Influence of Extraversion and Neuroticism on Risk Attitude, Risk Perception and Return Expectations

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Abstract

We analyze the influence of individuals' degree of extraversion and neuroticism on the determinants of their risk taking behavior in investment decisions. Since there are no studies which investigate the influence of personality traits on risk attitude, risk perception and return expectations in investment decisions simultaneously, we provide a meaningful contribution to existing literature. We use a unique dataset which contains 342 undergraduate business students' questionnaire responses measuring the students' degree of extraversion and neuroticism as well as their risk attitude, risk perception and return expectations. Therefore, we are able to determine which determinants of risk taking are influenced by extraversion and neuroticism and induce individuals to take investment risks. We find that extraversion and neuroticism affect individuals' risk attitude. More extraverted individuals are less risk averse than less extraverted individuals whereas more neurotic subjects are more risk averse than less neurotic ones. Further research should consider individuals' personality as an influence factor on the determinants of risk taking behavior in investment decisions.

Key Words: Investor Personality, Risk Attitude, Risk Perception, Return Expectations, Investment Decisions

JEL Codes: D81, D84, G02, G11

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1 Introduction

We analyze whether investors' personality traits influence the determinants of risk taking behavior in investment decisions. According to Nosic and Weber (2010), we decompose risk taking behavior in *risk attitude, risk perception and return expectations* (see e.g., Sarin and Weber 1993; Weber and Milliman 1997; Jia, Dyer and Butler 1999; Weber, Weber and Nosic 2013).[1] Recent studies in the context of economics and psychology focus only on the influence of personality traits on risk taking behavior in general, e.g. in different domains (e.g., Nicholson et al. 2005) and risk attitude (e.g., Lauriola and Levin 2001; Borghans et al. 2009; Becker et al. 2012; Rustichini et al. 2012; Pan and Statman 2013). The influence of personality on risk perception and return expectations in investment decisions is barely considered. To the best of our knowledge, there are no contributions which investigate the influence of personality traits on risk attitude, risk perception and return expectations in investment decisions simultaneously. Therefore, it remains unclear which risk determinants are influenced by the personality traits and induce individual investors to take investment risks. Thus, we carve out a unique contribution to the literature by addressing this gap.

Using a questionnaire among 342 undergraduate business students, we analyze potential causal effects of investors' personality on risk attitude, risk perception and return expectations in financial decisions. To measure individuals' personality traits, we rely on the Big Five taxonomy from Goldberg (1981, 1993) which proposes five personality traits, *conscientiousness, extraversion, agreeableness, neuroticism and openness to experience.* We use the German version of the Big-Five-Inventory-10 developed by Rammstedt and John (2007) and Rammstedt et al. (2012) to measure personality traits. In our analysis we focus on extraversion and neuroticism due to their influence on optimism and pessimism (e.g., Williams 1992), which we assume to have an influence on risk perception and return

[1] Nosic and Weber (2010) use the term *perceived return* instead of *return expectations.*

expectations. Since the determinants of risk taking behavior are influenced by other characteristics, such as emotional states (e.g., Isen and Patrick 1982; Forgas 1995; Grable and Roszkowski 2008), locus of control (e.g., McInish 1980), age (e.g., Barber and Odean 2001; Dorn and Huberman 2005; Albert and Duffy 2012), and gender (e.g., Jianakoplos and Bernasek 1998; Powell and Ansic 1997; Hariharan, Chapman and Domian 2000), we control for these variables.

We use different methods to measure risk attitude, risk perception and return expectations. We employ the design of the choice of risky lotteries employing certainty equivalents used in different ways in empirical studies to measure individuals' risk attitude (see e.g., Schoemaker and Hershey 1992; Krahnen, Rieck and Theissen 1997; Altmann, Dohmen and Wibral 2008; Nosic and Weber 2010; Becker et al. 2012). Since it is difficult to measure stable and consistent individual risk attitudes (e.g., Krahnen, Rieck and Theissen 1997; Oehler 1998), we additionally measure individuals' financial risk attitude separately with a quick and easy classification method often used in investment advice and in the Socio-Economic-Panel (SOEP) (e.g., Nosic and Weber 2010; Dohmen et al. 2011). We elicit individuals' risk perception and return expectations with the task employed by Nosic and Weber (2010). We show participants different stock charts and ask them to judge the related investment risk. We elicit individuals' return expectations for these stocks using the method proposed by Keefer and Bodily (1983). We control for possible framing effects by varying the price level and the order of presented stock charts.

Our contribution to the literature is threefold. To the best of our knowledge, we provide the first analysis which examines the influence of personality traits on the determinants of risk taking behavior in investment decisions. We measure individuals' degree of extraversion and neuroticism simultaneously and examine the influence on individuals' risk attitude, risk perception and return expectations using a unique dataset including data on 342 individuals.

By applying a structural equation modeling beside regression and correlation analysis, we are able to evaluate both the accuracy of the measures and the strength of the relationships between the personality traits and the determinants of risk taking behavior. Moreover, we extract the impact of extraversion and neuroticism from gender differences and from individuals' locus of control and their emotional states.

The main results of our analysis are as follows. More extraverted individuals are less risk averse than less extraverted individuals and more neurotic individuals are more risk averse than less neurotic ones. The results provide implications for financial service providers, retail investors, and academics alike. Financial service providers should be aware that retail investors with different personality traits need a different and a more focused financial advice, e.g., that more neurotic retail investors are more risk averse than less neurotic ones and therefore may choose less risky investments. Therefore, financial service providers should discuss with more neurotic retail investors more detailed related investment risks and the riskiness of investments. The results are also relevant for academics and further research, e.g., to consider personality traits as an influence factor on the determinants of risk taking behavior.

The paper is organized as follows. In Section 2 we discuss related research of the individual characteristics' impact on risk taking behavior and its determinants. In Section 3 we derive the hypotheses for our empirical analysis. In Section 4 and 5 we describe our questionnaire and the methodology. In Section 6 we present our empirical results. In Section 7 we discuss the implications of our findings and conclude.

2 Related Literature

Extraversion

More extraverted individuals have more positive affect (e.g., Costa and McCrae 1980; Larsen and Ketelaar 1989; Meyer and Shack 1989; Rusting and Larsen 1995; Oehler et al. 2016), a higher degree of internal locus of control (e.g., Morris and Carden 1981; Kovaleva et al. 2012; Oehler et al. 2016), and are more optimistic, excitement seeking, and active than less extraverted individuals (e.g., Costa and McCrae 1992; Williams 1992). Furthermore, they pay more attention to positive and less attention to negative information (Noguchi, Gohm and Dalsky 2006). The degree of extraversion is lower for men than for women (e.g., Roth 2002; Rammstedt et al. 2012; Vianello et al. 2013; Oehler et al. 2016). Results indicate that younger individuals are more extraverted (see e.g., McCrae et al. 1999; Körner, Geyer and Brähler 2002; Donnellan and Lucas 2008; Lucas and Donnellan 2009; Terracciano et al. 2005; Anusic, Lucas and Donnellan 2012; Rammstedt et al. 2012).[2]

Results of recent studies suggest that extraversion influences risk attitude as well as risk taking behavior positively. Becker et al. (2012) examine the influence of personality traits on risk aversion. They measure risk aversion as the switching point between a risky lottery and a safe option (see Holt and Laury 2002). They find that more extraverted individuals are less risk averse than less extraverted ones. Dohmen et al. (2010) measure risk aversion in a similar way but do not find an influence of individuals' degree of extraversion. Mayfield, Perdue and Wooten (2008) use a self-designed questionnaire to measure risk aversion and find no significant relation between the degree of extraversion and risk aversion. Nicholson et al. (2005) conduct a questionnaire using the Risk Taking Index to measure domain-specific risk taking behavior (e.g., health risk or financial risk). They find that higher values in

[2] However, some studies do not find a significant correlation between extraversion and age (e.g., Srivastava et al. 2003; Allemand, Zimprich and Hendriks 2008; Soto et al. 2011; Oehler et al. 2016).

extraversion and especially in the subscale sensation seeking are a strong predictor for risk taking behavior (see e.g., Harlow and Brown 1990; Kowert and Hermann 1997).

Pan and Statman (2013) analyze the influence of personality traits on individuals' risk tolerance and rely on the questionnaire from Pan and Statman (2012).[3] They find that more extraverted individuals have a higher risk tolerance than less extraverted ones. In contrast, Filbeck, Hatfield and Horvath (2005) do not find a relationship between extraversion and risk tolerance.

Durand, Newby and Sanghani (2008) examine the relationship between personality traits and portfolio decisions. They find that more extraverted individuals invest more money in stocks than less extraverted individuals, but they do not find a higher portfolio risk, measured in terms of the volatility of portfolio returns, for these investors. Oehler et al. (2016) conduct an experimental asset market similar to the design from Smith, Suchanek and Williams (1988). They find that more extraverted individuals are willing to pay higher prices for financial assets and tend to buy more overpriced financial assets than less extraverted individuals. This could be an indication for a riskier investment behavior.

Brown and Taylor (2011) analyze the relationship between household finances and personality traits and find, that more extraverted individuals are concerned with higher levels of indebtedness and therefore bear more financial risks than less extraverted individuals.

