex	0.1050 (0.1213)	0.0706 (0.1650)	-0.0206 (0.1684)	-0.0182 (0.1681)	0.0630 (0.1223)
age	0.0329 (0.0274)	0.0071 (0.0361)	0.0079 (0.0356)	0.0060 (0.0356)	0.0292 (0.0274)
ln(monthincome)	0.0511 (0.0852)	0.0340 (0.1091)	0.0605 (0.1088)	0.0693 (0.1089)	0.0163 (0.0862)
ln(wealth)	0.0114 (0.0392)	-0.0328 (0.0505)	-0.0418 (0.0502)	-0.0447 (0.0501)	0.0128 (0.0398)
uncertainty avoidance	0.0000 (0.0009)	-0.0007 (0.0012)	-0.0008 (0.0012)	-0.0008 (0.0012)	-0.0002 (0.0009)
power distance	0.0003 (0.0013)	0.0026 (0.0017)	0.0030* (0.0017)	0.0030* (0.0017)	0.0006 (0.0013)
individualism	0.0028*** (0.0010)	0.0033** (0.0014)	0.0030** (0.0014)	0.0030** (0.0014)	0.0026** (0.0010)
masculinity	-0.0007 (0.0006)	-0.0002 (0.0008)	-0.0004 (0.0008)	-0.0003 (0.0008)	-0.0006 (0.0006)
risk aversion α		0.3233 (0.2898)		0.3340 (0.2857)	
loss aversion λ		0.0241 (0.0334)	0.0039 (0.0315)	0.0161 (0.0331)	
probability bias γ			0.5069** (0.2486)	0.5121** (0.2482)	
presentbias β					0.3972** (0.1807)
long-term discount factor δ					-0.5336 (0.5964)
R^2	0.0603	0.1114	0.1343	0.1451	0.0861
adjusted R^2	0.0247	0.0299	0.0549	0.0581	0.0413
number of observations	211	109	109	108	204
F-statistic	1.6936	1.3670	1.6912	1.6670	1.9227
p-value	0.1014	0.2052	0.0917	0.0907	0.0438
standard error	0.7955	0.7482	0.7385	0.7372	0.7843

Notes: *** indicates the coefficient is different from 0 at the 1 % level, ** at the 5 % level, and * at the 10 % level. Standard errors in parentheses.

Table 5. Regression results on the country-level.

independent variable	*dependent variable: equities*	
uncertainty avoidance	0.0907** (0.0406)	0.0992*** (0.0375)
power distance	0.0875* (0.0484)	0.1060** (0.0499)
individualism	0.0963* (0.0514)	0.1410* (0.0801)
masculinity	-0.0625* (0.0306)	-0.0668** (0.0274)
stockmarket capitalization	0.0719** (0.0298)	0.0770*** (0.0270)
median income	-0.0306 (0.0516)	-0.0535 (0.0564)
trust	-0.0351 (0.0363)	-0.0388 (0.0321)
dependency ratio	-0.0450 (0.0459)	-0.0544 (0.0423)
constant	0.2360*** (0.0377)	0.2200*** (0.0406)
R^2	0.3960	0.3770
adjusted R^2	0.2020	0.1780
number of observations	34	34
F-statistic	2.0450	
p-value	0.0820	
standard error	0.1630	0.1410

Notes: *** indicates the coefficient is different from 0 at the 1 % level, ** at the 5 % level, and * at the 10 % level.
Standard errors in parentheses.