A Work Project, presented as part of the requirements for the Award of a Masters Degree in Management from the Faculdade de Economia da Universidade Nova de Lisboa.

OVERCONFIDENCE AND FINANCIAL DECISION MAKING

– THE IMPACT OF FINANCIAL RISK TOLERANCE ON CONFIDENCE JUDGMENTS –

KORAY CAGDAS, # 3042

A Project carried out on the Behavioral Decision Making course,

with the supervision of: Prof. Luis F. Martinez

6th of January 2017

Abstract

A wide range of research has shown that people are overconfident in their judgments displaying a contradiction to modern economic theories supposing individuals as rational agents with the goal of maximizing expected utility and minimizing risk exposure. However, overconfident agents overestimate their judgments and expertise or presume themselves to be better than their peers leading those individuals to exhibit a higher willingness to engage in risky behaviors. So, it can be expected that overconfidence and financial risk tolerance are positively associated with each other. A sample consisting of 137 people was analyzed with the result that there is no evidence supporting this hypothesis, neither in a group level nor on an individual basis. The degrees of overconfidence and risk tolerance are not correlated. Nevertheless, financial risk tolerance has a significant positive correlation on observed level of confidence, whereas accuracy of judgments is not significantly affected by the degree of risk tolerance.

Key words: *Overconfidence Miscalibration Financial Decision Making Risk Tolerance*

Introduction

„It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so"

- Mark Twain -

The overconfidence bias is said to be the most examined research field in both, theoretical and empirical, behavioral economics and finance literature (Glaser et. al., 2004). A wide range of studies have shown the presence of overconfidence by using different samples including clinical psychologists (Oskamp, 1965), managers and executives (Russo and Schoemaker, 1992; Malmendier and Tate, 2005; Ben-David et. al., 2013), traders (Odean, 1999; Barber and Odean, 2001), entrepreneurs (Cooper et. al., 1988; Camerer and Lovallo, 1999), and investment bankers (Glaser et. al., 2010). Overconfidence occurs when people

overestimate their actual performance and knowledge, presume themselves better than others or excessively belief in their own judgments (Moore and Healy, 2007). However, researchers offered overconfidence a wide range of deleterious implications starting from risky and uncertain entrepreneurial and financial activities up to an impact in committing crimes (Loughran et. al., 2011) or even a reason causing wars (Johnson, 2004). Thus, it can be expected that overconfident people tend to engage in behaviors and environments exposing higher levels of risk, respectively displaying a higher *risk tolerance*. The purpose of the work project is to analyze this relationship, as both variables are crucial for financial decision-making.

Hypothesis Development and Literature Review

Hypothesis Development

Modern economic theories have claimed people to be risk averse agents and unbiased Bayesian forecasters with the goal of maximizing utility and making rational decisions based on rational expectations. However, during the last four decades theories within the field of behavioral economics have proved those underlying assumptions to be wrong, as real behavior of people often seems to be contradictory to rational behavior and decisions (e.g. Tversky and Kahneman 1975; Kahneman and Tversky, 1979). The overconfidence bias is mentioned as one of that distortion from rationality. Several studies have shown that people are overconfident in their judgments and beliefs. The occurrence of overconfidence in individual judgments is affecting decision-making in a harmful manner, leading mostly to undesirable outcomes. According to De Bondt and Thaler (1995) overconfidence represents the most robust finding in the psychology of judgments with a wide range of consequences for financial decision making. Camerer and Lovallo (1999), for instance, have offered overconfidence as an explanation for high rates of business failures and financial losses, as entrepreneurial confidence increases new venture creations despite very high failure rates.

Additionally, overconfidence is seen as a factor causing excess price volatility and speculative price bubbles (Scheinkman and Xiong, 2003). The studies of both, Roll (1986) and Malmendier and Tate (2005), are explaining overpriced corporate takeovers and unfavorable corporate investment policies through managerial overconfidence. Hirshleifer et. al. (1994) argues that overconfidence can cause herding behavior in financial markets. However, excessive trading volumes are claimed to be the most observed cause of overconfidence (Benos, 1998; Odean, 1998; Odean, 1999; Barber and Odean, 2001). Overconfident individuals trade more than others and hold undiversified portfolios, which consequently leads to a decrease of net returns and thus lowers expected utility of those traders (Odean, 1998; Barber and Odean, 2001). Glaser and Weber (2007) have shown that those investors who belief themselves being above average regarding trading skills and knowledge have the tendency to trade more than others. In general overconfidence is seen as a reason for individual investors performing poorly and suffering losses in capital markets (Barber and Odean, 2000; Barber and Odean, 2011).

Summarizing those implications of overconfidence on financial decision-making it is observable that overconfident individuals display a higher exposure to risky behaviors. As Loughran et. al. (2011) argues, overconfidence seems to have a stimulating effect on a persons' willingness to engage in behaviors revealing a higher level of risk, including stock market trading or uncertain business and investment decisions, as most of those behaviors are to their detriment. Therefore, it can be expected that financial risk tolerance is positively related to the degree of overconfidence. In other words, individuals displaying a higher tolerance for financial risks, i.e. exhibiting a low risk aversion, will tend to have a higher degree of overconfidence in their judgments. The hypothesis is stated as follows:

"The overconfidence bias is positively related with financial risk tolerance."

