WHAT DRIVES INVESTORS' RISK APPETITE - Empirical evidence from private Finnish investors 2007-2008

Finance

Master's thesis

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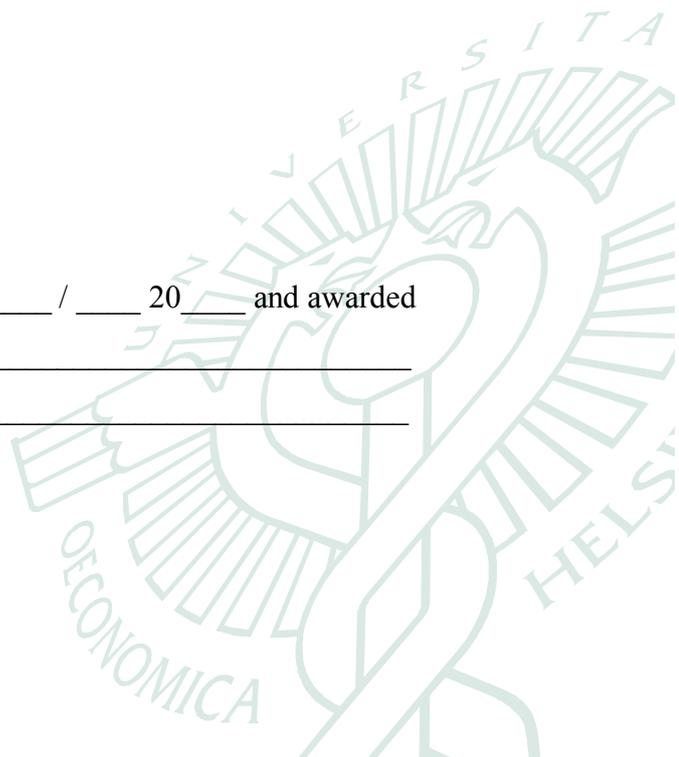
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WHAT DRIVES INVESTORS' RISK APPETITE

Empirical evidence from private Finnish investors 2007-2008

PURPOSE OF THE STUDY

The objective of this Thesis is to study the risk attitudes of private investors from two aspects. Firstly I asses, how traditional determinants of risk, such as age or gender, affect individuals' risk appetite. Secondly, I address the effect of risk attitude on actual investments made by the investors. The effect of different variables on risk attitude is studied by conducting variable-by-variable data analysis, which is extended with ordered logistic and ordinary-least squares regressions.

This study adds to the numerous of existing studies on risk attitudes by providing a large scale sample, which includes demographic data about the investors and also verified information about their financials, which enable me to study the link between actual investments made and risk attitude in more detail than in preceding studies.

DATA

The data of the study is gathered from OP-Pohjola Group's Investment Advisory Tool, software aimed at determining customers' attitude towards risk and suggesting investments according to the results of the questionnaire. The data set covers a time period from March 2007 to December 2008. In total, the data includes 85,063 private Finnish investors' attitude towards risk as well as their actual portfolio composition. Additionally the data is enriched with age, gender, wealth, income and debt parameters. All data is masked in such a way that no investor can be identified from the dataset.

RESULTS

I found that in general Finnish investors are very risk averse, but their risk allocation and risk attitude go hand in hand; the more investor has invested on equities, the more willing he is to take risk. Furthermore, in regression analysis, I found that experience, being male and having debt are linked with positive attitude towards risk, consistent with the previous literature. I also found that age is negatively and non-linearly related to risk attitude and that aging investors tend to be more risk averse, but actually their portfolios actually reflect their attitudes with a delay.

KEYWORDS

Risk preferences, risk tolerance, age, gender, wealth, income, debt, investments

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MITKÄ TEKIJÄT SELITTÄVÄT SIJOITTAJIEN RISKINOTTOHALUUKKUUTTA

Empiirinen tutkimus suomalaisista piensijoittajista 2007-2008

TUTKIMUKSEN TARKOITUS

Tutkielman tarkoituksena on selvittää piensijoittajien riskinottohalukkuuden muovautumista kahdesta näkökulmasta. Ensimmäinen näkökulma on demografisten muuttujien, kuten iän ja sukupuolen vaikutus riskinottohalukkuuteen. Toinen näkökulma on sijoittajan riskinottohalukkuuden vaikutus todellisiin sijoituksiin. Tutkimus on toteutettu arvioimalla ensin jokaista tutkittavaa parametriä yksinään selittävänä tekijänä, jonka jälkeen parametrien yhteisvaikutusta riskinottohalukkuuteen on tutkittu regressioilla.