Neuroticism

More neurotic individuals have more negative affect (e.g., Costa and McCrae 1980; Larsen and Ketelaar 1989; Meyer and Shack 1989; Rusting and Larsen 1995; Oehler et al. 2016), a

[3] Hoffmann and Post (2013), p. 2 argue that „risk tolerance reflects investors' general attitude (like or dislike) toward financial risk.

higher degree of external locus of control (e.g., Morris and Carden 1981; Kovaleva et al. 2012; Oehler et al. 2016), are more pessimistic (e.g., Williams 1992), anxious, and depressed (e.g., Bolger 1990; Costa and McCrae 1992; Scheier, Carver and Bridges 1994) and pay more attention to negative information and less attention to positive information (Noguchi, Gohm and Dalsky 2006) than less neurotic ones. The degree of neuroticism is higher for women than for men (e.g., Körner, Geyer and Brähler 2002; Roth 2002; Rammstedt et al. 2012; Vianello et al. 2013; Oehler et al. 2016). The majority of studies find a negative relation between age and neuroticism (e.g., McCrae et al. 1999; Srivastava et al. 2003; Terracciano et al. 2005; Roberts, Walton and Viechtbauer 2006; Lucas and Donnellan 2009; Soto et al. 2011; Oehler et al. 2016).[4]

Whereas Becker et al. (2012) and Mayfield, Perdue and Wooten (2008) find that more neurotic individuals are more risk averse than less neurotic ones, Dohmen et al. (2010) do not report a relation. Borghans et al. (2009) elicit the degree of risk aversion by using the method proposed by Halevy (2007). They document a positive correlation between individuals' degree of neuroticism and risk aversion. Rustichini et al. (2012) measure individuals' risk attitude by choices with differing expected values. Both, for high and low expected values, more neurotic individuals are more risk averse and less willing to take risks in the domain of gains than less neurotic individuals. They also find a negative, but insignificant relationship in the domain of losses.

Lauriola and Levin (2001) examine the influence of personality traits on risk taking behavior in the gain and loss domain in a controlled experimental environment by offering participants a bundle of risky choices or a sure gain. They find that more neurotic individuals show less risk taking behavior in the domain of gains than less neurotic ones. However, in the domain of

[4] See e.g. Allemand, Zimprich and Hendriks (2008) and Anusic, Lucas and Donnellan (2012) who do not find a significant relationship and Donnellan and Lucas (2008) who report a negative correlation.

losses, they find that more neurotic individuals are willing to take higher risks than less neurotic individuals. They state that more neurotic individuals focusing more on the negative consequences of the guaranteed losses and are therefore more willing to take risks to avoid the guaranteed losses. Nicholson et al. (2005) find that highly neurotic individuals behave less risky in decisions related e.g., to their careers or finances, but show a more risky behavior in their actions concerning their own health, e.g. regarding smoking or alcohol consumption. However, the overall behavior of more neurotic individuals is less risky than the behavior of less neurotic individuals.

In the context of portfolio decisions, Oehler et al. (2016) find in an experimental setting that more neurotic individuals hold a smaller number of risky assets in their financial portfolios than less neurotic ones. Contrary to aforementioned studies, Durand, Newby and Sanghani (2008) and Durand et al. (2013a) find that more neurotic retail investors prefer portfolios bearing a higher financial risk than less neurotic ones.

Other Individuals' Characteristics

Further individuals' characteristics such as gender, age, emotional states and locus of control seem to influence risk taking behavior and the determinants risk attitude, risk perception and return expectations in different ways. There is evidence that women hold less risky portfolios than men (e.g., Jianakoplos and Bernasek 1998; Sundén and Surette 1998; Hariharan, Chapman and Domian 2000; Barber and Odean 2001; Bernasek and Shwiff 2001; Felton, Gibson and Sanbonmatsu 2003; Weber, Weber and Nosic 2013), are less risk seeking (e.g., Powell and Ansic 1997), and have a lower risk tolerance (e.g., Barsky et al. 1997). Moreover, there are hints that younger individuals invest more risky (e.g., Barber and Odean 2001; Dorn and Huberman 2005) and are less risk averse (e.g., Albert and Duffy 2012) than older individuals.

Individuals with positive affect perceive that risks occur less frequently and are less dangerous for themselves (e.g., Johnson and Tversky 1983), are willing to take higher risks (e.g., Deldin and Levin 1986; Chou, Lee, and Ho 2007; Grable and Roszkowski 2008; Leith and Baumeister 1996; Mittal and Ross 1998; Yuen and Lee 2003; Cyders and Smith 2008),[5] have higher return expectations than individuals with less positive affect (see e.g., Kaplanski et al. 2015), and assign higher probabilities to positive and lower probabilities to negative events (e.g., Wright and Mischel 1982; Wright and Bower 1992; Nygren et al. 1996). In contrast, individuals with negative affect have a lower willingness to take risks (e.g., Deldin and Levin 1986; Yuen and Lee 2003), are more pessimistic and assign lower probabilities to positive events and higher probabilities to negative events (e.g., Wright and Mischel 1982; Wright and Bower 1992). Gasper and Clore (1998) argue that more anxious individuals tend to focus more on threatening information than less anxious ones which causes a bias in their risk perception (see e.g., Butler and Matthews 1987; Pietromonaco and Rook 1987).

The influence of external and internal locus of control on risk taking behavior remains still unclear. Whereas McInish (1980) find a negative relation between an individuals' degree of an external locus of control and risk taking behavior in the context of portfolio choices, McInish (1982) find a positive relationship. Oehler et al. (2016) do not find a significant influence of individuals' degree of external and internal locus of control on risk taking behavior in the context of portfolio decisions.

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[5] In contrast, the strand of literature related to Mood Maintenance Hypothesis argues that individuals with positive affect are unwilling to take risks due to prevailing this affect whereas individuals with negative affect take more risks to increase the probability to get positive outcomes and get out of their negative affect (e.g., Isen and Patrick 1983).

Interaction between Risk Attitude, Risk Perception and Return Expectations

Between individuals' risk attitude, risk perception and return expectations exist various interactions. It is documented in literature that an individual's risk attitude seems to be relatively constant and stable over time (e.g., Harrison et al. 2005; Andersen et al. 2008; Sahm 2007; Baucells and Villasis 2010; Weber, Weber and Nosic 2013). However, individual's risk perception is less stable and varies over time (e.g., Weber and Milliman 1997; Mellers, Schwartz , and Weber 1997; Weber, Weber and Nosic 2013). There are similar findings for subject's return expectations (e.g., Fisher and Statman 2002; Vissing-Jorgensen 2003; Dominitz and Manski 2005). Both concepts are largely influenced by past experiences (e.g., Weber and Milliman 1997; Loewenstein et al. 2001). These findings indicate that the more stable risk attitude may influence the less stable risk perception and return expectations. Schneider and Lopes (1986) find that more risk averse individuals pay more attention to negative outcomes by overestimating the probability of losses. Moreover, risk seeking individuals overestimate the probabilities of gains and therefore expect positive outcomes more frequently (e.g., Brockhaus 1980; Vlek and Stallen 1980).[6]

Furthermore, risk perception seems to influence return expectations (e.g., Nygren 1997). Ganzach (2000) examine the relationship between risk perception and return expectations in terms of whether individuals are familiar or unfamiliar with financial assets. Contrary to fundamental finance literature, he finds that individuals' risk perception influence return expectations negatively which means that individuals who perceive assets as less risky will expect higher returns. Return expectations seem not to influence risk perception. However, when individuals are familiar with financial assets, risk perception and return expectations are positively correlated and influences each other.

[6] See e.g. Sitkin and Pablo (1992), pp. 18-19.

3 Hypotheses Development

Impact of Extraversion

Given the findings in literature, individuals with high values in extraversion are optimistic, excitement seeking and more willing to accept risks. Therefore, we expect that more extraverted individuals are more willing to take risky choices to achieve higher returns than less extraverted ones which indicate a lower degree of risk aversion. We hypothesize:

> *Hypothesis 1: More extraverted individuals are less risk averse than less extraverted individuals.*

With respect to risk perception, we expect that individuals with higher values in extraversion pay more attention to positive information and expect more favorable events, e.g. possible increases in asset prices, with a higher probability. Moreover, they pay less attention to potential risks related to investments. We hypothesize the impact of the degree of extraversion on risk perception as follows:

> *Hypothesis 2: More extraverted individuals perceive investments in assets as less risky than less extraverted individuals.*

Since individuals with higher values in extraversion are in general more optimistic and expect positive events for themselves, we hypothesize:

> *Hypothesis 3: More extraverted individuals have higher return expectations than less extraverted individuals.*

Impact of Neuroticism

According to literature, more neurotic individuals are more pessimistic, anxious, and less willing to accept risks than less neurotic ones. We expect that individuals with higher values in neuroticism are less willing to take risks to achieve higher returns which results in a higher degree of risk aversion. This leads us to hypothesize:

> *Hypothesis 4: More neurotic individuals are more risk averse than less neurotic individuals.*

We assume that more neurotic individuals are more anxious and pay more attention to negative information and related risks, e.g. a possible decline in asset prices and resulting losses, than less neurotic ones. Therefore, we expect that individuals with high values in neuroticism perceive investments in assets as more risky. Following this line of argument, we expect:

> *Hypothesis 5: More neurotic individuals perceive investments in assets as more risky than less neurotic individuals.*

Due to a higher degree of pessimism, negative affect and anxiety among neurotic individuals, we expect that more neurotic individuals have lower return expectations for investments in assets than less neurotic individuals Hypothesis 6 summarizes these effects:

> *Hypothesis 6: More neurotic individuals have lower return expectations than less neurotic individuals.*

4 Questionnaire and Variable Description

In this section we present a detailed overview of the variables and measures used in our study. All variables were elicited with a questionnaire. Overall, the questionnaire consisted of 6 pages. We present the aim and the purpose of the study on the cover page. The participants needed in average 10 minutes answering the questionnaire.

Individuals' Characteristics

We measure individuals' degree of extraversion and neuroticism, positive and negative affect, internal and external locus of control and socio-demographics (gender and age). We follow Oehler et al. (2016) and use established five point Likert short scales ranging from one (strongly disagree) to five (strongly agree), which are useful for questioning under limited assessment time. We employ the German version of the Big-Five-Inventory-10 (hereafter BFI-10, see Rammstedt and John 2007; Rammstedt et al. 2012) to measure individuals' degree of extraversion and neuroticism. The BFI-10 measures the personality traits valid and reliable and is able to replicate results from more extensive scales such as the Revised NEO Personality Inventory (NEO-PI-R) of Costa and McCrae (1992) or from the originally derived Big Five Inventory (BFI) developed by John, Donahue and Kentle (1991).[7] We combine the two items (Item 1 and Item 2, respectively) on extraversion (neuroticism) and calculate the median value of individual *i*'s responses to get the variable $EXTRAVERT_i$ ($NEUROT_i$).