Related Literature

Overconfidence in Financial Decisions

The most commonly used notion for overconfidence is the term miscalibration concerning a wide range of studies referred to as "Calibration Literature" (e.g. Lichtenstein et. al., 1982; Griffin and Tversky, 1992). Psychological research has shown that people tend to overestimate their knowledge and skills ensuing a strong belief in the accuracy of their own judgments (Pulford, 1996). As argued by Lichtenstein et. al., (1982) it is crucial for optimal decision making to be well-calibrated. Two methods are used to measure the degree of miscalibration. In *probability evaluation* tasks participants usually have to answer a set of knowledge questions and subsequently assign a probability for each of the questions that their answer is correct. However, when using *interval production* tasks people are asked to provide a low and a high estimate for a series of uncertain continuous quantities within a given confidence interval, e.g. 90%. Generally, it is observed that in both cases people overestimate the precision of their judgments, which consequently leads to overconfidence (Alpert and Raiffa, 1982; Lichtenstein et. al., 1982; Griffin and Tversky, 1992; Russo and Schoemaker, 1992; Klayman et. al., 1999; Soll and Klayman, 2004; Glaser and Weber, 2010).

Psychological studies have also revealed other findings of overconfident behavior. Individuals tend to have overly optimistic prospects about the future, thinking that good things will happen to them and bad to others (Weinstein, 1980). Taylor and Brown (1988) have shown that people distort reality by having an unrealistic positive view about themselves and thus evaluate their skills and prospects higher than those of their colleagues. The authors further argue that, indeed, these traits can aid an individual's mental health by improving creativity, motivation and social interactions albeit both, positive and negative information received, are processed in an overly optimistic and unthreatening manner. Those positive illusions have the benefit of mitigating negative feedback (Taylor and Brown, 1988), while

simultaneously impeding adjustments in destructive behavior. However, other studies are doubtful that the benefits of overconfidence are able to exceed its costs (e.g. Griffin and Tversky, 1992). Another manifestation of overconfidence is the better-than-the-average effect, also called overplacement (Moore and Healy, 2007). In this case overconfidence consist on the belief that people think they are above average regarding their knowledge or abilities (Glaser and Weber, 2010). In the study of Svenson (1981), 82% of a group of students have declared themselves to be among the 30% of drivers with the best driving skills. Similarly, in the study of Cooper et. al. (1988) 81% of the 2994 surveyed new entrepreneurs supposed a 70% or better chance of success for their ventures and 33% have even declared odds of 100%. However, considering the prospects for similar ventures like their own, they stated significantly lower survival rates.

Several established studies have demonstrated that individuals facing tasks or questions of moderate or high difficulty tend to display greater levels of overconfidence (Lichtenstein and Fischhoff, 1977; Gigerenzer et. al., 1991; Brenner, 2003). Odean (1999), who offers overconfidence as an explanation for excessive trading, argues that due to the difficult task of selecting the right securities, traders exhibit larger levels of overconfidence. Moreover, *information* influences overconfidence in individual judgments by increasing the level of confidence in decision-making tasks (Oskamp, 1965). Hence, confidence depends on the amount and strength of information supporting the decision made (Koriat et. al., 1980). However, whether information has an amplifying or a mitigating effect on the degree of overconfidence depends on the usefulness of the information provided. Valuable information reduces overconfidence by improving the accuracy of the judgments (Peterson and Pitz, 1986), while information without valuable insights do not increase the precision (Oskamp, 1965). Odean (1998) has demonstrated that overconfident traders can cause markets to underreact to information of rational investors and to abstract, profound, and highly

significant information. He argues further, that on the contrary markets overreact to salient but less important information (Odean, 1998). *Expertise* in a specific task can also affect overconfidence. Regarding financial decision-making, the recent research of Glaser et. al. (2010) has analyzed whether professional investment bankers and traders are contingent to the same judgment biases (e.g. miscalibration) as students, with the result that all bias scores for professionals were significantly higher compared to the respective values for students. On the contrary, Murphy and Winkler (1977) have shown that weather forecasters, who had several years of experience in assessing probabilities and estimating confidence interval, were indeed well calibrated and thus not overconfident. Similarly, Keren (1987) argues that expert bridge players tend also to be well calibrated. Therefore, it is crucial to understand the importance of *predictability* and *outcome feedback* on overconfidence. Experts seem to be better calibrated than laymen when predictability is reasonably high and when undertaking repetitive tasks with immediate and clear feedback. Nevertheless, when predictability is very low (e.g. in the stock market) and tasks do not provide fast and clear feedback, professionals tend to be more subject to biases (Griffin and Tversky, 1992; Einhorn, 1980; Keren, 1987). Researchers argue that feedback for most decision made in financial markets is delayed and noisy leading to higher overconfidence (Odean, 1998; Daniel et. al. 1998; Barber and Odean, 2001). Moreover, the evidentially existence of positive self-attribution and the disposition effect, i.e. holding securities decreasing in value and selling securities increasing in value, can further facilitate overconfident behavior, as people tend to infer their skills depending on good and bad investments they have made (Shefrin and Statman, 1985; Odean, 1998b). Individuals are inclined to attribute too much importance on successes when appraising their skills, leading to a biased self-evaluation (Gervais and Odean, 1997). Considering the distribution effect, where negative feedback is delayed, Odean (1998) argues that individuals will incorrectly judge themselves to have made less bad decisions, further enhancing overconfidence.

