Young Adults' Subjective and Objective Risk Attitude in Financial Decision Making: Evidence from the Lab and the Field

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Key Words: Risk Aversion, Young adults, Retail Investors, Household Finance

JEL Codes: C91, D12, D14, G02, G11

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Abstract

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1 Introduction

Recent studies show that individuals' financial outcomes depend on the financial behavior established in young adulthood (e.g. Xu et al. 2015; Eccles et al. 2013).[1] Consequently, concepts that aim to improve individuals' financial well-being should target at the determinants of young adults' financial behavior. Although risk attitude is one of the key determinants of investment behavior (e.g. Cohn et al. 1975; Dorn and Huberman 2005), there is a lack of studies that focus on young adults' risk attitude.[2] The aim of our paper is threefold: (1) answering the question whether young adults' risk attitude in the context of financial decisions is stable, (2) deriving the determining factors of young adults' risk attitude, (3) providing a comparison of the factors influencing young adults' and older adults' risk attitude to better connect with existing literature and to derive clearer implications for concepts that aim explicitly on young adults' financial behavior.

The most obvious differences between young adults and older adults are their age and their amount of financial wealth. Consequently, our study contributes to literature regarding the influence of age (e.g., Morin and Suarez 1983; Schooley and Worden 1996; Dorn and Huberman 2005; Deutsche Bundesbank 2015) and wealth (e.g. Morin and Suarez 1983; Barsky et al. 1997; Oehler 1998; Dorn and Huberman 2005; Paravisini, Rappoport and Ravina 2010; Oehler and Horn 2016) on investors' risk attitude.

The Life-cycle Risk Aversion Hypothesis from Bakshi and Chen (1994) postulates an increasing risk aversion with age. This hypothesis is supported by several studies which find that younger people invest more money in risky assets than older people (see e.g., Bakshi and Chen 1994; Palsson 1996; Schooley and Worden 1996; Ameriks and Zeldes 2004). In contrast, Bellante and Saba (1986) and Wang and Hanna (1997) find that older people are willing to take more risks than younger ones.

The relation between wealth and risk attitude is primarily discussed in the literature building on the concept of investors' relative risk aversion independently developed by Pratt (1964) and Arrow

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[1] We follow the common approach to define young adults by their age in the range between 18 to 35 years (see e.g., Brown and Taylor 2011, Albert and Duffy 2012). A further reaching definition of young adults could capture their income situation, e.g. persons who recently started into their working life.
[2] An exception is the study from Albert and Duffy (2012), which compares risk attitudes between young and old adults and find a higher degree of risk aversion for old persons (age above 64). However, the study's dataset (in sum 26 and 34 subjects per group) and methodology (only the Holt-Laury paired lottery is used to measure individuals' risk aversion) leave some space for further research.

(1965). Relative risk aversion is determined by the amount of risky assets in relation to the amount of risk-free assets in an investor's portfolio. Studies of this strand of literature differentiate between constant (CRRA), decreasing (DRRA), and increasing (IRRA) relative risk aversion. Support for a CRRA, meaning that the percentage of risky assets in investors' portfolio stays stable when investors get wealthier, is found by e.g. Friend and Blume (1975). Cohn et al. (1975), Morin and Suarez (1983), and Oehler (1998) observe DRRA, i.e. raising percentages of risky assets when investors get wealthier. IRRA, decreasing percentages of risky assets when investors' wealth increases, is discovered by e.g. Pratt (1964), Arrow (1971), and Siegel and Hoban Jr. (1982). Paya and Wang (2016) find mixed support on relative risk aversion, depending on which measure is used to assess investors' wealth. In contrast to previous studies, Paya and Wang (2016) do not solely rely on cross-sectional data but also on panel data. The motivation for this approach is that "evidence gathered by cross-sectional analysis would only be informative of the shape of preferences if risk aversion was independent of wealth" (Paya and Wang, 2016, p. 221).

We follow Nosic and Weber (2010) and differentiate between "subjective" and "objective" risk attitude. We are aware that a literally objective risk attitude hardly exists. The naming of the terms *subjective risk attitude* and *objective risk attitude* originates from their methods of measurement employed in different research designs. Subjective risk attitude is generally captured by an individual's self-assessment regarding her general willingness to take risks. Objective risk attitude is commonly measured by outcomes of (former) investment decisions. These investment decisions, however, are just the result of individuals' decision process. Since individuals' decision process is influenced by individuals' subjective perception, heuristics, and bounded rationality (see e.g. the surveys of Oehler 1995 and Hirshleifer 2015 on the behavioral aspects of the decision process) the resulting decisions (and likewise the measured risk attitude) are not literally objective.

In contrast to Paya and Wang (2016), we do not use panel data but an experimental questionnaire design to estimate whether young adults' objective risk attitude is stable or generally independent of time-invariant wealth effects. More precisely, we analyze whether young adults change their objective risk attitudes towards a financial investment when only the absolute value of the outcome but not the expected distribution of outcomes is varied (with young adults' financial wealth

meanwhile staying stable). Moreover, we use data from the PHF-Survey performed and provided by the German central bank (Deutsche Bundesbank) (1) to analyze the determining factors of young adults' subjective and objective risk attitude and (2) to provide a comparison of the factors influencing young adults' and older adults' risk attitude.

Our results are fourfold. First, young adults' objective risk attitude is not stable. Instead, young adults get more risk averse when a financial decision's absolute amount of money rises (with young adults' financial wealth being unchanged). Second, we find that young men show a lower degree of subjective risk aversion than young women. Third, young adults' subjective risk attitude is a better predictor for their objective risk attitude than a set of commonly employed socio-demographics and -economics like age or income. Forth, young adults and older adults generally show a similar degree of subjective risk aversion. However, young adults show a higher degree of objective risk aversion due to stronger financial restrictions. We find indication that young adults would show a lower degree of objective risk aversion than older adults if they were equally wealthy.

The results provide implications for financial advisers, academics, and policymakers. Financial advisors should take the gender dependence of young adults' subjective risk aversion in account and be aware that young adults generally have fewer savings than older adults. This finding is also relevant for policy makers and academics when they elaborate on concepts to enhance the engagement of young adults in financial markets. If policy makers and academics tried to simultaneously affect the objective risk attitude of both young and older adults, without considering the financial restrictions of young adults, the interventions would most probably fail.

Our study is organized as follows. Section 2 addresses data and methodology of the experimental study and the PHF-Survey as well as the methodological approach to answer the research question. We report our results in Section 3. In section 4, we discuss the implications of our findings and conclude.