We employ the scale suggested by Kovaleva et al. (2012) to measure the internal and external locus of control with two items, respectively. $INTLOCUS_i$ and $EXTLOCUS_i$ indicate the degree of individual *i's* internal and external locus of control. Following the same approach, we calculate the median value of the responses to the two items from the questionnaire, respectively.

Based on the Positive and Negative Affect Schedule (PANAS) developed by Watson, Clark and Tellegen (1988), we use the German version of Krohne et al. (1996). We select six items from the originally twenty items to measure positive and negative affect. We choose the items *active, interested and determined* to measure positive affect and the items *distressed, nervous and jittery* to measure negative affect. We employ the median value of individual *i's* responses to establish the variables $POSAFFECT_i$ and $NEGAFFECT_i$. To control for possible

[7] See Rammstedt and John (2007) and besides the reported correlations between the scales.

gender and age differences, we include the dummy variable $GENDER_i$, which takes the value 1 for male participants and 0 for female participants and the variable AGE_i which indicates individual *i's* age in years.

Risk Attitude, Risk Perception and Return Expectations

We measure individuals' risk attitude, risk perception and return expectations with different methods derived from literature. Since it is difficult to assess stable risk attitudes and a multitude of heterogeneous methods exists (see e.g. the discussions in Krahnen, Rieck und Theissen 1997; Oehler 1995 and 1998), we employ two fundamentally different approaches. First, we measure risk attitude with the certainty equivalent method in a lottery context (see e.g., Schoemaker and Hershey 1992; Krahnen, Rieck and Theissen 1997; Altmann, Dohmen and Wibral 2008; Nosic and Weber 2010; Becker et al. 2012). The participants are able to choose between a sure payment (varying amounts between 1 and 9 Euros) and a lottery, which pays with an equally weighted probability 0 or 10 Euros. As Wärneryd (1996) shows, hypothetical risky lottery choices can be used to measure risk attitude related to investment decisions. We follow Nosic and Weber (2010) and calculate individual *i's* risk attitude, $RISKATT_i^{CE}$, as follows (Equation 1):

$$RISKATT_i^{CE} = CE^{\alpha} \qquad (1)$$

where *CE* is the certainty equivalent and α is the risk aversion coefficient which takes the value 0.88 (see Tversky und Kahneman 1992).[8] A higher value in $\mathrm{RISKATT}_i^{CE}$ indicates that the individual is less risk averse. Second, we measure individuals' risk attitude with a question used e.g., in the Socio-Economic Panel (SOEP) (see e.g., Nosic and Weber 2010; Dohmen et al. 2011,). We ask participants to assess their attitude to bear financial risks

[8] Note that our results remain stable if we simply use the certainty equivalents.

($RISKATT_i^{Fin}$) on a five point Likert scale ranging from one (very low willingness) to five (very high willingness). A higher value indicates that the individuals assess themselves as less risk averse.

We capture risk perception and return expectations in the context of hypothetical investment decisions (see e.g., Nosic and Weber 2010). Therefore, we show participants five year charts of three different stocks and ask them to make their respective price estimates for one year. The stocks' closing prices are approximately in the middle of the charts, respectively, and the range between the highest and lowest price of the stocks covers about 40% of the chart (see Lawrence and O'Connor 1993). We make these adjustments to exclude an influence of boundaries of the chart and the high and low points on individuals' price estimates. We follow Oehler (1995) and take hypothetical company names to avoid an influence regarding real existing companies. Furthermore, we follow Oehler (1995) and use charts with an upside, constant and downside price trend (see e.g. Glaser et al. 2007). To avoid possible framing effects such as the priming effect, we vary the order of the charts. Moreover, we vary the absolute price level of the stocks. One part of the participants makes price estimates for stocks with the closing prices 31 Euros (upside price chart), 29 Euros (constant price chart) and 27 Euros (downside price chart). The other part of the participant makes their estimates for stocks with the closing prices 310, 290 and 270 Euros, respectively. Except from the different price levels, the stocks are totally identically related to their price patterns.[9]

To measure risk perception, individuals have to assess the risk of the three different stocks on a Likert scale ranging from one (no risk at all) to five (very high risk).[10] $RISKPERC_i$ represents the median value of individual *i's* answers to judge the risk perception of different

[9] We control for the order and the price level in our analyses but find no differences between the groups.
[10] See e.g. Pennings and Wansink (2004) who also use Likert scales to measure risk perception.

stocks ($RISKPERC_{up}$, $RISKPERC_{Const}$, $RISKPERC_{down}$).[11] A higher value indicates a stronger risk perception and a more risky assessment of the prescribed stocks.

We ask individuals to make a prediction for the best guess and the upper (the correct answer should be below this bound with a probability of 95 percent) and lower bound (the correct answer should be above this bound with a probability of 95 percent) to identify return expectations. We use individual *i's* best guess ($p_{i,j}$ (0.5)) and individual *i*'s guess for the lower ($p_{i,j}$ (0.05)) and upper bound ($p_{i,j}$ (0.95)) for stock *j* (=1, 2, and 3). We use the method proposed by Keefer and Bodily (1983) to calculate individual *i's* return expectations for stock *j* as follows (Equation 2):

$$RETURNEXP_{i,j} = 0{,}63 * r_{i,j}(0.5) + 0{,}185 * (r_{i,j}(0.05) + r_{i,j}(0.95)) \qquad (2)$$

where $r_{i,j}(0.5; 0.05; 0.95) = \frac{p_{i,j}(0.5;0.05;0.95) - value_j}{value_j}$. $Value_j$ is stocks‘ *j* closing price.

We combine individual *i's* return expectations for stock $j_{(=1,\ 2,\ 3)}$ ($RETURNEXP_{up}$, $RETURNEXP_{Const}$, $RETURNEXP_{down}$) and calculate the mean value to get the variable $RETURNEXP_i$.[12] Table 1 provides an overview of the variables used in our analysis.

[Please insert Table 1 here]

5 Methodology

We conduct correlation analysis by calculating non-parametric Spearman correlation coefficients and Kendall's Tau coefficients between the variables $EXTRAVERT_i$ and

[11] We disclaim reporting regression results for the different stocks, since results remain the same.
[12] We use discrete returns for the calculation of $RETURNEXP_i$. The results are the same for continuous returns.

$NEUROT_i$ and the variables measuring individuals' risk determinants. Furthermore, we measure the influence of $EXTRAVERT_i$ and $NEUROT_i$ on risk attitude, risk perception and return expectations with a cross-sectional regression analysis. To differentiate between the influence of other factors such as gender, age, emotional states, and locus of control, we run stepwise regressions as well as regressions with all explanatory variables.

To capture the influence of $EXTRAVERT_i$ and $NEUROT_i$ on individuals' degree of risk aversion (Hypotheses 1 and 4), we regress $RISKATT_i^{CE}$ and $RISKATT_i^{Fin}$, respectively, on $EXTRAVERT_i$ and $NEUROT_i$ and the control variables. Equation 3 displays the full regression model:

$$RISKATT_i^{CE}/RISKATT_i^{Fin} = \beta_0 + \beta_1 * EXTRAVERT_i + \beta_2 * NEUROT_i + \beta_3 * INTLOCUS_i + \beta_4 * EXTLOCUS_i + \beta_5 * POSAFFECT_i + \beta_6 * NEGAFFECT_i + \beta_7 * AGE_i + \beta_8 * GENDER_i + \varepsilon \quad (3)$$

We use the baseline model (Equation 3) to analyze the influence of extraversion and neuroticism on individuals' risk perception and return expectations. To test Hypotheses 2 and 5, we use $RISKPERC_i$ as dependent variable. We employ $RETURNEXP_i$ as dependent variable to test Hypotheses 3 and 6. For the model presented in Equation 3, we use OLS-regressions.[13] We are aware of multicollinearity between our explanatory variables and therefore, we calculate the variance inflation factors (VIF). However, we do not find hints that multicollinearity between our explanatory variables influences our results.

Additionally, we apply a unique structural equation model to measure the strength of the relationships between the two personality traits (i.e. extraversion and neuroticism) and the determinants of risk taking using AMOS 23 (see e.g. Byrne 2010). Therefore, we are also able

[13] Because some of our dependent variables are theoretically bounded, we additionally use censored Tobit-regressions. The results remain the same. However, we only report OLS-regression results in this paper since the theoretical bounds are rarely reached.

to evaluate the accuracy of the measures (i.e., the estimation of the factor loadings and error terms). Figure 1 displays the structural component of the theoretically assumed relationships between extraversion, neuroticism and the determinants of risk taking behavior.

[Please insert Figure 1 here]

Table 2 gives an overview of the employed variables in the structural equation model.

[Please insert Table 2 here]

To examine the influence of extraversion (ξ_1) and neuroticism (ξ_2) on the latent variables risk attitude (η_1), return expectations (η_2) and risk perception (η_3), we derive the following equations for the structural component of the model:

$$\eta_1 = \gamma_{11} * \xi_1 + \gamma_{12} * \xi_2 + \zeta_1 \quad (4)$$

$$\eta_2 = \gamma_{11} * \xi_1 + \gamma_{12} * \xi_2 + \beta_{21} * \eta_1 + \beta_{23} * \eta_3 + \zeta_2 \quad (5)$$

$$\eta_3 = \gamma_{11} * \xi_1 + \gamma_{12} * \xi_2 + \beta_{31} * \eta_1 + \zeta_3 \quad (6)$$

The equations of the measurement component regarding the endogenous variables are as follows:

$$y_1 = \lambda_{11} * \eta_1 + \varepsilon_1 \quad (7)$$

$$y_2 = \lambda_{21} * \eta_1 + \varepsilon_2 \quad (8)$$

$$y_3 = \lambda_{32} * \eta_2 + \varepsilon_3 \quad (9)$$

$$y_4 = \lambda_{42} * \eta_2 + \varepsilon_4 \quad (10)$$

$$y_5 = \lambda_{52} * \eta_2 + \varepsilon_5 \quad (11)$$

$$y_6 = \lambda_{63} * \eta_3 + \varepsilon_6 \quad (12)$$

$$y_7 = \lambda_{73} * \eta_3 + \varepsilon_7 \quad (13)$$

$$y_8 = \lambda_{83} * \eta_3 + \varepsilon_8 \quad (14)$$

with y_i as manifestation of $item_i$ in the questionnaire.