Financial Risk Tolerance

In the domain of finance, risk tolerance is generally defined as the maximum amount of uncertainty an individual is willing to accept when making financial decisions (Grable and Joo, 2004) or according to Weber et. al. (2002: 264) it is "a person's standing on the continuum from risk aversion to risk seeking". In economic research the notion of risk aversion is more commonly used instead of risk tolerance (Nobre and Grable, 2015). A person's risk aversion can be easily interpreted as the inverse of his or hers risk tolerance (Faff et. al., 2008; Nobre and Grable, 2015). Thus, more risk averse people will display a lower degree of risk tolerance for financial risk and less risk averse people, i.e. risk seekers, will show a higher degree of risk tolerance. Financial risk tolerance affects a wide range of areas in individual decision-making, like the use of debt, financial planning, whether to start a business or not, short and long-term investments, engagement in stock trading activities, and personal investment style (e.g. Grable, 2006; Koellinger et. al, 2007; Hvide and Panos, 2014). For instance, high risk tolerant people tend to invest more aggressively than low risk tolerant individuals who are investing more conservatively. Hvide and Panos (2014) declare a positive correlation between entrepreneurial activity and risk tolerance by using stock market participation and personal leverage as a proxy for high financial risk tolerance. As a conclusion, it is reasonable to believe that people displaying a higher risk tolerance are more likely to trade, to start a business, to have a more aggressive investments style with the goal to obtain higher returns, or at least to engage more often in risky behaviors than people with a low risk tolerance.

Methodology and Data Collection

Survey Design and Structure

In order to analyze the research questions an online survey, consisting of three parts, was designed. In the first part, personal data was collected from each participant regarding

age, nationality, gender, education level, and current occupation. After responding to the personal questions the participants were asked to answer a multiple-choice questionnaire with 13 questions (Appendix A) to analyze their individual risk tolerance regarding financial decisions. This part was used to build an individual risk score for each participant and to group the sample into different subgroups with respect to different levels of risk tolerance. The last part insists on a confidence quiz containing 13 knowledge questions with two answer options for each question (Appendix B). This, in turn, requires the participant to choose the more likely response option and subsequently to state his or hers level of confidence that the chosen answer is right. According to Kahneman and Tversky (1982) a statement of confidence expresses a participant's uncertainty in his predictions respectively estimates to which he is already committed. Therefore, assigned "confidence is the subjective probability or degree of belief associated with what we 'think' will happen*"* (Kahneman and Tversky, 1982: 12). So, the purpose of the quiz is to measure a participants' *metaknowledge*. Russo and Schoemaker (1992: 8) have defined the term metaknowledge as "*an appreciation of what we know and what we do not know*". Metaknowledge requires a higher level of expertise including the uncertainty of our predictions together with the scope and limits of our basic knowledge (Russo and Schoemaker, 1992).

Measure of Financial Risk Tolerance

The risk assessment instrument used is the 13-item Grable and Lytton (1999) risk tolerance scale (GL-RTS), which is a commonly accepted and frequently used method to measure an individuals' financial risk tolerance (For a review, see Grable and Lytton, 1999; Grable and Lytton, 2001, Gilliam et. al., 2010). The GL-RTS measures different dimensions of financial risk tolerance such as investment risk, risk comfort and experience, loss aversion, investor experience or knowledge about personal finance, and speculative risk, which offers the scale a strong degree of multidimensionality (Grable and Lytton, 1999). Moreover, the

GL-RTS has shown a great explanatory power in comparison to other popular methods (e.g. Survey of Consumer Finance's) (Gilliam et. al., 2010). However, to measure an individual risk score every participant had to answer each of the 13 questions by choosing the response option, which suits his or hers individual preferences the most. The scoring for each question consists of a scale from 1 to 4 for the possible response alternatives, with a higher value suggesting a higher tolerance for risk. Finally, a variable representing an individual's financial risk score, ranging between 13 and 50, was calculated as the sum of the scores for each of the 13 items. The variable *financial risk score* is going to be used as the independent variable to measure its effect on the degree of confidence and the degree of accuracy. In general the score can be interpreted as follows: *13 to 18*: Low risk tolerance (i.e. conservative investors); *19 to 22*: Below-average risk tolerance; *23 – 28*: Moderate risk tolerance; *29 – 32*: Above-average risk tolerance; *33 – 50*: High risk tolerance (i.e. aggressive investor).

Measure of Overconfidence as Miscalibration

The *probability evaluation* method on a half range scale (ranging from 50% to 100%) was used to measure the degree of miscalibration of each participant (e.g. Lichtenstein et. al., 1982). A confidence level of 50% would imply that the participants' answer was a guess, whereas an assigned value of 100% would indicate that the subject was totally sure about the answer. The *interval production* was not used, as it comes with a higher effort for the participants and is more time consuming compared to a *probability evaluation* task, which could have decreased the response rate. Moreover, the results of a *probability evaluation* task can be visualized using a calibration curve, which was used as an analysis tool. According to the responses of the confidence quiz it was possible to measure two variables for each participant. The variables were the *mean confidence* level *(in %)* calculated as the average level of confidence assigned throughout the 13 questions and the *percentage of correct* answers as a measure for accuracy. These variables are going to be used as *dependent*

variables in the analysis to measure the effect of financial risk tolerance on it. Additionally, a *bias score* is calculated by the difference of the mean confidence score and percentage of correct answers indicating whether the observed bias is under- or overconfidence through maintaining a negative or a positive sign (e.g. Pulford, 1996).

Procedure

An online survey tool was used to design the aforementioned questionnaire. The survey was also translated into German to counteract possible language barriers and improve response rate as German participants represent a major target group. Afterwards, the study was distributed primarily online using social media. The online method was used as it allows a higher reach and a faster data collection. Some personal requests were also used to gather data, which were entered in the survey afterwards. The data was collected during a 5-week period between November and December. Finally, the data that could be used in further analysis consisted of a sample with 137 participants. Some responses had to be deleted, as they were incomplete and thus could not be used for a proper analysis.

Methods

The analysis involves two parts. The first one had the goal to analyze the impact of risk tolerance on overconfidence on a more comprehensive level by splitting the data into different subgroups. For this purpose the sample was divided into five different subgroups representing different tolerances for risk such as low, below average, moderate, above average, and high risk tolerance. However, this evaluation make it possible to test the hypothesis on a more broad, group level instead of an individual level. The second part consists of the analysis of the hypotheses on an individual level. The latter should display how the individual level of risk tolerance affects confidence and accuracy whereas the first analysis should find an answer to the same question, but between different subgroups.