2 Data and Methodology

Nosic and Weber (2010) differentiate between subjective and objective risk attitude and find that subjective risk attitude is a stable predictor of objective risk taking behavior. Subjective risk attitude is commonly measured by a subjective question about the willingness to take risks (e.g., Nosic and Weber 2010, Dohmen et al. 2011). Objective risk attitude is computed with either subject's decisions in hypothetical lotteries (e.g., Holt and Laury 2002; Fellner and Maciejovsky 2007) or subject's amount of wealth invested in risky assets (e.g., Friend and Blume 1975; Fama and Schwert 1977; Schooley and Worden 1996,;Oehler 1998). One central contribution of our paper is that our methodological design implements the findings of Nosic and Weber (2010) by combining both one subjective risk attitude measure and one objective risk attitude measure in the experimental questionnaire design as well as in the cross sectional analysis of the PHF-Survey.

2.1 Experimental Questionnaire Design

We employ a questionnaire setting including a subjective question to assess young adults' subjective risk attitude and a hypothetical lottery design as objective risk attitude measure to analyze whether young adults' risk attitude is stable and generally independent of wealth.

Employing the subjective question, we ask participants to rate their attitude to take financial risks on a five point Likert scale (see e.g., Nosic and Weber 2010; Dohmen et al. 2011) ranging from one (very low willingness) to five (very high willingness). The questionnaire additionally asks for participants' gender ($Gender_j$, see e.g., Barsky et al. 1997; Eckel and Grossman 2008; Booth and Katic 2013; Oehler and Horn 2016 for the influence of investors' gender on their risk attitude) and age[3] (see e.g., Morin and Suarez 1983; Schooley and Worden 1996; Albert and Duffy 2012; Deutsche Bundesbank 2015; Oehler and Horn 2016 for the influence of investors' age on their risk attitude) as potential influencing factors of participants' subjective and objective risk attitude.

The hypothetical lottery design covers increasing stake sizes based on the design of Deutsche Bundesbank (2015). We would like to point out that even if we use the lottery design to measure participants' objective risk attitude according to the literature (e.g. Nosic and Weber 2010), participants' decisions in this design are influenced by their subjective perception and heuristics and,

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[3] Since age showed a very tight distribution among participants (standard deviation of 2 years) we do not consider age in the further analysis of the experimental questionnaire design.

consequently, not literally objective. In the lottery design, participants have the option to choose between one certain payment and taking part in a lottery (risky choice). The lottery offers, with equal probability, the chance to either win the doubled amount of the fixed payment or getting nothing. Moreover, the participants have the choice to indicate that they are indifferent between these two options since the certain payment and the lottery have the same expected value. We provide three different designs with a certain payment of 5, 50 and 500 Euros. The winning amounts of the lottery vary correspondingly (i.e. 10 Euros or zero, 100 Euros or zero, 1.000 Euros or zero). The different choices are independent from each other and every participant takes part in every design. Choosing the certain payment in the questionnaire indicates risk aversion whether choosing the lottery states risk seeking. A risk neutral subject is indifferent between both options. All participants are undergraduate business students at Bamberg University.

If participants' choices regarding the decision between the certain payments or participating in the lotteries varies across the three designs, young adults' risk attitude is not stable and independent of their wealth (since their wealth does not change while answering the questionnaire). We provide Wilcoxon tests to prove these potentially arising differences between the decisions of the three designs. We furthermore provide cross-sectional regression analyses to shed light on the determining factors of young adults' objective risk attitude in the experimental questionnaire design. We follow Nosic and Weber (2010) and employ young adults' subjective risk attitude and gender as independent variables. The baseline model for the regression analyses is set up as follows:

$$RiskAtt_{Obj,i} = \beta_0 + \beta_1 * RiskAtt_{Subj,j} + \beta_3 * Gender_j + \varepsilon \tag{1}$$

The dependent variable $RiskAtt_{Obj,i}$ denotes the objective risk attitude of participant j, i.e. her choice (certain payment =1, indifference =2, gamble = 3) in the design i (expected value 5, 50, 500 EUR). The independent variable $RiskAtt_{Subj,j}$ is participants' subjective risk attitude and can take a value between 1 (very high degree of subjective risk aversion) and 5 (very low degree of subjective risk aversion). $Gender_j$ is a dummy variable which takes the value 1 for men and zero otherwise.

2.2 PHF-Survey

We employ the dataset of the PHF-Survey (DOI: 10.12757/PHF.01.01.01.stata) performed and provided by Deutsche Bundesbank (1) to analyze the determining factors of young adults' risk attitude and (2) to provide a comparison of the factors influencing young adults' and older adults' risk attitude. The dataset includes information about the absolute amount of money a household invests per asset class, allowing us to compute households' objective risk attitude as amount of wealth invested in risky assets. In addition, the survey provides data on households' subjective risk attitude ($RiskAtt_{Subj,h}$ ranging from 1 (very high degree of subjective risk aversion) to 4 (very low degree of subjective risk aversion)) measured with a subjective question similar to the question used in Nosic and Weber (2010) and Dohmen et al. (2011). All in all, Deutsche Bundesbank interviewed 3,565 German households from September 14th 2010 to July 15th 2011 for the PHF-Survey.

In the first part of our cross-sectional analysis, we solely include households with young adults as financial decision makers. Since Nosic and Weber (2010) identified subjects' subjective risk attitude as predictor for their objective risk attitude, we first provide regression analysis to examine the influence of young adults' socio-demographics and -economics on their subjective risk attitude. Regarding the independent variables we rely on socio-demographic factors that have been proven as significant in related studies: the gender ($Gender_h$) and age (Age_h) of the person who is mainly responsible for the financial decisions, the household's logarithmized monthly income ($Income_h$, see e.g., Tanaka, Camerer, and Nguyen 2010 for the influence of income on risk attitude), and its logarithmized total wealth in EUR ($TWealth_h$, see e.g., Morin und Suarez 1983; Barsky et al. 1997; Oehler 1998; Dorn and Huberman 2005; Paravisini, Rappoport and Ravina 2010; Oehler and Horn 2016 for the influence of wealth on risk attitude). The regression model is set up as follows:

$$RiskAtt_{Subj,h} = \beta_0 + \beta_1 * Gender_h + \beta_2 * Age_h + \beta_3 * Income_h + \beta_4 * TWealth_h + \varepsilon \text{ (2a)}$$

As measure of objective risk attitude, we employ the amount of wealth invested in risk assets. However, not all young adults are, e.g. due to their relatively low financial wealth (Taylor et al. 2011), able to invest in risky financial assets (which again emphasizes that the measured risk attitude