We provide the equations of the measurement component regarding the exogenous variables as follows:

$$x_1 = \lambda_{11} * \xi_1 + \delta_1 \quad (15)$$

$$x_2 = \lambda_{21} * \xi_1 + \delta_2 \quad (16)$$

$$x_3 = \lambda_{32} * \xi_2 + \delta_3 \quad (17)$$

$$x_4 = \lambda_{42} * \xi_2 + \delta_4 \quad (18)$$

with x_i as manifestation of $item_i$ in the questionnaire.

Based on the above derived equations, Figure 2 graphically presents our full structural equation model.

[Please Insert Figure 2 here]

6 Results

Descriptive Statistics

Table 3 displays descriptive statistics regarding individuals' characteristics for our full sample (342 participants) in Panel A. More women (N=192) than men (N=149) take part in our survey with a median age of 22 years (mean: 22.4; maximum: 34 and minimum: 19). The values for $EXTRAVERT_i$ vary from 1 to 5 with a median value of 3.5 (mean: 3.5). The same range applies for $NEUROT_i$ with a median value of 3.0 (mean: 2.9). The values are in line with those of Rammstedt et al. (2012), who report a mean value of 3.7 for $EXTRAVERT_i$ and 2.4 for $NEUROT_i$, and Oehler et al. (2016), who document median values of 3.5 (mean: 3.6) for $EXTRAVERT_i$ and 3.0 (mean: 2.8) for $NEUROT_i$.[14] The median value for participants' internal locus of control ($INTLOCUS_i$) is 4.0 (mean: 4.2), whereas the median value for participants' external locus of control ($EXTLOCUS_i$) is 2.0 (mean: 2.1). Kovaleva et al. (2012) and Oehler et al. (2016) report similar values. The median value of $POSAFFECT_i$ is 3.0 (mean: 3.1), whereas the median value of $NEGAFFECT_i$ is 1.0 (mean: 1.5). Oehler et al. (2016) report mean values of 3.3 for $POSAFFECT_i$ and 1.3 for $NEGAFFECT_i$.

The descriptive statistics of the determinants of individuals' risk taking behavior are provided in Panel B of Table 2. $RISKATT_i^{CE}$ ranges from 1.0 to 7.6 with a median value of 4.1 (mean: 4.6). The median value of 2.5 (mean: 2.6) for $RISKATT_i^{Fin}$ indicates that the majority of individuals have in general a lower willingness to bear financial risks. The values for individuals' risk perception ($RISKPERC_i$) ranging from 2 to 5 with a median value of 2.5 (mean: 2.6). With respect to individuals' return expectations, $RETURNEXP_i$, we find a median value of .079 (mean: .096), which implies that participants expect stock price

[14] Both studies use the BFI-10; reported values refer to the age group 18 to 35 (Rammstedt et al. 2012) and 19 to 31 (Oehler et al. 2016).

increases of 7.9% and 9.6%, respectively, in average. Return expectations range between -26.8% and 11.8%.

[Please insert Table 3 here]

Table 4 provides non-parametric Spearman correlation coefficients and Kendall's Tau coefficients between the independent variables. We find a significant negative relation between $EXTRAVERT_i$ and $NEUROT_i$, which is in line with further literature (see e.g., Borkenau and Ostendorf 1993; Körner, Geyer and Brähler 2002; Roth 2002; Rammstedt and John 2005; Mayfield, Perdue and Wooten 2008; Oehler et al. 2016). Furthermore, $EXTRAVERT_i$ is positively correlated with $INTLOCUS_i$ and $POSAFFECT_i$, respectively, and negatively correlated with $EXTLOCUS_i$ and $NEGAFFECT_i$. With respect to $NEUROT_{i,}$, we find significant negative correlations to $INTLOCUS_i$, $POSAFFECT_i$, and $GENDER_i$, and significant positive correlations to $EXTLOCUS_i$ and $NEGAFFECT_i$, respectively. All correlations are significant at the one percent level. Moreover, $NEUROT_i$ is negatively correlated with AGE_i at the ten percent level.

[Please insert Table 4 here]

Table 5 provides non-parametric Spearman correlation coefficients and Kendall's Tau coefficients between the determinants of individuals' risk taking behavior. We find a significant positive correlation at the one percent level between $RISKATT_i^{CE}$ and $RISKATT_i^{Fin}$. Individuals who demand higher certainty equivalents to abstain from gambling also appreciate themselves as more willing to take risks. We find no significant correlation between the two measures of risk aversion and $RISKPERC_i$. Furthermore, we find significant positive correlations at the one percent level between $RISKATT_i^{CE}$ and $RETURNEXP_i$ as well as between $RISKATT_i^{Fin}$ and $RETURNEXP_i$. This indicates that less risk averse individuals have higher return expectations. The significant negative correlation at the one percent level between $RISKPERC_i$ and $RETURNEXP_i$ indicates that individuals who perceive investments in risky assets as less risky have also higher return expectations.

[Please insert Table 5 here]

Correlation Analysis

We report non-parametric Spearman correlation coefficients and Kendall's Tau coefficients between the variables $EXTRAVERT_i$ (Panel A) and $NEUROT_i$ (Panel B) and the determinants of individuals' risk taking behavior in Table 6. The significant negative correlations at the one percent level between $EXTRAVERT_i$ and $RISKATT_i^{CE}$ ($RISKATT_i^{Fin}$) support Hypothesis 1, that more extraverted individuals are less risk averse. We do not find support for Hypothesis 2 regarding the influence of individuals' degree of extraversion on their risk perception ($RISKPERC_i$). The positive, but small correlation coefficient between $EXTRAVERT_i$ and $RETURNEXP_i$ indicates support for Hypothesis 3 concerning a positive relationship between individuals' degree of extraversion and return expectations. The correlation is, however, statistically insignificant. Our assumption that more neurotic subjects are more risk averse than less neurotic ones (Hypothesis 4) is supported by the significant negative correlations between $NEUROT_i$ and $RISKATT_i^{CE}$ ($RISKATT_i^{Fin}$) at the one percent level. The negative, but insignificant, correlation between $NEUROT_i$ and $RISKPERC_i$ is contrary to Hypothesis 5.

$NEUROT_i$ and $RETURNEXP_i$ are negatively correlated at the five percent level which presents support for Hypothesis 6 that a higher degree in neuroticism leads to lower return expectations.

[Please insert Table 6 here]

Regression Analysis

We provide results of the regression analysis regarding the impact of extraversion and neuroticism on risk attitude in Table 7. Panel A (B) contains the results for the regressions with $RISKATT_i^{CE}$ ($RISKATT_i^{Fin}$) as dependent variable. All regression coefficients of $EXTRAVERT_i$ in Panel A are positive, but insignificant. Additionally, we find a significant positive influence being statistically significant at least at the five percent level of $EXTRAVERT_i$ on $RISKATT_i^{Fin}$ in all regression specifications. Although the results are not clear-cut, they seem to support in general our assumption, that more extraverted individuals are less risk averse than less extraverted ones (Hypothesis 1). Nosic and Weber (2010) argue that a measurement of individuals' risk attitude with a subjective question similar to ours is more accurate and provides a better explanation for individuals' risk taking behavior than with an objective method like a lottery. Regarding the influence of neuroticism, we find for $RISKATT_i^{CE}$ as well as for $RISKATT_i^{Fin}$ for all regression specifications negative coefficients for $NEUROT_i$, which are all significant at the one percent level. These findings strongly support Hypothesis 4 meaning that more neurotic individuals are more risk averse than less neurotic ones. Moreover, we find a significant positive influence of $GENDER_i$ on $RISKATT_i^{Fin}$. The coefficient solely combined with $EXTRAVERT_i$ and $NEUROT_i$ as well as in the full regression model is significant at the one percent level, respectively. This means that men behave less risk averse than women. Moreover, the influence of $GENDER_i$ on $RISKATT_i^{CE}$ is positive, but insignificant.

[Please insert Table 7 here]

Table 8 provides the results of the regression analysis regarding the impact of extraversion and neuroticism on risk perception. We find no significant influence of $EXTRAVERT_i$ on $RISKPERC_i$ for all regression models. Moreover, neuroticism is not a significant factor predicting individuals' risk perception. None of the regression coefficients for $NEUROT_i$ exerts a significant influence on $RISKPERC_i$. Additionally, no other independent variable seems to have an influence on $RISKPERC_i$, which is reflected in a low (negative) R^2 for the regression analyses, respectively. All in all, we do not find support for Hypotheses 2 and 5.

[Please insert Table 8 here]

Table 9 shows the results of the regression analysis with $RETURNEXP_i$ as dependent variable. The predominantly positive coefficients of $EXTRAVERT_i$ indicate that more extraverted individuals have higher return expectations than less extraverted ones. However, due to the non-significance of the coefficients, this hardly presents support for Hypothesis 3. The results regarding $NEUROT_i$ assume a negative influence of neuroticism on return expectations. However, the results are not clear-cut and support for Hypothesis 6 is low. In all regression specifications, $NEUROT_i$ exerts a negative influence on $RETURNEXP_i$ which implies that more neurotic individuals have lower return expectations. The coefficients of $NEUROT_i$ solely combined $EXTRAVERT_i$ and AGE_i are significant at the five percent level, respectively, whereas the remaining coefficients are insignificant. Regarding the influence of the other independent variables on $RETURNEXP_i$, we find that only $GENDER_i$ exerts a statistically significant influence at the one percent level. The positive coefficient signals that men have higher return expectations than women.