Analysis of the Results

Descriptive Statistics

The sample containing 137 participants is composed of 84 men and 53 women. People from 21 different countries have participated while the majority was German. The mean age was 26.80 (median = 26) with the youngest participants being 20 and the oldest 50. For 35% of the sample the highest degree achieved was a bachelor, 45.3% hold a master degree, and 0.7% a PhD or doctor degree. High school or less were for 19% of the participants the educational background. In regard to employment status, the majority was either working as an employee (43.8%) or still studying (46.7%). Moreover, 5.1% stated to be self-employed, 2.2% being entrepreneurs and 0.7% being unemployed at the time of data collection.

Financial Risk Tolerance Scale Reliability

In order to analyze the reliability of the GL-RTS scale used in the study, the measure of Cronbach's alpha was calculated. In previous researches the 13-item scale of Grable and Lytton (1999) has displayed a high reliability value of 0.75. Moreover, it has been shown that the estimated value remained robust with an alpha of 0.77 during the time period of 2007 to 2013 (Kuzniak et. al., 2015). Internal consistency is ensured for reliability values in the range of 0.5 to 0.8 (e.g. Grable and Lytton, 1999). In this research the GL-RTS scale reveals a relatively high reliability value of 0.81.

***Part I**: Group Analysis*

To analyze the hypothesis on a group level, calibration curves were used and an analysis of variance (ANOVA) was conducted. By using calibration curves (e.g. Lichtenstein et. al., 1982; Arkes et. al. 1987; Griffin and Tversky, 1992) it is possible to have a general overview and a first impression about the results obtained. The calibration curves give a visual impression to the degree of miscalibration for a group as the relative distance of a curve to the reference line displaying perfect calibration. Therefore, the greater the distance between

the curve and the reference line the greater the degree of miscalibration. The calibration plots were derived for the five subgroups representing different levels of financial risk tolerance as explained above. The descriptive statistics for the subgroups can be observed in table 1. The calibration plot is shown in figure 1.

Figure 1

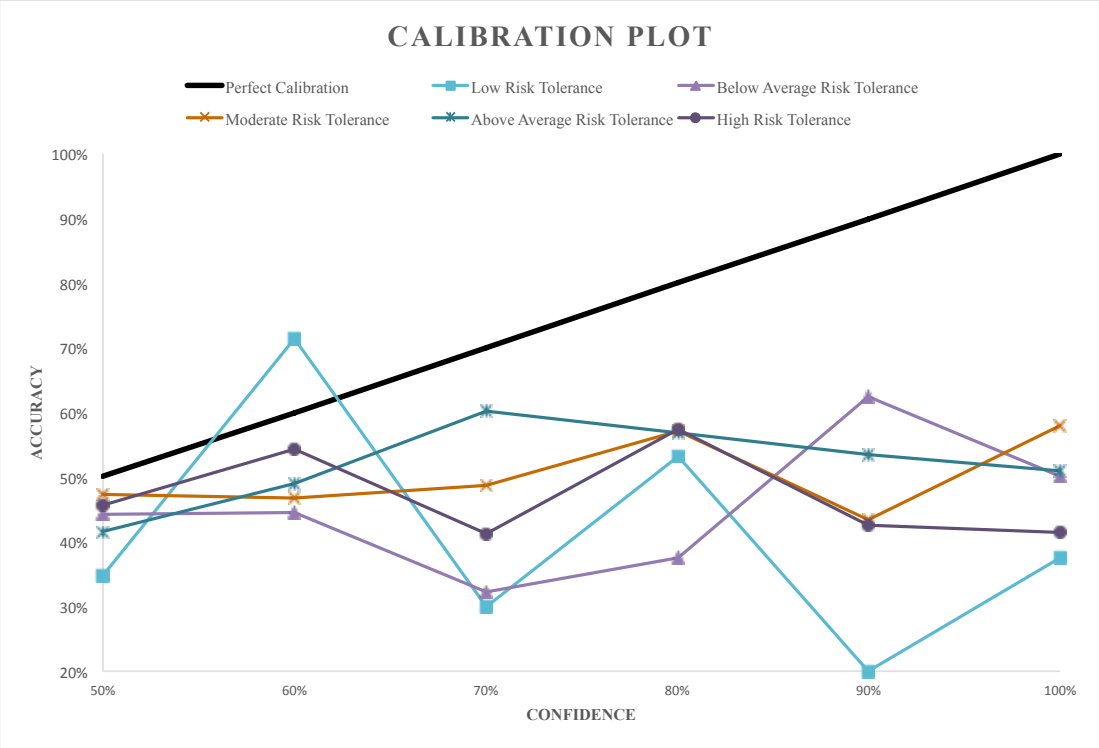

Table 1

Fin. Risk Tolerance Subgroups

	Frequency	Percent	Valid Percent	Cumulative Percent
low	7	5,1	5,1	5,1
below average	15	10,9	10,9	16,1
moderate	44	32,1	32,1	48,2
above average	36	26,3	26,3	74,5
high	35	25,5	25,5	100,0
Total	137	100,0	100,0	

The visual analysis depicts an overall miscalibration for all groups within the sample. All of the five subgroups are highly overconfident. However, the calculated mean confidence scores, percentage of correct answers and overconfidence scores for each subgroup implies a slightly increase in confidence level with a higher risk tolerance whereby accuracy seems not to be affected (see table 2). The degree of overconfidence is the highest for the subgroup with

the highest risk tolerance. However, a pattern could not be observed using the summary in table 2, as the second highest observed bias score is the one for the low risk tolerance subgroup.