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can hardly be interpreted as literally objective). We therefore follow Oehler and Horn (2016) and compute for each household the amount of money that is investable when all expenses for debts, insurances, and retirement provisions are taken into account. This remaining amount of money and investments in the asset classes *Money market*, *Stocks*, *Bonds*, *Real estate funds*, and *Articles of great value,* always net of liabilities ascribed to these asset classes, are summarized in a so called speculation portfolio. Portfolios with a net value smaller than 1,000 EUR[4] are not considered since the owners of such portfolios are hardly able to invest in risky assets (e.g. due to high short-dated liabilities). Since just being affluent enough to invest in financial assets or spending money for consumption after having covered basic needs might influence young adults' subjective risk attitude, we introduce an adaption of the first regression model to capture differences between young adult households with and without speculation portfolios. The presence of a speculation portfolio in household h is denoted by the dummy variable $SPortfolio_h$ that is 1 if household h owns a speculation portfolio and 0 otherwise. We furthermore add interaction variables consisting of the first regression model's independent variables times $SPortfolio_h$. The adapted regression model is set up as follows:

$$RiskAtt_{Subj,h} = \beta_0 + \beta_1 * Gender_h + \beta_2 * (Gender_h * SPortfolio_h) + \beta_3 * Age_h + \beta_4 * (Age_h * SPortfolio_h) + \beta_5 * Income_h + \beta_6 * (Income_h * SPortfolio_h) + \beta_7 * TWealth_h + \beta_8 * (TWealth_h * SPortfolio_h) + \beta_9 * SPortfolio_h + \varepsilon \qquad (2b)$$

We measure young adults' objective risk attitude ($RiskAtt_{Obj,h}$) by analyzing their actual investments, i.e. the percentage of wealth invested in risky assets. More specifically, we employ a regression model with young adults' objective risk attitude as dependent variable and include the socio-demographic and -economic variables of Model (2a) and the logarithmized net value of the young adults' speculation portfolio ($ValueSP_h$, to control for differences in the value of speculation portfolios) as independent variables (Model 3a). As risky assets we define stocks, bonds, real estate funds, and articles of great value as captured in the PHF-Survey. Furthermore, we examine whether

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[4] See also von Gaudecker (2015) for this threshold.

young adults' subjective risk attitude has an influence on their real financial decision making, i.e. if young adults' subjective risk attitude predicts their objective risk attitude, as indicated in the experimental setting by Nosic and Weber (2010) (Model 3b). The full regression models are set up as follows:

$$RiskAtt_{Obj,h} = \beta_0 + \beta_1 * Gender_h + \beta_2 * Age_h + \beta_3 * Income_h + \beta_4 * TWealth_h + \beta_5 *$$
$$ValueSP_h + \varepsilon \tag{3a}$$

$$RiskAtt_{Obj,h} = \beta_0 + \beta_1 * Gender_h + \beta_2 * Age_h + \beta_3 * Income_h + \beta_4 * TWealth_h + \beta_5 *$$
$$ValueSP_h + \beta_6 * RiskAtt_{Subj,h} + \varepsilon \tag{3b}$$

In the second part of our cross sectional analysis, we provide a comparison of the factors influencing young adults' and older adults' risk attitude. Given the significant socio-demographic and -economic differences between young adults' and older adults' households, we analyze if and how the subjective risk attitude of young adults and their older peers are differently influenced by their socio-demographics and -economics. For this purpose, we use the complete dataset of the PHF-survey and expand the regression model (2b) with the dummy variable $YoungAdult_h$ (which is 1 for households with young adults as financial decision makers and 0 for the remaining households) and the interacted variables consisting of the regression model's independent variables times $YoungAdult_h$. The full regression model is as follows:

$$RiskAtt_{Obj,h} = \beta_0 + \beta_1 * Gender_h + \beta_2 * (Gender_h * YoungAdult_h) + \beta_3 * Age_h + \beta_4 *$$
$$(Age_h * YoungAdult_h) + \beta_5 * Income_h + \beta_6 * (Income_h * YoungAdult_h) + \beta_7 *$$
$$TWealth_h + \beta_8 * (TWealth_h * YoungAdult_h) + \beta_9 * SPortfolio_h + \beta_{10} *$$
$$(SPortfolio_h * YoungAdult_h) + \beta_{11} * YoungAdult_h + \varepsilon \tag{4}$$

In addition, we examine possible differences in the driving factors of young adults' and the remaining adults' objective risk attitude. We adjust regression model (3b) and include $YoungAdult_h$ and consequent interaction variables. The adapted regression model is:

$$RiskAtt_{Obj,h} = \beta_0 + \beta_1 * Gender_h + \beta_2 * (Gender_h * YoungAdult_h) + \beta_3 * Age_h + \beta_4 * (Age_h * YoungAdult_h) + \beta_5 * Income_h + \beta_6 * (Income_h * YoungAdult_h) + \beta_7 * TWealth_h + \beta_8 * (TWealth_h * YoungAdult_h) + \beta_9 * ValueSP_h + \beta_{10} * (ValueSP_h * YoungAdult_h) + \beta_{11} * RiskAtt_{Subj,h} + \beta_{12} * (RiskAtt_{Subj,h} * YoungAdult_h) + \beta_{13} * YoungAdult_h + \varepsilon \qquad (5)$$

3 Results

3.1 Findings from the experimental questionnaire design

Participants' median age is 22 (mean: 22.4) years with a minimum of 19 and a maximum of 34 years (standard deviation: 2 years). Our dataset includes more women (N=192) than men (N=149). Table 1 reports results on participants' subjective risk attitude ($RiskAtt_{Subj,j}$). The mean value of all participants' degree of subjective risk attitude is 2.6 (med: 2.5). Subjects' responses range from the minimum (1) to the maximum (5) of the scale. The results indicate that men have a lower subjective risk aversion than women: the mean value for men is 3.1 (med: 3.0) whereas 2.3 (med: 2.0) for women. The difference between men and women regarding the mean and median values is statistically significant at the one percent level.