[Please insert Table 9 here]

Structural Equation Model

We provide the results of the structural equation model in Table 10. Additionally, Figure 3 displays the results graphically. The exogenous and endogenous latent (unobserved) variables extraversion (ξ_1), neuroticism (ξ_2), risk attitude (η_1), return expectations (η_2) and risk perception (η_3) are depicted in ovals and represent the structural component. The numbers at the arrows show the standardized path regression coefficients and indicate the respective strength of the relationship between the latent variables. According to Chin (1998a), coefficients of .20 or greater are meaningful. We find a significant negative double sided relationship between extraversion and neuroticism which implies that more extraverted individuals are less neurotic and vice versa (Φ_{21}). Φ_{21} (-.43) is significant at the one per mill level. In line with Hypothesis 1, we find a significant influence of extraversion on risk attitude, which means that more extraverted individuals are less risk averse than less extraverted ones. The path coefficient (γ_{11}) of .20 is considered as meaningful and indicates that if extraversion increases by one standard deviation, risk attitude increases by .20 standard deviations. The path coefficient is significant at the ten percent level. The path coefficient of -.058 (γ_{12}) between neuroticism and risk attitude is significant at the one per mill level. This finding indicates that more neurotic individuals are more risk averse than less neurotic ones and supports Hypothesis 4. The remaining path coefficients between extraversion and neuroticism on the one hand and risk perception and return expectations on the other hand (γ_{21}, γ_{31}, γ_{22}, γ_{32}), are considered as negligible regarding their strength and significance.

[Please insert Figure 3 here]

Regarding the relationships between the determinants of risk taking behavior, we only find a noticeable relation between risk perception and return expectations. The path coefficient of -.52 (β_{23}) is significant at the five percent level. This means that individuals who perceive assets as more risky have lower return expectations. This finding is obviously contrary to classic finance literature, which argues that more risky assets should compensate with higher returns. However, the finding is in line with Ganzach (2000), who find similar results for subjects' risk and return judgments for unfamiliar financial assets. The measurement model captures the relation between the scores on the respective measuring instruments (observed variables) and the underlying construct (latent variables) which they attempt to measure (see also Figure 2). The measurement component includes the manifest (observed) variables measured in the rectangles (e.g., individuals' responses to assess their degree of extraversion) and the respective factor loading (i.e., the numbers at the arrows from the latent variables to the observed variables), the error term associated with the observed variables (i.e., the numbers in the small circles) and the residual term associated with the latent variables (i.e., the numbers in the big circles). Regarding the accurateness of factor loadings, Ford, MacCallum and Tait (1986) analyze literature and conclude that values above .40 are meaningful and significant. The majority of factor loadings in our model are above this value which indicates that the observed variables measure the latent variables in a satisfactory way. The exceptions are the loadings λ_{52}, λ_{73} and λ_{83} ($RETURNEXP_{down}$, $RISKPERC_{Cons}$, and $RISKPERC_{down}$), which means that these three observed variables are not a very accurate measurement proxy for risk perception and return expectations in our model. The error terms associated with the observed variables indicate how much of the variance in subjects' answers or decisions are explained by other factors than the latent variables. For example, δ_1 (error term for x_1) is .15 which means that the latent (exogenous) variable extraversion explains 85% of the variance in individuals' scores on the question belonging to item 1 (x_1) and that other factors explain the remaining 15%. We see quite different error terms in our model. Especially the error terms associated with the observed variables ε_5, ε_7 and ε_8 ($RETURNEXP_{down}$, $RISKPERC_{Cons}$, and $RISKPERC_{down}$) are very high which leads us to assume that risk perception is only able to explain a low degree of variation in individuals' scores on the respective questions. The residual term represents the error of the prediction of the respective latent (endogenous) variable by the other explaining (latent) variables. The squared multiple correlations (SMC) of η_1, η_2 and η_3 are calculated as one minus the value of the respective residual term (ζ_1, ζ_2 or ζ_3). According to Chin (1998b), values for SMC of .33 are seen as moderate and of .66 as substantial. The SMC values for risk attitude (.48) and return expectations (.38) lie in this range whereas the value for risk perception (.04) is far below this range.

To evaluate the goodness-of-fit between the hypothesized model and the sample data, we calculate several fit indices based on inferential (i.e., Root-Mean-Square-Error of Approximation (RMSEA) and chi-square divided by its degree of freedoms (CMIN/DF)) and descriptive statistic (i.e., Adjusted-Goodness-of-Fit-Index (AGFI)). Browne and Cudeck (1993) suggest values for RMSEA below .05 as an approximation of a good model fit and values below .08 as an approximation of a reasonable model fit. Following this classification, the RMSEA for our model (.05) indicates a reasonable fit. Moreover, according to Byrne (1989), values for CMIN/DF should be lower than 2. The lower the ratio of chi-square to its degrees of freedoms, the better is the model fit. We estimate a CMIN/DF of 1.87 and therefore fulfill the condition of Byrne (1989). Regarding the AGFI, values above .90 provide a good model fit (Weiber and Mühlhaus 2014). Additionally, the AGFI value of .92 for our model is in line with this measure. Overall, we can conclude that the calculated fit indices indicate a good model fit.

[Please insert Table 10 here]

Robustness Check

We separate the full data sample into different subsamples and provide a robustness check by comparing individuals in the top and bottom quintiles relating to their values in extraversion and neuroticism. We report respective results for pairwise tests of equality of the determinants of individuals' risk taking behavior in Table 11 for extraversion (Panel A) and neuroticism (Panel B). The results support the findings in the regression and correlation analyses.

With respect to the extraversion subsamples, we find significant differences for $RISKATT_i^{CE}$ and $RISKATT_i^{Fin}$ at the one percent level. The higher mean and median values of $RISKATT_i^{CE}$ and $RISKATT_i^{Fin}$ indicate that individuals with the highest values in extraversion have a lower degree of risk aversion than individuals with the lowest values in extraversion. This finding is in line with Hypothesis 1. We do not find differences between the subsamples for $RISKPERC_i$. The mean and median values for $RETURNEXP_i$ in the highly extraverted group are higher than the values in the group with the lowest values for extraversion. However, we observe no statistically significant difference between the groups.

Panel B displays the results for the neuroticism subsamples. We find that the mean and median values of $RISKATT_i^{CE}$, $RISKATT_i^{Fin}$ and $RETURNEXP_i$ are lower in the top subsample than in the bottom subsample. This means that individuals with the highest values in neuroticism are more risk averse and have lower return expectations than individuals with the lowest values in neuroticism. These findings are in line with our further results and supports Hypotheses 4 and 6. The differences for $RISKATT_i^{CE}$ and $RISKATT_i^{Fin}$ are statistically significant at the one percent level. The difference for $RETURNEXP_i$ is significant at the five percent level. We find no significant difference between the top and bottom subsamples for $RISKPERC_i$.

[Please Insert Table 11 here]

7 Discussion and Conclusions

To the best of our knowledge, we provide the first analysis which examines the influence of personality traits on the three determinants of risk taking behavior simultaneously. Specifically, we analyze how individuals' degree of extraversion and neuroticism affects their risk attitude, risk perception and return expectations and consequently influence their risk taking behavior in investment decisions using a unique dataset of 342 individuals' answers in a questionnaire.

We find that more extraverted individuals are less risk averse than less extraverted individuals. This finding is consistent with the results in Becker et al. (2012) and Pan and

Statman (2013) but contrary to Filbeck, Hatfield and Horvath (2005), Mayfield, Perdue and Wooten (2008), and Dohmen et al. (2010), who do not find an influence of extraversion on risk attitude. Further, our analysis reveals that more neurotic individuals are more risk averse than less neurotic individuals. Our results are in line with Borghans et al. (2009), Becker et al. (2012), Rustichini et al. (2012), and Mayfield, Perdue and Wooten (2008) but contrary to Dohmen et al. (2010). Additionally, we find only weak evidence that more neurotic individuals have lower return expectations than less neurotic individuals. Extraversion and neuroticism both seem to exert no influence on risk perception. To conclude, it seems that individuals' degree of extraversion and neuroticism mainly influence risk taking behavior and their related investment behavior through their influence on risk attitude and partly on return expectations.

Beside the influence of extraversion and neuroticism, gender has a strong influence on risk attitude and return expectations as well. Men are less risk averse and have higher return expectations than women. This finding validates former results, which suggests that there are differences between men and women regarding their investment behavior (see e.g., Barsky et al. 1997; Powell and Ansic 1997; Jianakoplos and Bernasek 1998; Sundén and Surette 1998; Hariharan, Chapman and Domian 2000; Barber and Odean 2001; Bernasek and Shwiff 2001; Felton, Gibson and Sanbonmatsu 2003; Weber, Weber and Nosic 2013; and Oehler et al. 2016).

Our results indicate that the personality traits extraversion and neuroticism strongly influence risk attitude and to a lower degree return expectations and therefore should be considered when examining the influence of individuals' characteristics on risk taking behavior. Since our paper is based on a questionnaire setting under experimental conditions, future research may expand the research focus and methodology by examining the influence of personality traits on the determinants of risk taking behavior in real financial markets. Furthermore, further literature with a different research design is needed to examine whether extraversion and neuroticism influence risk perception or not.