Table 2

Fin. Risk Tolerance	*low*	*below average*	*moderate*	*above average*	*high*
Mean Confidence	64,51%	63,59%	70,44%	72,00%	76,90%
Percentage Correct	41,17%	45,15%	50,18%	52,04%	47,11%
Overconfidence Score	23,33%	18,44%	20,26%	19,96%	29,79%

To test the hypothesis, whether calculated scores differ significantly between the subgroups, an ANOVA was conducted. According to this analysis, the only variable that is significantly different between the five subgroups is the mean confidence score. For the two other variables the p-value gives no reason to reject the null hypothesis assuming equal means for all subgroups. The results can be observed in figure 2. Consequently, it can be stated that observed level of overconfidence is not significantly affected by the risk tolerance within a group. Overconfidence is independent of financial risk tolerance.

Figure 2

ANOVA Financial Risk Tolerance Subgroups

		Sum of Squares	df	Mean Square	F	Sig.
MeanConfidence	Between Groups	2425,317	4	606,329	6,877	,000
	Within Groups	11638,187	132	88,168		
	Total	14063,504	136			
PercentageCorrect	Between Groups	1683,924	4	420,981	1,126	,347
	Within Groups	49343,828	132	373,817		
	Total	51027,752	136			
OverconfidenceScore	Between Groups	2266,798	4	566,700	1,183	,321
	Within Groups	63233,771	132	479,044		
	Total	65500,569	136			

***Part II**: Individual analysis*

Descriptive Statistics for the dependent and independent variables

Figure 3 shows the descriptive statistics obtained for the variables used in the analysis. Accordingly, 18 individuals (13.14%) of the sample were underconfident, a single one was well calibrated (0.73%) and the majority of 118 (86.13%) people were overconfident.

Figure 3

Descriptive Statistics

		Fin. RiskTolerance	MeanConfidence	Percentage Correct	Overconfidence Score
N	Valid	137	137	137	137
	Missing	0	0	0	0
Mean		28,88	71,6861	47,6350	24,1022
Median		29,00	71,0000	46,0000	22,0000
Std. Deviation		6,173	10,16898	19,37018	21,94588
Range		30	44,00	92,00	100,00
Minimum		13	52,00	,00	-25,00
Maximum		43	96,00	92,00	75,00
Percentiles	25	25,00	64,0000	31,0000	8,5000
	50	29,00	71,0000	46,0000	22,0000
	75	33,00	78,0000	62,0000	39,5000

Control Variables

Before conducting a multiple linear regression analysis it is important to take into account control variables, i.e. demographic variables, which could also affect the dependent variables. Research has shown that gender has an influence on overconfidence and thus influences mean confidence and accuracy (Lundeberg et. al., 1994). Moreover, it is reasonable to assume that an individual's judgments can be affected by age, education level and employment status. For this purpose, several analyses in form of t-tests and ANOVAs were conducted to determine whether those variables have a significant influence on the respondent's mean confidence score or percentage of correct answers, i.e. accuracy. According to the result of this analysis the control variables will be selected for further analysis. A first conducted ANOVA for the variable gender at a 5% level of significance has shown, that the mean confidence scores are significantly different by gender, whereby the observed level of accuracy does not significantly differ for males and females (see figure 4).

Figure 4

ANOVA Gender

		Sum of Squares	df	Mean Square	F	Sig.
MeanConfidence	Between Groups	2907,195	1	2907,195	35,179	,000
	Within Groups	11156,309	135	82,639		
	Total	14063,504	136			
PercentageCorrect	Between Groups	971,247	1	971,247	2,619	,108
	Within Groups	50056,505	135	370,789		
	Total	51027,752	136			

A second demographical variable to test is the level of education. The conducted analysis has shown that the highest educational degree achieved has no impact on the dependent variables. Both obtained p-values (see the results in figure 5) give no reason to reject H_0.

Figure 5

ANOVA Education Level

		Sum of Squares	df	Mean Square	F	Sig.
MeanConfidence	Between Groups	204,613	3	68,204	,655	,581
	Within Groups	13858,891	133	104,202		
	Total	14063,504	136			
PercentageCorrect	Between Groups	441,211	3	147,070	,387	,763
	Within Groups	50586,541	133	380,350		
	Total	51027,752	136			

A last ANOVA regarding employment status had the result that the dependent variables seem to differ at least in two of the possible occupations (see figure 6 for the results). Both p-values obtained are very small and implicate a significant difference between mean confidence scores and the percentage of correct answers at least in two different employment levels.

Figure 6

ANOVA Employment Status

		Sum of Squares	df	Mean Square	F	Sig.
MeanConfidence	Between Groups	1769,448	4	442,362	4,889	,001
	Within Groups	11761,811	130	90,475		
	Total	13531,259	134			
PercentageCorrect	Between Groups	4249,747	4	1062,437	2,966	,022
	Within Groups	46567,779	130	358,214		
	Total	50817,526	134			

Nevertheless, as the categories ‘entrepreneur’, self-employed’ and ‘unemployed’ do not have sufficient observations to obtain valuable predictions, they were excluded for a further test where just the occupations of ‘student’ and ‘employee’ were used. The new analysis has shown that occupation ‘student’ and ‘employee’ still has a significant influence on the percentage of correct ($p = 0.018$) but mean confidence does not significantly ($p = 0.286$) differ between both groups.

Correlations and Multiple Regression Analysis

The following paragraph describes the obtained results from a bivariate correlation analysis for the numerical variables in the sample. The received correlation matrix can be observed below (figure 7).