[Please insert Table 1 here]

Table 2 contains the results regarding subjects' choices in the different lotteries. We provide results of the lottery with an expected value of 5 EUR in Panel A. 51% (N=175) of the participants choose the certain payment instead of gambling which is preferred by 37% (N=127). The remaining 40 participants (12%) are indifferent between the two choices. More women (60%; N=116) than men (39.6%; N=59) prefer the certain payment. Approximately the same amount of men and women are

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indifferent between the two choices. Consequently, men (47%; N=70) more strongly prefer gambling than women (29%; N=55). Panel B displays the results of the lottery with an expected value of 50 EUR. Compared to the lottery with the lower expected value of 5 EUR, a higher number of participants (74%; N= 255) chooses the certain payment and less are willing to gamble (19%; N=65) or are indifferent (6%; N= 22). This means that participants become more risk averse when the absolute amount of the financial decision increases. Again, less women (13%; N=25) than men (27%; N=40) prefer gambling and more women (83%; N=150) than men (62.4; N=93) choose the certain payment. The results of the lottery with an expected value of 500 EUR (in Panel C) reveal a further increase of participants' objective risk aversion with increasing stake sizes. 89 percent (N= 305) of the participants prefer the certain payment of 500 EUR compared to 8 percent (N= 26) who like to gamble for 1.000 EUR. The differences between men and women diminish. Only slightly less men (85%; N= 127) than women (92%; N= 176) prefer the certain payment.

We employ Wilcoxon tests to examine whether young adults' risk attitude varies at statistical significant levels between the lotteries. We find that differences between young adults' choices for the three lotteries being statistically significant at the one percent level. This finding indicates that young adults' risk attitude is not stable. Size, in contrast, young adults' wealth stays unchanged in this time, their risk attitude is independent of time-invariant wealth effects.

In general, the results of the lotteries reveal three main findings. First, the majority of participants prefer the certain payment (indicating risk aversion). Second, participants' objective risk aversion increases with increasing stake sizes. And third, in all lotteries, men show a lower objective risk aversion than women.

[Please insert Table 2 here]

We further provide an overview of subjects' migration regarding their decisions in the different lotteries in Figure 1. We find that the 175 subjects who choose the certain payment in the first lottery (expected value: 5 EUR) largely choose the certain payment of 50 EUR (N= 162) and 500 EUR (N= 157). Just a few subjects prefer the certain payment of 5 EUR and switch to the gambling option

regarding the lotteries with an expected value of 50 EUR (N = 11) and 500 EUR (N= 2). Of the 127 subjects who would gamble with an expected value of 5 EUR, 72 individuals switch to the certain payment in the lottery with an expected value of 50 EUR and just 51 subjects further prefer gambling. Of these 51 subjects, 37 switch to the certain payment when the expected value rises to 500 EUR. The individuals, who are indifferent between both options in the first lottery, largely choose the certain payment in the second and third lottery. The analysis reveals that most young adults' objective risk attitude becomes more risk averse when the decision's absolute amount of money rises (or stays stable when subjects were already risk averse at the smallest absolute amount of money). Only a negligible percentage of young adults become less risk averse when the decision's absolute amount of money rises

[Please insert Figure 1 here]

In Table 3, we provide the results of the regression analysis regarding the influence of participants' subjective risk attitude and their gender on the choice of the payment in the lottery using model (1). For all lotteries and regression specifications, we see significant positive regression coefficients for $RiskAtt_{Subj,j}$ at the one percent level. This means that participants with a lower subjective risk aversion are less likely to take the certain payment in the lottery. The influence of participants' gender is different between the respective lotteries. In the lotteries with 5 and 50 EUR as expected value, we find $Gender_j$ being statistically significant at least at the ten percent level. The positive regression coefficients indicate that men choose less often the certain payment than women. Regarding the lottery with an expected value of 500 EUR, subjects' gender does not seem to have an influence on their choices.

[Please insert Table 3 here]

To sum up, the findings show that young adults' objective risk attitude is not stable. Young adults who still gamble in financial decisions with small absolute amounts become more risk averse when

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the financial decisions show higher absolute amounts. Additionally, men show a lower subjective and objective degree of risk aversion than women. Young adults with a higher subjective risk aversion also show a higher degree of objective risk aversion.

3.2 Findings from the PHF-Survey

Of the 3,565 interviewed households, 535 have a young adult as financial decision maker of whom 271 are female and 264 are male.

We provide descriptive statistics of young adults who are responsible for households' financial decisions in Table 4. The young adults have a mean (median) age of 28 (29) years. Their households generate a mean net monthly household income of 2,309 EUR. The median net monthly income is 1,900 EUR, indicating a right-skewed distribution of households' income emerging in line with a right skewed-distribution of wealth. With 123,888 EUR the mean total wealth of young adults' households clearly overcuts the median total wealth of 10,000 EUR. This pattern is in accordance with findings of e.g. Badarinza, Campbell, and Ramadorai (2016).

[Please insert Table 4 here]

We report results regarding the influence of young adults' socio-demographics and –economics on their subjective risk attitude in Table 5. Out of the four independent variables *gender*, *age*, *income* and *total wealth* from regression model (2a) only gender and income have a statistically significant influence on young adults' subjective risk attitude. The results are in line with findings of our experimental setting and previous studies. Female financial decision makers show a higher subjective risk aversion than their male peers (e.g., Jianakoplos and Bernasek 1998; Hariharan, Chapman and Domian 2000; Mayfield, Perdue and Wooten 2008). As income rises, young adults' subjective risk aversion decreases.

Using regression model (2b) we analyze whether the subjective risk attitude of young adults that are affluent enough to buy risky assets differs from young adults that are not able to invest in risky

assets. The previous result that women have a higher subjective risk aversion than men is supported. In contrast, the influence of *income* vanishes when young adults' possibility to buy risky assets is considered. Instead, young adults' age negatively correlates with their degree of subjective risk aversion but only if they are able to invest in risky assets. However, having enough financial wealth to buy risky assets generally seems to increase young adults' subjective risk aversion. The regression coefficient of the speculation portfolio dummy is negative and statistically significant at the five percent level. These findings indicate that young adults' subjective risk attitude depends on the absolute amount of money of their investment decisions. When young adults face investment decisions with a relatively high absolute amount of money (i.e. in the scope of investment decisions in their portfolio), they try to avoid risks. The finding of our experimental setting, that young adults' objective degree of risk aversion increases with stake sizes, can be interpreted in a similar way and support this line of argument.

[Please insert Table 5 here]

In Table 6 we present results regarding the question whether young adults' objective risk attitude, i.e. the amount of their financial wealth invested in risky assets, can be predicted by young adults' socio-demographics and/or their subjective risk attitude. Generally the small adjusted R^2s (ranging from .008 to. 016) of the individual socio-demographics used in regression model (3a) convey that the socio-demographics have little explanatory power. In the light of the significant role of young adults' gender for their subjective risk attitude, it surprises that the gender does hardly influence their objective risk attitude. The only significant (at the one percent level) determinant is the value of the speculation portfolio. The amount of risky assets young adults invest in rises with the worth of their speculation portfolio. Employing regression model (3b) shows that young adults' objective risk attitude is solely significantly influenced by young adults' subjective risk attitude. Since the regression coefficient of .108 shows a positive relation between both variables, this finding, in turn, indicates that young adults have an idea of different asset classes' risk and deploy this knowledge in

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investment decisions. The influence of the remaining variables diminishes when young adults' subjective risk attitude is taken into account.