Tutkielman panos olemassa olevaan tutkimukseen on se, että käytössä on suuri aineisto, joka sisältää todennettua tietoa piensijoittajien suhtautumisesta riskiin, mikä mahdollistaa todellisten sijoitusten ja riskinottohalukkuuden välisen yhteyden arvioimisen, mihin aikaisemmissa tutkimuksissa on kyetty vain rajoitetusti.

TUTKIMUSAINEISTO

Tutkimusaineisto on kerätty OP-Pohjola-ryhmän sijoittajakuvankartoituksesta, joka on työkalu sijoittajan riskinottohalukkuuden määrittämiseksi. Aineisto kattaa 85,063 havaintoa suomalaisista piensijoittajista maaliskuusta 2007 joulukuuhun 2008. Aineisto käsittää tietoja sijoittajien riskinottohalukkuudesta, sijoituksista, sekä iästä, sukupuolesta, varallisuudesta ja velasta. Aineisto on käsitelty siten, ettei tietoja voida yhdistää yksittäiseen henkilöön.

TUKIMUSTULOKSET

Tutkimuksen tuloksena voidaan sanoa, että keskimääräinen suomalainen sijoittaja välttää riskiä, ja että sijoittajan riskinottohalukkuus ja sijoittajan ottama riski kulkevat käsi kädessä. Regressioanalyysissä havaitsin, että sijoituskokemuksella, miehillä ja velkaisuusasteella on positiivinen suhde riskinottohalukkuuteen, mikä tukee aiempien tutkimusten havaintoja. Lisäksi havaitsin, että iällä on negatiivinen ja ei-lineaarinen vaikutus riskinottohalukkuuteen. Yleisesti ottaen, mitä vanhempi sijoittaja on, sitä negatiivisemmin hän suhtautuu riskiin. Yllättäen ikääntyvien sijoittajien portfolioiden riskitaso seuraa sijoittajien riskinottohalukkuuden laskua viiveellä.

ASIASANAT

Riskipreferenssi, riskinottohalukkuus, ikä, sukupuoli, varallisuus, tulo, velka,

sijoittaminen

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1 Introduction

The aim of this study is to elaborate the risk taking of individual investors from two aspects: (1) How exogenous variables, such as age, gender and education affect investors' risk attitudes (determinants of risk); (2) How investors' risk attitude affects their investment allocation (risky decision making). Answers to both of these questions are of relevance in explaining investor behavior under risky choices. Risky decision making process plays a key role in economic research; investors' attitude towards risk and the investment decisions and patterns deriving from risk attitudes are of key importance in behavioral finance, not to mention the interests of financial institutions as the sellers of investment products. Therefore, understanding which attributes affect customer's perception of risk and risky decision behavior, may give practitioners valuable information about their customers' needs, which in turn should result in improved selling efforts, making this research of practical and academic interest.

In this thesis I use an extensive dataset of 85,063 private Finnish investors to assess the investors' risk attitude in comparison to the actual risk they are taking. My contribution to the existing literature is the large empirical dataset, which includes investors' demographic variables, risk attitudes and *actual investments*, which allow me to build my analysis on actual investment decisions made instead of hypothetical lottery situations. So far, only few existing studies are able to base their results on extensive empirical data (Dorn and Huberman, 2005; Glaser and Weber, 2007, Haarala, 2008). Furthermore, many preceding studies haven't been able to address all aforementioned aspects of risk within the same quantity and quality as my data allows. For instance in many studies, investor portfolio compositions have been determined by surveys, whereas my portfolio composition data is validated by bank officers, thus the investments allocations of individuals should be captured in more accurate manner.

Previous studies on *determinants of risk* include Halko and Kaustia (2009), who study individuals familiar with risky financial decisions, namely investors, investment advisors and students, and their willingness to take risks. Haarala (2008), who studies a subset of my dataset, covering the responses of 10,000 Finnish investors, from one month of data. Dohmen et al. (2005), who study sample of roughly 22,000 individuals living in Germany using a