Figure 7

Correlations

		MeanConfidence	Percentage Correct	Overconfidence Score	Fin. RiskTolerance	Age
MeanConfidence	Pearson Correlation	1	-,012	,472**	,486**	,282**
	Sig. (2-tailed)		,893	,000	,000	,001
	N	137	137	137	137	137
PercentageCorrect	Pearson Correlation	-,012	1	-,887**	,076	,103
	Sig. (2-tailed)	,893		,000	,380	,231
	N	137	137	137	137	137
OverconfidenceScore	Pearson Correlation	,472**	-,887**	1	,160	,040
	Sig. (2-tailed)	,000	,000		,062	,641
	N	137	137	137	137	137
Fin.RiskTolerance	Pearson Correlation	,486**	,076	,160	1	,189*
	Sig. (2-tailed)	,000	,380	,062		,027
	N	137	137	137	137	137
Age	Pearson Correlation	,282**	,103	,040	,189*	1
	Sig. (2-tailed)	,001	,231	,641	,027	
	N	137	137	137	137	137

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The highly significant correlations between the two dependent variables and the overconfidence score should be ignored as the latter is calculated using the two dependent variables. Moreover, it can be observed that risk tolerance is highly significant correlated with the variable of mean confidence at a 1% level of significance. Nevertheless, no significant relationship can be observed between risk tolerance and accuracy, which seem reasonable as causally a person's maximum amount of accepted uncertainty should be unrelated to percentage of correct answer in a knowledge quiz. Furthermore, no significant correlation can be observed between both dependent variables. However, just the factor age as a demographical variable, seems to have an impact on mean confidence. Lastly, it is interesting to see, that similar to the group analysis, the variable of financial risk tolerance has no significant influence on the individual overconfidence score. Therefore, it is possible to conclude that the results obtained for the group analysis are applicable to the individual

analysis regarding the effect of financial risk tolerance on overconfidence. No evidence exists to accept the hypothesis in both cases. Nonetheless, the mean confidence score is affected by an individuals' risk tolerance. Higher risk tolerance supposes higher confidence in judgments.

Lastly, a stepwise multiple regression analysis was conducted to test the impact of risk tolerance on mean confidence score. The first model consists of the control variables gender and age only, whereas in the second model the variable of financial risk tolerance will be included. This method allows for a clearer result as the impact of risk tolerance can be revealed through the change of the R^2. The result of the regression can be observed in the compact figure 8 below.

Figure 8

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,511[a]	,261	,250	8,80408
2	,567[b]	,322	,307	8,46783

a. Predictors: (Constant), GenderDummy, Age

b. Predictors: (Constant), GenderDummy, Age, Fin. RiskTolerance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3676,912	2	1838,456	23,718	,000[b]
	Residual	10386,592	134	77,512		
	Total	14063,504	136			
2	Regression	4526,851	3	1508,950	21,044	,000[c]
	Residual	9536,652	133	71,704		
	Total	14063,504	136			

a. Dependent Variable: MeanConfidence

b. Predictors: (Constant), GenderDummy, Age

c. Predictors: (Constant), GenderDummy, Age, Fin.RiskTolerance

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	60,581	4,783		12,667	,000
	Age	,543	,172	,235	3,151	,002
	GenderDummy	-8,921	1,554	-,429	-5,741	,000
2	(Constant)	47,362	5,992		7,904	,000
	Age	,454	,168	,197	2,706	,008
	GenderDummy	-5,510	1,793	-,265	-3,073	,003
	Fin.RiskTolerance	,495	,144	,300	3,443	,001

a. Dependent Variable: MeanConfidence

Both models and all independent variables used are significant as p-values are below the 5% threshold. The independent variable 'financial risk tolerance' adds value to the model according to the increase in the R^2. A further 6.1% of the variance can be explained using financial risk tolerance. However, the greatest influence on the mean confidence score is preserved by gender. A regression of risk tolerance on accuracy with the control variables 'occupation student' and occupation 'employee' has shown no significance.

Discussion of the Results and Limitation

The purpose of the work project was to examine the relationship between *overconfidence* and *financial risk tolerance*, i.e. risk aversion. A review over related literature concerning overconfidence in (financial-) decision-making has shown a stimulating effect of overconfidence on the willingness to engage in risky behaviors with mostly undesirable goals. Thus, it was reasonable to predict a positive relationship between both variables. A 'macro' and 'micro' analysis was conducted to exhibit changes of overconfidence levels between groups with different levels of risk aversion and subsequently on an individual basis for every person participated in the study. In both analyses there was no evidence to accept the hypothesis. Nevertheless, it was possible to show a significantly positive correlation between *mean confidence scores* and risk tolerance, both for groups and individuals. A higher tolerance for financial risk increases confidence in judgments. In both analyses the variable of *accuracy*, i.e. percentage of correct, was not affected by risk tolerance. However, some limitations regarding the study have to be taken into account when discussing the obtained results. First of all, the sample size of 137 might be prone to biases to make reliable predictions. Further, research predicts higher (over-) confidence scores for people who are self-employed or entrepreneurs (Koellinger et. al., 2007). Due to a lack of sufficient observation this could not be analyzed using the existing data. Moreover, some possible measurement issues exist. First of all, observed level of overconfidence depends on the judgment task used (Pulford, 1996). Probability judgments are prone to display lower degrees of miscalibration than interval tasks (Klayman et. al. 1999). Thus, task and item selection at the beginning influences observed overconfidence significantly. Moreover, risk tolerance can be influenced by a wide range of environmental and biophysical factors such as self-esteem, financial knowledge, income or martial status that are not considered in the measurement of the risk score (Grable and Joo, 2004). Financial knowledge could also influence the degree of

overconfidence, as financial literate people tend to exhibit higher bias scores than layman (Griffin and Tversky, 1992; Glaser et. al. 2010). Last of all, the study is not conducted in a controlled environment such as laboratory experiments to hold the influence of externalities as low as possible.