[Please insert Table 6 here]

Taken together, our findings support findings of Nosic and Weber (2010) by showing that young adults' subjective risk attitude serves as statistical significant predictor regarding their objective risk attitude in both theoretical (as in the experiment) and actual (as in the context of the PHF-survey) financial decisions. Young adults' subjective risk aversion, in turn, is mainly influenced by young adults' gender and by the presence of enough financial wealth to invest in risky assets. The combined findings of the experimental design and the PHF-survey show that young adults get more risk averse when the absolute value of a financial decision rises.

3.3 Comparative Analysis between young and old adults

Having identified the determinants of young adults' risk attitude, we aim at analyzing whether the influence of these determinants appears differently on young adults than their older peers. This research question is of interest since it seems possible that a habituation effect in context of financial decisions may appear when people get older. E.g., people should, due to their income, get wealthier over time and, as a consequence, more frequently confronted with investment decisions. One could assume that getting wealthier and gaining more experience regarding investment decisions reduce the fear of financial losses and consequently the degree of risk aversion regarding financial decisions. We therefore analyze whether young adults' subjective and objective risk aversion are differently influenced by their socio-demographics and socio-economics compared to their older peers.

We report descriptive statistics and the statistical significance of differences between socio-economics and -demographics of young adults' households and their older peers in Table 7. Whereas we find on average no statistical significant differences regarding their subjective risk attitude, households of young adults are clearly more limited regarding their available monthly

income and their total wealth. The monthly income of young adults' households is on average roughly 900 EUR and the total wealth 230,000 EUR lower compared to the remaining households. We consider this discrepancy in wealth and income as explanation why only 33 percent of the young adult households have enough financial wealth to invest in risky assets while 55 percent of the remaining households would be affluent enough to do so.

[Please insert Table 7 here]

We provide results of the stepwise regression analysis using regression model (4) regarding the influencing factors of households' subjective risk attitude in Table 8. Again, the pattern that male decision makers show a lower subjective risk aversion is statistically significant. Results regarding the age of the decision maker show differences between young adults and their older peers. Regarding the full sample, subjective risk aversion statistical significantly increases with age. In contrast, the insignificant coefficient of the interaction variable combining *age* with the dummy variable $YoungAdult_h$ is positive with nearly the same absolute value, which equalizes the influence of *age* for young adults. Therefore, the age of the household member responsible for the financial decisions only serves as determinant for the subjective risk attitude, when the household member is older than 35 years. An increase in households' income and/or total wealth generally goes hand in hand with a lower degree of subjective risk aversion which is in line with Oehler (1998). Interaction variables' negative coefficients of the stepwise and the full model, however, show that this effect is significantly weaker pronounced for households with young adult decision makers. When the presence of enough financial wealth to invest in risky assets is solely addressed with a dummy variable, we cannot observe a statistical significant effect. The regression coefficient of the dummy variable $YoungAdult_h$ is not statistically significant in the full regression model, but when the wealth measures are considered separately. We interpret this pattern as follows: young adults would generally show a lower degree of subjective risk aversion than older adults if the remaining socio-economics were similar. However, this initial discrepancy is hardly observable

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since older adults earn higher incomes and own more financial wealth which decreases their level of subjective risk aversion to the levels of the less wealthy young adults.

[Please insert Table 8 here]

We focus on households that are able to invest in risky assets to answer the question whether young adults differ from their older peers regarding their objective risk attitude. We provide results of t-tests between young adults and older adults of this subsample in Table 9. Even if young adults show a slightly lower (although not statistically significant) subjective risk aversion than older adults, older adults show a significantly lower degree of objective risk aversion.[5] Their portfolios, on average, consist of 24 percent risky assets (e.g. stocks, bonds or real estate funds), whereas portfolios of young adults only comprise 16 percent of such risky assets. As indicated by previous results, the younger adults are significantly less affluent. The net value of their portfolios is on average 23,000 EUR which is only one fifth compared to the average net value of the remaining adults' portfolios. Furthermore, the observed young adult households have 1,000 EUR less monthly income and a 320,000 EUR smaller total wealth than their older peers.

[Please insert Table 9 here]

The different preconditions of young adult households and their older peers raise the question whether both groups follow the same determinants to set the riskiness of their investment decisions. We employ regression analysis using model (5) to assess the factors influencing households' objective risk attitude. The results of the regression analysis are presented in Table 10. Results of the stepwise approach reveal that the five variables $Gender_h$, $Income_h$, $TWealth_h$, $ValueSP_h$, and, $RiskAtt_{Subj,h}$ provide explanatory power regarding the objective risk attitude. The results are in line with our previous findings. The objective risk attitude decreases with investors' degree of subjective risk aversion. This holds true for both young adults and older investors. In addition, the degree of

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[5] Please note that the measure of objective risk attitude needs to be interpreted inversely since a higher percentage of risky assets in the portfolio leads to a higher value of RiskAtt_{Obj,h}.

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objective risk aversion decreases with rising net value of the portfolio, confirming findings of Oehler (1998). Again, portfolios of young adults are no exception. Like portfolios of young adults, the remaining portfolios mirror a higher objective risk attitude, when managed by a woman. But an increase in $Income_h$ or $TWealth_h$ has a weaker effect on young adults' objective risk attitude than on the remaining portfolios. In young adults' portfolios the share of risky assets has a higher initial level which young adults increase only hesitantly with raising income or wealth. In contrast, portfolios of older investors show a lower initial level of risky assets which the portfolio holders extend more rigorously when their income or wealth rises. After combining all mentioned factors in the full regression model, the influence of $Gender_h$ and $TWealth_h$ disappears whereas $RiskAtt_{Subj,h}$, $ValueSP_h$, and $Income_h$ stay significant at the one percent level. In addition, the positive coefficient of the dummy variable $YoungAdult_h$ indicates that young adults generally show a lower degree of objective risk aversion. However, young adults' portfolios show on average smaller amounts of risky assets than the remaining portfolios because households of older investors are by far wealthier which drives them to take higher financial risks.

[Please insert Table 10 here]

We sum up and interpret our findings as follows. Young adults do not generally show a lower degree of subjective risk aversion compared to older people. For both groups, the degrees of subjective risk aversion work as predictor for the degrees of objective risk aversion, indicating that young adults and their older peers likewise know the risk of different asset classes and furthermore deploy this knowledge in investment decisions. The latter implication supports survey evidence of Oehler (2012) that younger adults are neither less interested nor less caring about their personal finances than older adults. Even if young adults, on average, would probably show a higher degree of objective risk aversion than comparable older investors, we do hardly observe this constellation in practice. The reason is simple: Young adults face stronger restrictions. They have a significant lower income and far fewer savings to compensate financial losses than older investors. As a consequence, young adults invest less risky.