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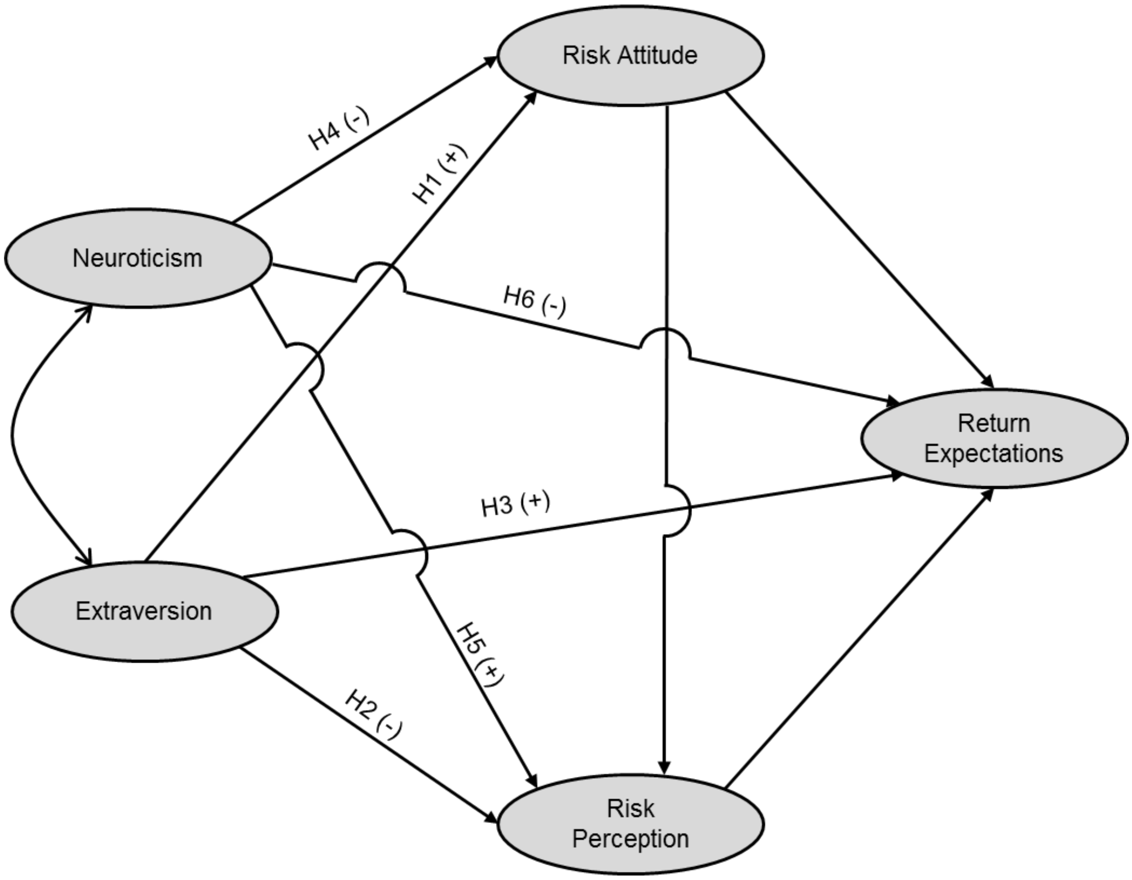
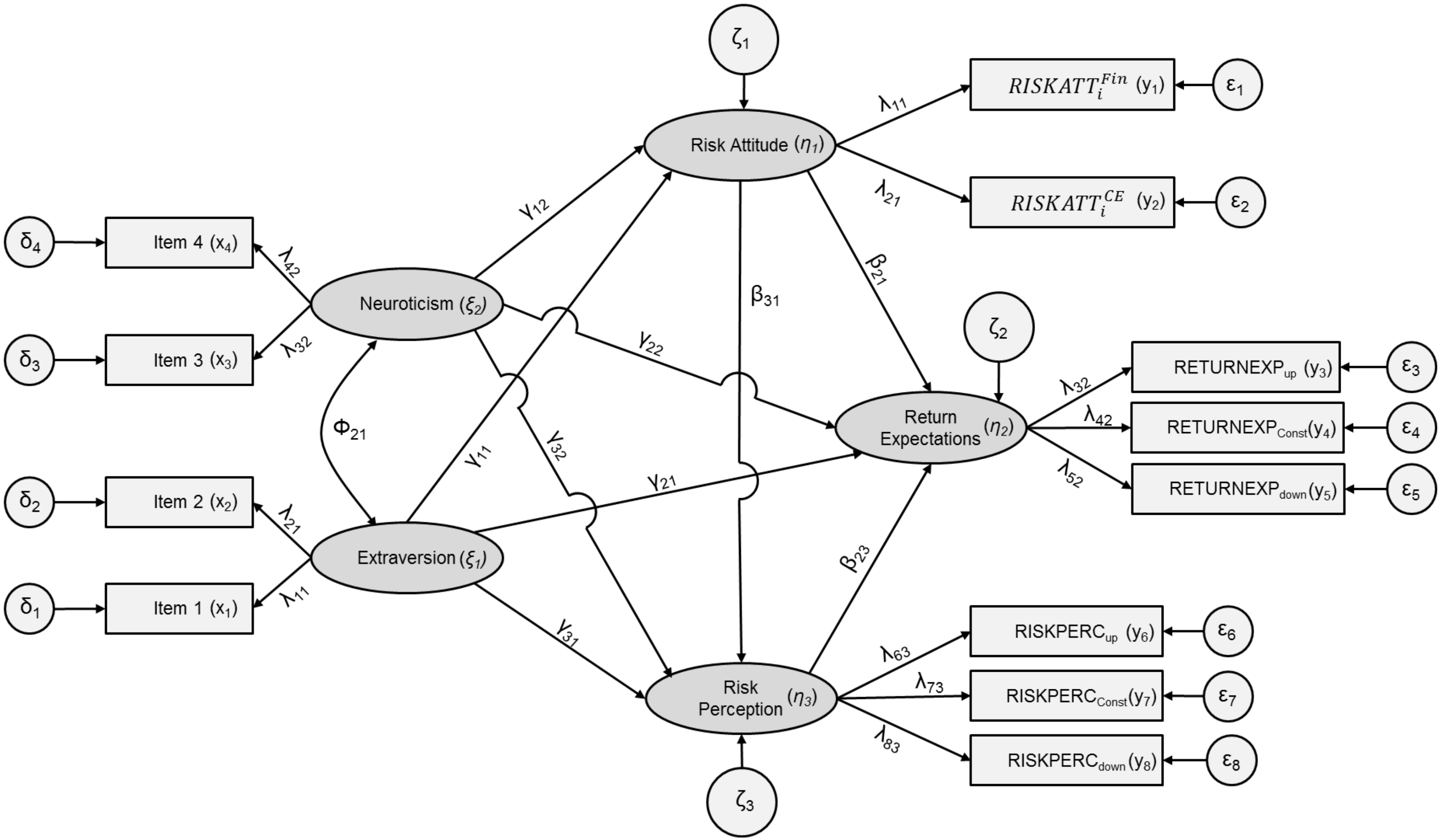
Figure 1: Relationships between the two personality traits and the determinants of risk taking behavior



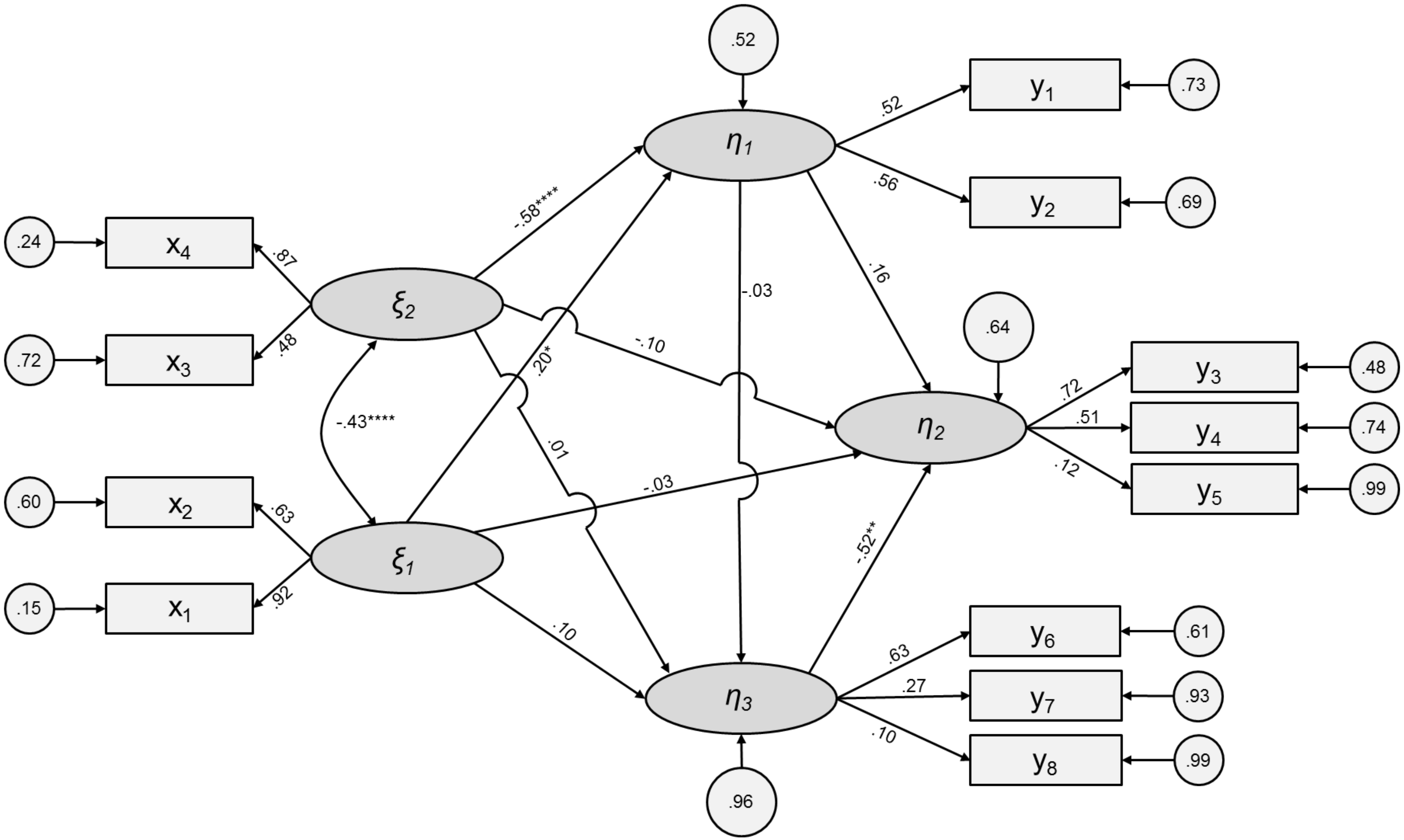
Notes: Figure 1 displays the deduced relationships between the two personality traits (extraversion and neuroticism) and the determinants of risk taking behavior. The directions of the arrows illustrate the expected influence of the respective latent variable. According to our hypotheses, the signs in the parentheses indicate whether we assume a positive or negative influence. Example: According to Hypothesis 1, we assume a positive influence of extraversion on risk attitude which means that more extraverted individuals are less risk averse than less extraverted individuals.