References

Alpert, Marc, and Howard Raiffa. 1982. "A progress report on the training of probability assessors." In *Judgment Under Uncertainty: Heuristics and Biases,* eds. Kahneman, Daniel, Paul Slovic, and Amos Tversky. 1982: 294-305. Cambridge, MA: Cambridge University Press.

Arkes, Hal R., Caryn Christensen, Cheryl Lai, and Catherine Blumer. 1987. "Two methods of reducing overconfidence." *Organizational Behavior and Human Decision Processes*, 39(1), 133-144.

Barber, Brad M., and Terrance Odean. 2000. "Trading is hazardous to your wealth: The common stock investment performance of individual investors." *The Journal of Finance,* 55(2): 773-806.

Barber, Brad M., and Terrance Odean. 2001. "Boys will be boys: Gender, overconfidence, and common stock investment." *Quarterly Journal of Economics,* 116(1): 261-292.

Barber, Brad M., and Terrance Odean. 2011. "The behavior of individual investors." In *Handbook of the Economics of Finance*, eds. Constantinides, G., M. Harris, and R. Stulz. Amsterdam: Elsevier.

Ben-David, Itzhak, John R. Graham, and Campbell R. Harvey. 2013. "Managerial miscalibration." *The Quarterly Journal of Economics* 128(4): 1547-1584.

Benos, Alexandros V. 1998. "Aggressiveness and survival of overconfident traders." *Journal of Financial Markets,* 1(3): 353-383.

Brenner, Lyle A. 2003. "A random support model of the calibration of subjective probabilities." *Organizational Behavior and Human Decision Processes,* 90(1): 87-110.

Camerer, Colin F., and Dan Lovallo. 1999. "Overconfidence and excess entry: An experimental approach." *American Economic Review,* 89(1): 306-318.

Cooper, Arnold C., Carolyn Y. Woo, and William C. Dunkelberg. 1988. "Entrepreneurs' perceived chances for success." *Journal of Business Venturing,* 3(2): 97-108.

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam. 1998. "Investor Psychology and Security Market Under-and Overreactions." *the Journal of Finance,* 53(6): 1839-1885.

De Bondt, Werner F. M., and Richard H. Thaler. 1995. "Financial Decision-Making in Markets and Firms: A Behavioral Perspective." In *Handbooks in Operations Research and Management Science* 9, eds. Jarrow, Robert A., Voijslav Maksimovic, and William T. Ziemba. 1995: 385-410. Amsterdam: North Holland.

Einhorn, Hillel J. 1980. "Overconfidence in judgment." *New Directions for Methodology of Social and Behavioral Science,* 4(1): 1-16.

Faff, Robert, Daniel Mulino, and Daniel Chai. 2008. "On the Linkage between Financial Risk Tolerance and Risk Aversion." *Journal of Financial Research,* 31(1): 1-23.

Gigerenzer, Gerd, Ulrich Hoffrage, and Heinz Kleinbölting. 1991. "Probabilistic mental models: a Brunswikian theory of confidence." *Psychological Review,* 98(4): 506-528.

Gilliam, John, Swarn Chatterjee, and John E. Grable. 2010. "Measuring the Perception of Financial Risk Tolerance: A tale of two measures." *Journal of Financial Counseling and Planning*, 21(2): 30-43.

Glaser, Markus, Markus Nöth, and Martin Weber. 2004. "Behavioral Finance." In *Blackwell handbook of judgment and decision-making,* eds. Derek J. Koehler and Nigel Harvey. 2004: 527-546. Oxford, U.K.: Blackwell Publishing.

Glaser, Markus, and Martin Weber. 2007. ”Overconfidence and Trading Volume.” *The Geneva Risk and Insurance Review*, 32(1): 1-36.

Glaser, Markus, and Martin Weber. 2010. “Overconfidence”. In *Behavioral Finance: Investors, Corporations, and Markets*, eds. Baker, H. Kent, and John R. Nofsinger. 2010: 241-258. John Wiley & Sons, Inc.

Glaser, Markus, Thomas Langer, and Martin Weber. 2010. “Overconfidence of professionals and lay men: individual differences within and between tasks?” Working Paper, University of Mannheim.

Grable, John E., and Ruth H. Lytton. 1999. “Financial risk tolerance revisited: the development of a risk assessment instrument☆.” *Financial Services Review*, *8*(3): 163-181.

Grable, John E., and Ruth H. Lytton. 2001. "Assessing the concurrent validity of the SCF risk tolerance question." *Journal of Financial Counseling and Planning,* 12(2): 43-53.

Grable, John E., and So-Hyun Joo. 2004. “Environmental and biophysical factors associated with financial risk tolerance.” *Journal of Financial Counseling and Planning*, 15(1): 73-82.

Griffin, D., and A. Tversky. 1992. “The Weighting of Evidence and the Determinants of Confidence.” *Cognitive Psychology,* 24(3): 411-435.

Hilton, Denis, Isabelle Regner, Laure Cabantous, Laetitia Charalambides, and Stéphane Vautier. 2011. “Do positive illusions predict overconfidence in judgment? A test using interval production and probability evaluation measures of miscalibration.” *Journal of Behavioral Decision Making*, 24(2): 117-139.

Hirshleifer, David, Avanidhar Subrahmanyam, and Sheridan Titman. 1994. "Security analysis and trading patterns when some investors receive information before others." *The Journal of Finance* 49(5): 1665-1698.

Hvide, Hans K., and Georgios A. Panos. 2014. "Risk tolerance and entrepreneurship." *Journal of Financial Economics,* 111(1): 200-223.