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4 Discussion and Conclusions

Our analysis is, to our knowledge, the first that explicitly focuses on the measurement of young adults' subjective and objective risk attitude in both an experimental setting and in a cross sectional analysis. Our main results, which arises from both the experimental setting as well as in the cross sectional data of the PHF-Survey, contribute to various strands of literature. First, we find that young adults' objective risk attitude is not stable. Instead their objective risk aversion increases with the absolute amount of money of a financial decision. The findings are generally in line with Markowitz (1952), Weber and Chapman (2005), and Fehr-Duda et al. (2010), however in contrast to Holt and Laury (2002, 2005) who do not find such an effect for hypothetical lotteries.

Second, we find that young adults' subjective risk attitude differs according to their gender, i.e. that women show a higher subjective risk aversion than men. Hence, our results are consistent with 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), Eckel and Grossman 2008, Weber, Weber and Nosic (2013) Booth and Katic 2013, Oehler and Horn (2016) and Oehler et al. (2016).

Third, young adults' subjective risk attitude is a better predictor for their objective risk attitude than a set of often employed socio-demographics and –economics like age or income. This finding is in line with Nosic and Weber (2010) as well as Dorn and Huberman (2005) who find that self-reported risk aversion is the most important determinant of portfolio diversification and turnover. More specifically, the results that young adults reporting a lower degree of subjective risk aversion invest a higher amount of wealth in risky assets and prefer gambling instead of taking the certain payment is comparable to Dorn and Hubermans' findings that investors with a low degree of subjective risk aversion hold less diversified portfolios and trade more aggressively.

Forth, young adults and older adults generally show a similar degree of subjective risk aversion. For both groups, the degrees of subjective risk aversion work as predictor for the degrees of objective risk aversion. However, young adults face stronger financial restrictions. They have a significant lower income and far fewer savings and, consequently, show on average a higher degree of objective

risk aversion. We find indications that young adults would show a lower degree of objective risk aversion than older adults if they were equally wealthy. These findings are in general in line with the Life-cycle Risk Aversion Hypothesis (e.g., Morin and Suarez 1983; Bakshi and Chen 1994; Palsson 1996; Schooley and Worden 1996; Ameriks and Zeldes 2004) but in contrast to Bellante and Saba (1986).

The results provide implications for financial advisers, academics, and policymakers. When counseling young adults, financial advisors should take the gender dependence of young adults' subjective risk aversion in account. In addition, financial advisors should be aware that young adults generally have less savings and income and are therefore stronger harmed by financial losses than older adults. This finding is also relevant for policy makers and academics. Previous findings that young adults borrow money at higher interest rates (e.g., Agarwal et al. 2009), hold less diversified portfolios (e.g., Goetzmann and Kumar 2008; Dorn and Huberman 2005), and earn less investment incomes (e.g., Cole and Shastry 2009) may be (at least) partially explained by the financial limits of young adults. Since young adults' objective risk attitude is in accordance with their subjective risk attitude, we follow the argumentation of Oehler (2012) that the lower engagement of young adults in financial markets is not driven by e.g. their allegedly low financial literacy (e.g., Lusardi, Mitchell, and Curto 2010) but rather by their tight budget. When policy makers and academics elaborate on concepts to e.g., enhance the engagement and performance of young adults in financial markets, they should be aware of young adults' challenging economic situation as determining factor. If policy makers and academics tried to simultaneously affect the objective risk attitude of both young and older adults, without considering the financial restrictions of young adults, the interventions would most probably fail.

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Figure 1: Subjects' choices in different lottery settings with 1=sure payment; 2=indifferent; 3=gambling; N=number of subjects

5 EUR stake	50 EUR stake	500 EUR stake

1 | N = 175

1 | N = 162
1 | N = 157
2 | N = 5

2 | N = 11
1 | N = 9
2 | N = 2

3 | N = 2
1 | N = 1
3 | N = 1

2 | N = 127

1 | N = 72
1 | N = 68
2 | N = 4

2 | N = 51
1 | N = 37
2 | N = 14

3 | N = 4
1 | N = 4

3 | N = 40

1 | N = 21
1 | N = 21

2 | N = 3
1 | N = 2
2 | N = 1

3 | N = 16
1 | N = 6
3 | N = 10
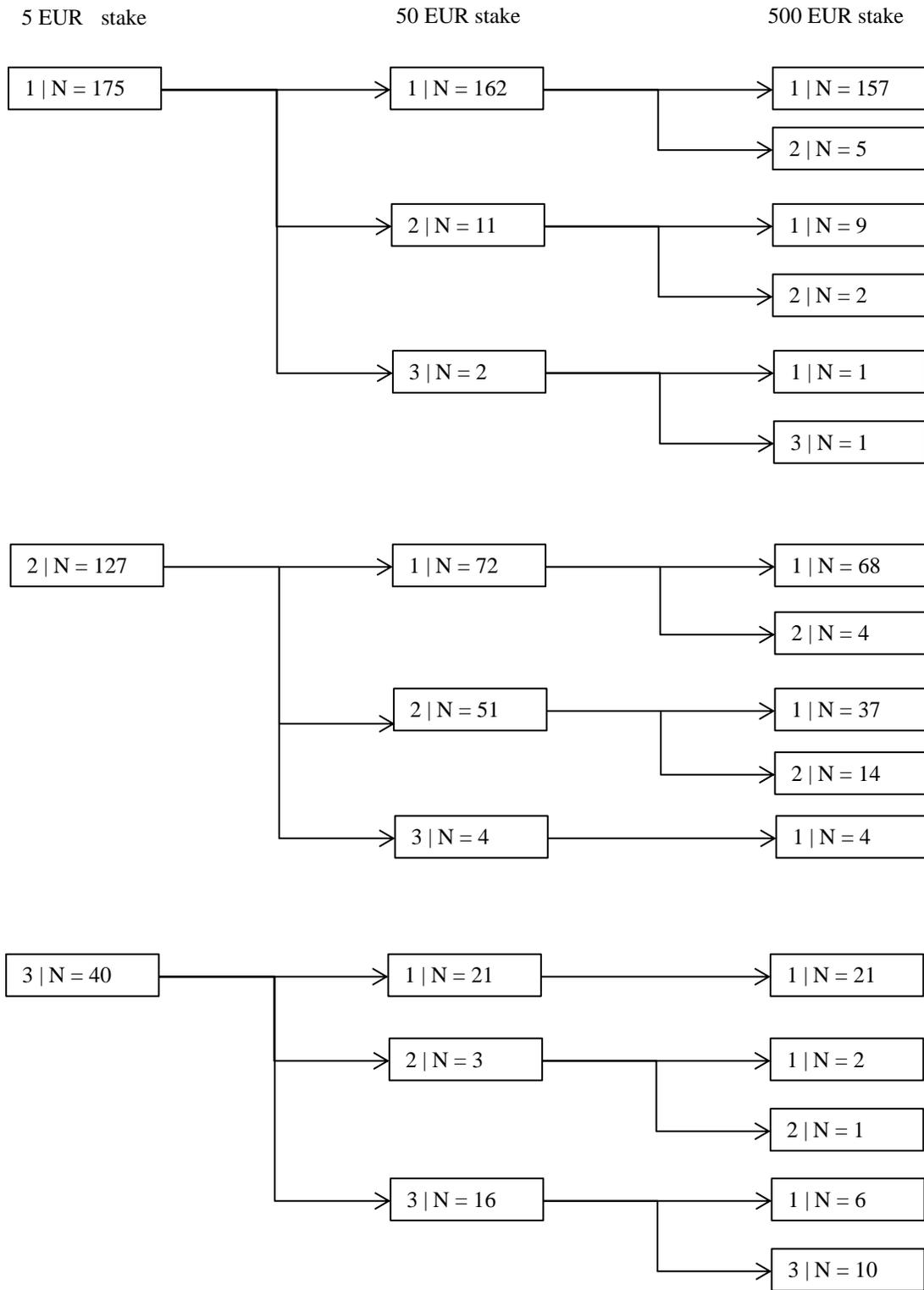
Table 1: Participants subjective risk attitude ($RiskAtt_{Subj}$)