Figure 2: Full structural equation model



Notes: Figure 2 displays the full structural equation model. The exogenous and endogenous latent (unobserved) variables are depicted in ovals. y_i and β_i represent the (standardized) path regression coefficient *i*. The rectangles display the manifest (observed) variables with the respective factor loadings (λ_i). The small circles display the error term of the manifest variables (δ_i and ε_i). The big circles represent the residual term of the latent variables (ζ_i).

Figure 3: Results of the structural equation model regarding the influence of extraversion and neuroticism on the determinants of risk taking behavior



Notes: Figure 3 displays the results of the structural equation model graphically. Example: The path coefficient of -.58 between ξ_2 (neuroticism) and η_1 (risk attitude) is significant at the one per mill level. Regarding risk attitude, the factor loading for y_i is .52 and the associated error term (ε_1) is .73. The residual term (ζ_1) of risk attitude is .52.

Table 1: Overview and description of variables in the regression analysis

Variable	Description
Panel A: Independent Variables	
AGE_i	Age in years
$EXTLOC_i$	External locus of control; measured as median value of two items based on Kovaleva et al. (2012)
$EXTRAVERT_i$	Extraversion; measured as median value of two items based on the BFI-10
$GENDER_i$	Dummy variable which takes a value of 1 when individual *i* is male and zero otherwise
$INTLOC_i$	Internal locus of control; measured as median value of two items based on Kovaleva et al. (2012)
$NEGAFFECT_i$	Negative affect; measured as median value of three items based on the PANAS
$NEUROT_i$	Neuroticism; measured as median value of two items based on the BFI-10
$POSAFFECT_i$	Positive affect; determined as median value of three items based on the PANAS
Panel B: Dependent Variables	
$RISKATT_i^{CE}$	Risk attitude; measured with the certainty equivalence method
$RISKATT_i^{Fin}$	Risk attitude; measured as individual *i's* response on the Likert scale measuring their willingness to bear financial risks
$RISKPERC_i$	Risk perception; determined as median value of individual *i's* responses to assess the risk of stock *j* (=1,2, and 3)
$RETURNEXP_i$	Return expectations; determined as mean value of individual *i's* stock return estimates for stock *j* (=1, 2 and 3)

Notes: Table 1 provides an overview of variables used in the regression analysis. Panel A includes the independent variables in our analyses for each individual *i*. Panel B includes the dependent variables for each individual *i*. In the left column, we provide the names of the variables in an alphabetic order. In the right column, we provide the respective descriptions of the variables.

Table 2: Overview and description of variables used in the structural equation model

Variable	Description	Manifestation
ξ_i	Exogenous (unobserved) latent variable *i* not explained by the model	Extraversion (ξ_1), Neuroticism (ξ_2)
η_i	Endogenous (unobserved) latent variable *i* explained by the model	Risk Attitude (η_1), Return Expectations (η_2), Risk Perception (η_3)
x_i	Manifest (observed) variable *i* for an exogenous variable	Item 1 (x_1), Item 2 (x_2), Item 3 (x_3), Item 4 (x_3)
y_i	Manifest (observed) variable i for an endogenous variable	$RISKATT_i^{Fin}$ (y_1), $RISKATT_i^{CE}$ (y_2), $RETURNEXP_{up}$ (y_3), $RETURNEXP_{Const}$ (y_4), $RETURNEXP_{down}$ (y_5), $RISKPERC_{up}$ (y_6), $RISKPERC_{Const}$ (y_7), $RISKPERC_{down}$ (y_8)
γ_i	(Standardized) path regression coefficient *i* between an exogenous and an endogenous variable	
β_i	(Standardized) path regression coefficient *i* between two endogenous variables	
λ_i	Factor loading *i*	
δ_i	Error term *i* for an manifest (observed) variable x_i	
ε_i	Error term *i* of an manifest (observed) variable y_i	
ζ_i	Residual term *i* of an endogenous (unobserved) latent variable η_i	
Φ_{21}	Covariance between the exogenous (unobserved) latent variables extraversion (ξ_1) and neuroticism (ξ_2)	

Notes: Table 2 provides an overview and description of the variables used in the structural equation model.

Table 3: Descriptive statistics

Panel A: Individuals' characteristics

	N	Mean	Med	Max	Min	Std
$GENDER_i$	341					
male	149					
female	192					
AGE_i	342	22.4	22	34	19	2.2
$EXTRAVERT_i$	342	3.5	3.5	5.0	1.0	0.9
$NEUROT_i$	342	2.9	3.0	5.0	1.0	0.9
$INTLOCUS_i$	342	4.2	4.0	5.0	2.5	0.5
$EXTLOCUS_i$	340	2.1	2.0	4.0	1.0	0.6
$POSAFFECT_i$	341	3.1	3.0	5.0	1.0	0.9
$NEGAFFECT_i$	341	1.5	1.0	5.0	1.0	0.8

Panel B: Determinants of individuals' risk taking behavior

		Mean	Med	Max	Min	Std
$RISKATT_i^{CE}$	330	4.6	4.1	7.6	1.0	1.0
$RISKATT_i^{Fin}$	342	2.6	2.5	5.0	1.0	1.1
$RISKPERC_i$	342	3.2	3.0	5.0	2.0	0.7
$RETURNEXP_i$	330	.096	.079	.489	-.268	0.118

Notes: Panel A displays descriptive statistics of individuals' characteristics. For each variable we provide the number of individuals' responses (N), mean value (Mean), median value (Med), maximum value (Max), Minimum value (Min), and standard deviation (Std). Example: The median value of the participants' level of neuroticism ($NEUROT_i$) is 3.0. Panel B displays descriptive statistics of the determinants of individuals' risk taking behavior. For each variable we provide the mean value (Mean), median value (Med), maximum value (Max), Minimum value (Min), and standard deviation (Std). Example: The mean value of individuals' risk perception ($RISKPERC_i$) is 3.2.

Table 4: Correlations between individuals' characteristics

	$GENDER_i$	AGE_i	$EXTRAVERT_i$	$NEUROT_i$	$INTLOCUS_i$	$EXTLOCUS_i$	$POSAFFECT_i$	$NEGAFFECT_i$
$GENDER_i$		.172***	-.036	-.401***	.133**	-.056	.085	-.122**
AGE_i	.150***		-.015	-.100*	.142***	-.034	.019	-.039
$EXTRAVERT_i$	-.031	-.011		-.197***	.169***	-.200***	.281***	-.186***
$NEUROT_i$	-.352***	-.076*	-.154***		-.244***	.252***	-.200***	.248***
$INTLOCUS_i$	.121**	.115***	.140***	-.197***		-.267***	.287***	-.185***
$EXTLOCUS_i$	-.051	-.028	-.158***	.202***	-.222***		-.119**	.199***
$POSAFFECT_i$	.079	.015	.229***	-.163***	.251***	-.102**		-.073
$NEGAFFECT_i$	-.177**	-.033	-.157***	.211***	-.164***	.174***	-.067	

Notes: We report Spearman correlation coefficients (above the diagonal) and Kendall's Tau coefficients (below the diagonal) between the independent variables describing individuals' characteristics in Table 4. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: The Spearman correlation coefficient between the individuals' level of neuroticism ($NEUROT_i$) and their degree of external locus of control ($EXTLOCUS_i$) is .252 with statistical significance at the one percent level.

Table 5: Correlations between the determinants of individuals' risk taking behavior

	$RISKATT_i^{CE}$	$RISKATT_i^{Fin}$	$RISKPERC_i$	$RETURNEXP_i$
$RISKATT_i^{CE}$		.315***	-.076	.153***
$RISKATT_i^{Fin}$	.264***		-.014	.182***
$RISKPERC_i$	-.066	-.011		-.207***
$RETURNEXP_i$	.114***	.138***	-.160***	

Notes: We report Spearman correlation coefficients (above the diagonal) and Kendall's Tau coefficients (below the diagonal) between the determinants of individuals' risk taking behavior in Table 5. The symbol *** denotes statistical significance at the one percent level. Example: The Spearman correlation coefficient between the individuals' attitude of risk aversion measured with the certainty equivalence method ($RISKATT_i^{CE}$) and return expectations ($RETURNEXP_i$) is .153 with statistical significance at the one percent level.

Table 6: Correlations of extraversion and neuroticism with the determinants of individuals' risk taking behavior

Panel A: Extraversion

	$RISKATT_i^{CE}$	$RISKATT_i^{Fin}$	$RISKPERC_i$	$RETURNEXP_i$
$EXTRAVERT_i$	.144*** (.115***)	.204*** (.164***)	-.001 (.000)	.039 (.027)
N	330	342	342	330

Panel B: Neuroticism

	$RISKATT_i^{CE}$	$RISKATT_i^{Fin}$	$RISKPERC_i$	$RETURNEXP_i$
$NEUROT_i$	-.340*** (-.268***)	-.284*** (-.227***)	-.012 (-.010)	-.138** (-.095**)
N	330	342	342	330

Notes: We report Spearman correlation coefficients and Kendall's Tau coefficients (in parentheses) between individuals' level of extraversion (Panel A) and neuroticism (Panel B) with the determinants of individuals' risk taking behavior. N denotes the number of individuals. The symbols *** and ** denote statistical significance at the one and five percent level, respectively. Example: The Spearman correlation coefficient between the individuals' level of neuroticism ($NEUROT_i$) and their return expectations is -.138 with statistical significance at the five percent level.