Johnson, Dominic D. P. 2004. "*Overconfidence and war: The havoc and glory of positive illusions*." Cambridge, MA: Harvard University Press.

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect theory: An analysis of decision under risk." *Econometrica: Journal of the Econometric Society,* 47(2): 263-291.

Kahneman, Daniel, and Amos Tversky. 1982. "Variants of uncertainty." *Cognition* 11(2): 143-157.

Keren, Gideon. 1987. "Facing uncertainty in the game of bridge: A calibration study." *Organizational Behavior and Human Decision Processes* 39(1): 98-114.

Klayman, Joshua, Jack B. Soll, Claudia González-Vallejo, and Sema Barlas. 1999. Overconfidence: It depends on how, what, and whom you ask." *Organizational Behavior and Human Decision Process,* 79(3): 216-247.

Koellinger, Phillip, Maria Minniti, and Christian Schade. 2007. " 'I think I can, I think I can': Overconfidence and entrepreneurial behavior." *Journal of Economic Psychology,* 28(4): 507-527.

Koriat, Asher, Sarah Lichtenstein, and Baruch Fischhoff. 1980. "Reasons for confidence." *Journal of Experimental Psychology: Human Learning and Memory,* 6(2): 107-118.

Kuzniak, Stephen, Abed Rabbani, Wookjae Heo, Jorge Ruiz-Menjivar, and John E. Grable. 2015. "The Grable and Lytton risk-tolerance scale: A 15-year retrospective." *Financial Services Review,* 24(2): 177-192,

Lichtenstein, Sarah, and Baruch Fischhoff. 1977. "Do those who know more also know more about how much they know?" *Organizational Behavior and Human Performance,* 20(2): 159-183.

Lichtenstein, Sarah, Baruch Fischhoff, and Lawrence D. Phillips. 1982. "Calibration of Probabilities: The State of the Art to 1980." In *Judgment under Uncertainty: Heuristics and Biases,* eds. Kahneman, Daniel, Paul Slovic, and Amos Tversky, Cambridge, UK: Cambridge University Press. 1982: 306-334.

Loughran, Thomas, Ray Paternoster, Alex R. Piquero, and Jeffrey Fagan. 2011. "'A Good Man Always Knows His Limitations': Overconfidence in Criminal Offending." *Columbia Public Law Research Paper,* paper number 11-264.

Lundeberg, Mary A., Paul W. Fox, and Judith Punćcohaŕ. 1994. "Highly confident but wrong: gender differences and similarities in confidence judgments." *Journal of Educational Psychology,* 86(1): 114-121.

Malmendier, Ulrike, and Geoffrey Tate. 2005. "CEO overconfidence and corporate investment." *Journal of Finance,* 60(6): 2661-2700.

Moore, Don A., and Paul J. Healy. 2008. "The Trouble with Overconfidence." *Psychological Review*, *115*(2): 502-517.

Murphy, Allan H., and Robert L. Winkler. 1977. "Can weather forecasters formulate reliable probability forecasts of precipitation and temperature." *National Weather Digest,* 2(2): 2-9.

Nobre, Liana Holanda N., and John E. Grable. 2015. "The Role of Risk Profiles and Risk Tolerance in Shaping Client Investment Decisions." *Journal of Financial Service Professionals,* 69(3): 18-21.

Odean, Terrance. 1998. "Volume, volatility, price, and profit when all traders are above average." *Journal of Finance,* 53(6): 1887-1934.

Odean, Terrance. 1998b. "Are investors reluctant to realize their losses?" *The Journal of Finance,* 53(5): 1775-1798.

Odean, Terrance. 1999. "Do investors trade too much?" *American Economics Review,* 89(5): 1279-1298.

Oskamp, Stuart. 1965. „Overconfidence in case-study judgments." *Journal of Consulting Psychology*, 29(3): 261-265.

Peterson, Dane K., and Gordon F. Pitz. 1986. "Effects of amount of information on predictions of uncertain quantities." *Acta Psychologica,* 61(3): 229-231 and 234-241.

Pulford, Briony D. 1996. “Overconfidence in Human Judgment.” PhD Thesis. Department of Psychology, University of Leicester.

Roll, Richard. 1986. "The hubris hypothesis of corporate takeovers." *Journal of Business* 59(2): 197-216.

Russo, J. Edward, and Paul J. H. Schoemaker. 1992. “Managing Overconfidence.” *Sloan Management Review*, 33(2): 7-17.

Scheinkman, José A., and Wei Xiong. 2003. „Overconfidence and speculative bubbles.“ *Journal of Political Economy*, 111(6): 1183-1220.

Shefrin, Hersh, and Meir Statman. 1985. "The disposition to sell winners too early and ride losers too long: Theory and evidence." *The Journal of Finance,* 40(3): 777-790.

Soll, Jack B., and Joshua Klayman. 2004. “Overconfidence in interval estimates.” *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 30(2): 299-314.

Svenson, Ola. 1981. “Are we all less risky and more skillful than our fellow drivers?” *Acta Psychologica,* 47(2): 143-148.

Taylor, Shelley E., and Jonathon D. Brown. 1988. „Illusion and well-being: a social psychological perspective on mental health.“ *Psychological Bulletin*, 103(2): 193-210.

Tversky, Amos, and Daniel Kahneman. 1975. "Judgment under uncertainty: Heuristics and biases." In *Utility, Probability, and Human Decision-Making*. 1975: 141-162. Netherlands: Springer.

Weber, Elke U., Ann-Renee Blais, and Nancy E. Betz 2002. “A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors.” *Journal of Behavioral Decision Making*, 15(4): 263-290.

Weinstein, Neil D. 1980. "Unrealistic optimism about future life events." *Journal of Personality and Social Psychology* 39(5): 806-820.