	All	Men	Women	significance
N	342	148	192	
Mean	2.6	3.1	2.3	***
Med	2.5	3.0	2.0	***
Max	5.0	5.0	5.0	
Min	1.0	1.0	1.0	
Std	1.1	1.1	0.9	

Notes: Table 1 displays descriptive statistics of individuals who participate in the questionnaire study. We provide the number of individuals' responses (N), mean value (Mean), median value (Med), maximum value (Max), Minimum value (Min), and standard deviation (Std) for $RiskAtt_{Subj}$. In addition we provide results of the t-test (mean) and U-test (median) as test of equality between men and women. The symbol *** denotes statistical significance at the one and five percent level, respectively. Example: The median value of the male participants' self-assessed risk attitude (*RiskAtt_{Subj}*) is 3.0.

Table 2: Participants' choices in the three different lotteries

	In % (absolute)	Men in % (absolute)	Women in % (absolute)
Panel A: *Lottery with expected value of 5 EUR*			
Certain Payment	51.0 (175)	39.6 (59)	60.4 (116)
Gambling	37.0 (127)	47.0 (70)	28.6 (55)
Indifferent	11.7 (40)	12.8 (19)	10.9 (21)
Panel B: *Lottery with expected value of 50 EUR*			
Certain Payment	74.3 (255)	62.4 (93)	83.3 (160)
Gambling	19.0 (65)	26.8 (40)	13.0 (25)
Indifferent	6.4 (22)	10.1 (15)	3.6 (7)
Panel C: *Lottery with expected value of 500 EUR*			
Certain Payment	88.9 (305)	85.2 (127)	91.7 (176)
Gambling	7.6 (26)	8.1 (12)	7.3 (14)
Indifferent	3.2 (11)	6.1 (9)	1.0 (2)

Notes: Table 2 displays participants' choices in the three different lotteries. We indicate the percentage of responses and the absolute frequency in parentheses for the certain payment, gambling and indifference, respectively. For each lottery, we report choices of all participants as well as separated for men and women. Panel A, B and C indicate the results for the lotteries with 5 EUR, 50 EUR and 500 EUR as expected values, respectively. Example: 116 women (60.4% of all women) prefer the certain payment in the lottery with an expected value of 5 EUR.

Table 3: Influence of subjects' choice of lottery

Dependent variable: $RiskAtt_{Obj,j}$, i.e. participants' choice (sure payment =1, indifferent =2, gamble = 3) in the lottery i (expected value 5, 50, 500 EUR).			
Panel A: *Lottery with expected value of 5 EUR*			
β_0	1.119***	1.682***	1.109***
$RiskAtt_{Subj,j}$	.283***		.254***
$Gender_j$		.392***	.177*
R^2 (adj.)	.112	.041	.119
Panel B: *Lottery with expected value of 50 EUR*			
β_0	.861***	1.297***	.864***
$RiskAtt_{Subj,j}$	.222***		.192***
$Gender_j$		.345***	.183**
R^2 (adj.)	.095	.044	.104
Panel B: *Lottery with expected value of 500 EUR*			
β_0	.870***	1.156***	.871***
$RiskAtt_{Subj,j}$	.120***		.126***
$Gender_j$		.067	-.040
R^2 (adj.)	.056	.001	.054

Notes: We provide cross-sectional regression coefficients and adjusted R^2 for the regression analysis using Equation (1) with the participants' choice in the lottery *i* as dependent variable. Panel A, B and C displays results for the lotteries with an expected value of 5, 50 and 500 EUR, respectively. We employ univariate as well as multivariate regressions. 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 $RiskAtt_{Obj,j}$ in the lottery with an expected value of 5 EUR (Panel A) on participants' subjective risk attitude ($RiskAtt_{Subj,j}$) as sole independent variable yields a coefficient of .283 with statistical significance at the one percent level.

Table 4: Age distribution of young adults responsible for financial decision in households and households' distribution of income and wealth

	age	estimation of monthly household income	estimation of total wealth
Mean	28	2,309	123,888
Std.	5	3,969	1,168,013
10st percentile	21	650	0
20th percentile	24	1,000	604
50th percentile	29	1,900	10,000
80th percentile	33	3,000	70,000
90th percentile	34	3,940	200,000

Notes: This table displays descriptive statistics of the age, monthly income, and total wealth (both in EUR) of young adults' households. We report mean and median values, the 10th, 20th, 80th, and 90th percentile and the standard deviation (Sdv.). Example: The mean value of households' total wealth is 123,888 EUR with a standard deviation of 1,1168,013 EUR. The 20th percentile is 604 EUR and the median value is 10,000 EUR. Twenty percent of the households have a higher total wealth than 70,000 EUR (80th percentile).