Table 7: Influence of extraversion and neuroticism on risk attitude

Panel A: Dependent variable: $RISKATT_i^{CE}$, individuals *i's* degree of risk aversion generated from certainty equivalence method

β_0	5.396***	5.221***	5.958***	5.588***	5.150***	5.717***
$EXTRAVERT_i$	.077	.082	.073	.068	.072	.072
$NEUROT_i$	-.353***	-.321***	-.345***	-.329***	-.351***	-.293***
$GENDER_i$		.138				.138
$INTLOCUS_i$			-.077			-.096
$EXTLOCUS_i$			-.119			-.100
$POSAFFECT_i$				-.013		-.001
$NEGAFFECT_i$				-.125*		-.114
AGE_i					.011	.011
R^2 (adj.)	.099	.100	.099	.103	.097	.100

Panel B: Dependent variable: $RISKATT_i^{Fin}$, individuals *i's* degree of risk aversion measured as individual i's response on the Likert scale measuring their willingness to bear financial risks

β_0	2.958***	1.847***	2.759***	2.806***	2.906***	1.997**
$EXTRAVERT_i$	.187***	.250***	.189***	.178**	.193***	.248***
$NEUROT_i$	-.333***	-.142**	-.337***	-.329***	-.331***	-.151**
$GENDER_i$		.764***				.768***
$INTLOCUS_i$			.025			-.019
$EXTLOCUS_i$			.048			.012
$POSAFFECT_i$				.048		.030
$NEGAFFECT_i$				.015		.032
AGE_i					.001	-.009
R^2 (adj.)	.099	.193	.094	.095	.097	.182

Notes: We provide regression coefficients and adjusted R^2 for the regression analysis using Equation (3) with $RISKATT_i^{CE}$ as dependent variable in Panel A. Panel B displays results for $RISKATT_i^{Fin}$ as dependent variable. In a stepwise approach we combine $EXTRAVERT_i$ and $NEUROT_i$ with the further explanatory variables separately. The last column includes the results for the full regression model. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: Regressing $RISKATT_i^{CE}$ on individuals' level of neuroticism ($NEUROT_i$) in the full regression model yields a coefficient of .248 with statistical significance at the one percent level.

Table 8: Influence of extraversion and neuroticism on risk perception

Dependent variable: $RISKPERC_i$, individuals *i's* risk perception measured as median value of individual *i's* responses to assess the risk of stock *j* (=1,2, and 3)

β_0	3.198***	3.136***	3.244***	3.078***	3.358***	3.296***
$EXTRAVERT_i$	.001	.006	.006	-.005	.002	.002
$NEUROT_i$	-.012	-.001	-.023	-.010	-.013	-.012
$GENDER_i$		.041				.040
$INTLOCUS_i$			-.029			-.044
$EXTLOCUS_i$			.043			.037
$POSAFFECT_i$				.036		.042
$NEGAFFECT_i$				.016		.009
AGE_i					-.007	-.007
R^2 (adj.)	-.006	-.008	-.010	-.010	-.008	-.019

Notes: We provide regression coefficients and adjusted R^2 for the regression analysis using Equation (3) with $RISKPERC_i$ as dependent variable in Table 8. In a stepwise approach we combine $EXTRAVERT_i$ and $NEUROT_i$ with the further explanatory variables separately. The last column includes the results for the full regression model. The symbol *** denotes statistical significance at the one percent level. Example: Regressing $RISKPERC_i$ on individuals' level of extraversion ($EXTRAVERT_i$) solely combined with individuals' level of neuroticism ($NEUROT_i$) yields a coefficient of .001 with no statistical significance.

Table 9: Influence of extraversion and neuroticism on return expectation

Dependent variable: *$RETURNEXP_i$*, individual *i's* stock return expectations determined as mean value of individual *i*'s stock return estimates for stock *j* (=1, 2 and 3)

β_0	.140***	.077*	.098	.124**	.198**	.125
$EXTRAVERT_i$	.000	.004	-.001	.001	.001	.003
$NEUROT_i$	-.016**	-.005	-.011	-.017	-.016**	-.003
$GENDER_i$		.043***				.043***
$INTLOCUS_i$			.015			.016
$EXTLOCUS_i$			-.013			-.016
$POSAFFECT_i$				.003		-.001
$NEGAFFECT_i$				.006		.010
AGE_i					-.003	-.004
R^2 (adj.)	.007	.031	.011	.003	.006	.033

Notes: We provide regression coefficients and adjusted R^2 for the regression analysis using Equation (3) with *$RETURNEXP_i$* as dependent variable in Table 9. In a stepwise approach we combine *$EXTRAVERT_i$* and *$NEUROT_i$* with the further explanatory variables separately. The last column includes the results for the full regression model. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: Regressing *$RETURNEXP_i$* on individuals' level of neuroticism (*$NEUROT_i$*) in the full regression model yields a coefficient of -.003 with no statistical significance.

Table 10: Results of the structural equation model

Panel A: (Standardized) path regression coefficient	Estimate	S.E.	C.R.
γ_{11} *(Risk Attitude* (η_1) <--- Extraversion (ξ_1))	.20*	.11	1.73
γ_{21} (Return Expectations (η_2) <--- Extraversion (ξ_1))	-.03	.02	-.57
γ_{31} (Risk Perception (η_3) <--- Extraversion (ξ_1))	.10	.05	.75
γ_{12} *(Risk Attitude* (η_1) <--- Neuroticism (ξ_2))	-.58****	.11	-3.25
γ_{22} (Return Expectations (η_2) <--- Neuroticism (ξ_2))	-.10	.02	-.57
γ_{32} (Risk Perception (η_3) <--- Neuroticism (ξ_2))	.01	.05	.05
β_{21} (Return Expectations (η_2) <--- Risk Attitude (η_1))	.16	.03	.73
β_{31} (Risk Perception (η_3) <--- Risk Attitude (η_1))	-.03	.11	-.78
β_{23} (Return Expectations (η_2) <--- Risk Perception (η_3))	-.52**	.08	-2.31
Φ_{21} (Extraversion (ξ_1) <--> Neuroticism (ξ_2))	-.43****	.05	-4.02

Panel B: Factor loadings	Estimate
λ_{11} (Item 1 (x_1) <--- Extraversion (ξ_1))	.92
λ_{21} (Item 2 (x_2) <--- Extraversion (ξ_1))	.63
λ_{32} (Item 3 (x_3) <--- Neuroticism (ξ_2))	.48
λ_{42} (Item 4 (x_4) <--- Neuroticism (ξ_2))	.87
λ_{11} ($RISKATT_i^{Fin}$ (y_1) <--- Risk Attitude (η_1))	.52
λ_{21} ($RISKATT_i^{CE}$ (y_2) <--- Risk Attitude (η_1))	.56
λ_{32} ($RETURNEXP_{up}$ (y_3) <--- Return Expectations (η_2))	.72
λ_{42} ($RETURNEXP_{Const}$ (y_4) <--- Return Expectations (η_2))	.51
λ_{52} ($RETURNEXP_{down}$ (y_5) <--- Return Expectations (η_2))	.12
λ_{63} ($RISKPERC_{up}$ (y_6) <--- Risk Perception (η_3))	.63
λ_{73} ($RISKPERC_{Const}$ (y_7) <--- Risk Perception (η_3))	.27
λ_{83} ($RISKPERC_{down}$ (y_8) <--- Risk Perception (η_3))	.10

Panel C: Residual terms	Estimate
ζ_1	.52
ζ_2	.64
ζ_3	.96

Notes: We provide estimates of path regression coefficients, standard errors (S.E.) and critical ratios (C.R.) in Panel A. Panel B displays the estimates of the factor loadings. We report residual terms of our latent (endogenous) variables in Panel C. Panel D displays the error terms of the manifest (observed) variables. Finally, we report fit indices of the structural equation model in panel E. The symbols ****, ***, **, and * denote statistical significance at the one per mill and the one, five, and ten percent level, respectively. Example: The (standardized) path regression coefficient of γ_{12} is -.58 with statistical significance at the one per mill level.

Table 10: Results of the structural equation model (cont'd)

Panel D: Error terms	
	Estimate
δ_1	.15
δ_2	.60
δ_3	.72
δ_4	.24
ε_1	.73
ε_2	.69
ε_3	.48
ε_4	.74
ε_5	.99
ε_6	.61
ε_7	.93
ε_8	.99

Panel E: Fit indices	
	Value
RMSEA	.05
CMIN/DF	1.87
AGFI	.92

Table 11: Pairwise test of equality between top and bottom quintiles of extraversion and neuroticism

	Top		Bottom		
	Mean	Med	Mean	Med	significance U-test
Panel A: Extraversion					
$RISKATT_i^{CE}$	4.99	4.84	4.50	4.12	***
$RISKATT_i^{Fin}$	2.87	3.00	2.20	2.00	***
$RISKPERC_i$	3.11	3.00	3.17	3.00	
$RETURNEXP_i$	.089	.077	.077	.063	
Panel B: Neuroticism					
$RISKATT_i^{CE}$	4.11	4.12	4.97	4.84	***
$RISKATT_i^{Fin}$	2.16	2.00	3.13	3.00	***
$RISKPERC_i$	3.23	3.00	3.23	3.00	
$RETURNEXP_i$	.083	0.057	.129	.101	**

Notes: We report mean (Mean) and median (Med) values of the determinants of individuals' risk taking behavior for the top and bottom quintiles with respect to participants' level of extraversion (Panel A) and neuroticism (Panel B). In addition we provide results of the U-test as test of equality between the top and bottom quintiles. The symbols *** and ** denote statistical significance at the one and five percent level, respectively. Example: The mean value of the individuals' average return expectations ($RETURNEXP_i$) is .083 in the top quintile of neurotic individuals and .129 in the bottom quintile of neurotic individuals. The difference is statistically significant at the five percent level.