Table 5: Influence of 317 young adults households' characteristics on their subjective risk attitude

Panel A: Model 2a

β_0	1.803***	1.458***	-.140	1.058***	.311
Gender	-.215***				-.167**
Age		.001			.001
Income			.207***		.155**
Twealth				.043***	.020
R^2	.038	.000	.043	.027	.068
R^2 (adj.)	.035	-.003	.040	.023	.054
F-Test	12.311	.006	14.021	7.554	4.913

Panel B: Model 2b

β_0	1.853***	1.792***	.385	1.206***	1.472**
Gender	-.279***				-.223***
Gender*SPortfolio	.205				.127
Age		-.013			-.016*
Age*SPortfolio		.032**			.034**
Income			.134**		.081
Income*SPortfolio			.184		.173
Twealth				.024	.012
Twealth*SPortfolio				.043	.020
SPortfolio	-.168	-.750*	-1.336	-.369	-2.646**
R^2	.060	.034	.059	.037	.115
R^2 (adj.)	.051	.025	.050	.026	.085
F-Test	6.678	3.674	6.493	3.490	3.826

Notes: We provide regression coefficients, R², adjusted R², and F-statistics for the stepwise regression analysis using Equation (2a) in Panel A and for the analyses using Equation (2b) in Panel B with households' subjective risk attitude as dependent variable. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: Regressing the households' subjective risk attitude on the full model of Equation (2a) yields a coefficient of households' monthly income of .155 with a statistical significance at the five percent level and an adjusted R² of .054.

Table 6: Influence of 108 young adults households' characteristics on households' objective risk attitude

	Model 3a						Model 3b	
β_0	.269***	-.018	-.107	-.121	-.476***	-.442	-.077	-.172
Gender	-.076*					-.070*		-.057
Age		.006				.004		-.001
Income			.035			.006		-.021
Twealth				.026**		-.005		.004
ValueSP					.067***	.065***		.039
$RiskAtt_{Subj,h}$							.133***	.108**
R^2	.021	.014	.008	.025	.093	.111	.084	.117
R^2 (adj.)	.016	.008	.002	.019	.088	.085	.075	.063
F-Test	3.821	2.487	1.413	4.395	18.112	4.235	9.699	2.152

Notes: We provide regression coefficients, R^2, adjusted R^2, and F-statistics for the stepwise regression analysis using Equation (3a) and (3b) with households' objective risk attitude as dependent variable. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: Regressing the households' objective risk attitude on the full model of Equation (3a) yields a coefficient of households' monthly income of .006 with no statistical significance and an adjusted R^2 of .085.

Table 7: T-Tests between households of young adults and older adults (Full Sample)

	Young Adults	Older Adults	sig.
RiskAtt$_{Subj}$	1.47	1.44	.381
Age	28	59	.000
Income	2,310	3,214	.000
Twealth	123,888	355,625	.000
Share of households with speculation portfolio	.33	.55	.000
N	317	2256	

Notes: Table 8 displays the mean values of 317 young adults' and 2256 older adults' subjective risk attitude (RiskAtt$_{Subj}$), age, monthly households income (Income), total wealth (TWealth), and the share of households that own a speculation portfolio, i.e. are able to invest in risky assets. In addition, we provide p-values (sig.) of the t-test regarding the differences between the mean values of young adults' households and older adults' households.

Table 8: Influence of households' characteristics on their subjective risk attitude

β_0	1.568***	1.723***	-1.121***	.470***	-.442**
Gender	-.121***				-.104***
Gender*YoungAdult	-.087				-.061
Age		-.006***			-.006***
Age*YoungAdult		.007			.006
Income			.316***		.221***
Income*YoungAdult			-.127**		-.053
Twealth				.084***	.049***
Twealth*YoungAdult				-.050***	-.041**
SPortfolio	.082***	.135***	.049**	-.015	.018
SPortfolio*YoungAdult	.061	.018	.065	.113	.098
YoungAdult	.177	-.316	1.079**	.643***	.736
R²	.023	.025	.105	.064	.134
R² (adj.)	.022	.024	.103	.062	.130
F-Test	12.,318	13.398	60.369	33.234	34.235

Notes: We provide regression coefficients, R², adjusted R², and F-statistics for the stepwise regression analysis using Equation (4) with households' subjective risk attitude as dependent variable. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: Regressing the households' subjective risk attitude on the full model of Equation (4) yields a coefficient of households' monthly income of .221 with a statistical significance at the one percent level and an adjusted R² of .130.

Table 9: T-Tests between households of young adults and older adults (SpeculationPortfolio Sample)

	Young Adults	Older Adults	sig
RiskAtt$_{Obj}$	.16	.24	.000
RiskAtt$_{Subj}$	1.57	1.49	.114
ValueSP	23,524	118,366	.000
Age	28	62	.000
Income	2,477	3,476	.000
Twealth	135,103	455,810	.000
N	108	1288	

Notes: Table 10 displays the mean values of 108 young adults' and 1288 older adults' objective (RiskAtt$_{Obj}$) and subjective (RiskAtt$_{Subj}$) risk attitude, the net value of their speculation portfolio (ValueSP), age, monthly households income (Income), and total wealth (TWealth). In addition, we provide p-values (sig.) of the t-test regarding the differences between the mean values of young adults' households and older adults' households.

Table 10: Influence of households' characteristics on their objective risk attitude

β$_0$	.318***	.252***	-1.019***	-.522***	-.771***	-.054**	-1.235***
Gender	-.058***						.004
Gender*YoungAdult	-.018						-.061
Age		.000					.001
Age*YoungAdult		.006					-.002
Income			.158***				.057***
Income*YoungAdult			-.123***				-.078
Twealth				.063***			.010
Twealth*YoungAdult				-.037**			-.005
ValueSP					.095***		.060***
ValueSP*YoungAdult					-.028		-.022
RiskAtt$_{Subj,h}$						.199***	.126***
RiskAtt$_{Subj,h}$*YoungAdult						-.066	-.018
YoungAdult	-.049	-.270**	.912***	.401**	.294*	-.023	1.063**
R²	.015	.007	.095	.094	202	.138	.261
R² (adj.)	.014	.006	.093	.092	.201	.136	.254
F-Test	9.584	4.442	64.184	62.602	155.804	73.981	37.040

Notes: We provide regression coefficients, R², adjusted R², and F-statistics for the stepwise regression analysis using Equation (5) with the households' objective risk attitude as dependent variable. The symbols ***, **, and * denote statistical significance at the one, five, and ten percent level, respectively. Example: Regressing the households' objective risk attitude on the full model of Equation (5) yields a coefficient of households' monthly income of .057 with a statistical significance at the one percent level and an adjusted R² of .254.