question that asks about willingness to take risks on an 11-point scale (general risk question) and a more standard lottery question. Dohmen et al.'s sample is complemented with a field experiment, based on a representative sample of 450 subjects. Hallahan et al. (2004) study a sample of 20,000 Australians with a risk tolerance score (RTS) ranging from 0 to 100 and compare it to the self assessed risk tolerance (SRTS). Guiso and Paiella (2005), Guiso et al. (2002), Guiso and Paiella (2001) study risk preferences with an abstractly framed hypothetical lottery, using a sample of 8,135 Italian households from the Italian Survey of Household Income and Wealth (SHIW). Diaz-Serrano and O'Neill (2004) use the same sample but also add the next 5 waves from the survey, which includes roughly 3,000 additional individuals. Donkers et al.(2001) uses a sample of 4,000 individuals living in the Netherlands, one half of which is representative and the other half of which is drawn from the top 10 percent of the income distribution, and measures risk preferences with a series of abstract lotteries. Barsky et al. (1997) uses an especially large sample, 14,000 individuals living in the US, but this comes from the Health and Retirement Survey which is focused on individuals between 51 and 61 years of age. They measure risk preference using a hypothetical lottery involving different future income streams.

The relevant *risky decision making* studies include the founding work on *Prospect Theory* by (Kahneman and Tversky 1979) and the improved *Cumulative Prospect Theory* (Tversky and Kahneman 1992, Wu 1994), followed by the work of Thaler (1980) on *Mental Accounting* theory. Other relevant studies include the work of Shlomo and Thaler (1995) on Equity Premium Puzzle, explained by loss aversion and mental accounting in and Odean's work on disposition effect, with studies on investors' reluctance to realize their losses and on overconfidence with his studies on excess trading volumes (see Odean, 1996, 1999, 2001). Common factor to aforementioned risky decision making studies is that they are based on either mathematical proof, simulation or on small experimental setups conducted primarily with students, with the exception of Odean, who uses a larger dataset. My study adds to the existing literature of risky decision making by providing knowledge derived from actual investment decisions of Finnish investors and linking that onto investors' risk attitudes.

The existing studies on *determinants of risk* and *risky decision making* try to explain risk behavior by demographic variables, such as age, gender, education or salary, but find

contradictory results. So far a clear consensus on the effect of demographic variables on risk attitudes has not been reached. Additionally, significant proportions of the larger studies lacks the actual financial data of the respondent portfolio and are instead based on unverified survey data. The smaller studies, in turn, are able to capture more detailed variables, but their drawbacks are, obviously, the sample size and the setup; many small studies are experiments, which involve none or very little actual investment and, therefore, their results do not reflect the actual investment decisions as accurately as real investment data. My study tries to improve the results obtained from large dataset by using only verified data. The main drawback of my study is the non-longitudinal nature. For instance it can be argued that the concept of risk is understood differently among differently aged investors (cohort effect) adding bias to the results. However, the preceding studies among others, Grable and Joo (1997), Wand and Hanna (1997), and Grable & Lytton (1998) note that age has a positive or no effect on risk tolerance, so the results should not be affected by the age of the investors. Still, a longitudinal study on risk attitudes might be a feasible suggestion for the future.

My evidence is based on a dataset comprised of 85,063 Finnish individual investors. The dataset includes demographic variables, such as age, gender and education as well as and actual contents of investors portfolio's divided onto 21 asset categories, including debt, thus, making the dataset unique in size and detail of actual investment. For instance Haarala (2008) uses the same data source, covering 10,000 investors from January 2008. My dataset actually represents 1.7 percent of Finnish nationals[1] divided among age classes from 18 to 100 years, thus it can be seen as a representative sample of the population.

The remainder of this thesis is organized as follows. Section 2 presents the related studies among determinants of risk and risky decision making. Section 3 introduces the research hypotheses. Section 4 describes the methods and data used. Section 5 presents the empirical results of the analysis. Finally, section 6 concludes and gives suggestions for further research.

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[1] At the end of 2007, the population of Finland was 5 300 484 according to Statistics Finland. Source: http://www.stat.fi/til/vaerak/index_en.html

2 Related literature

2.1 Determinants of Risk

In this section I examine the typical variables, which are used in determining individual risk attitudes. Generally many of the existing studies of same magnitude within *determinants of risk* explain risk behavior by exogenic (demographic) variables, such as age, gender, education or salary. Although the research has been going on for decades, there is a clear lack of consensus among on the effect of different determinants on risk (Hallahan et al., 2004) and some scientist even argue that individual characteristics do not play a significant role in risk attitudes. For instance Nosic and Weber (2007) argue that demographic variables are merely proxies of risk determinants. Furthermore, Guiso and Paiella (2001) find that characteristics such as age, gender, education and date of birth have only limited explanatory power as determinants of risk aversion, since the majority of explanatory power is derived from massive unexplained heterogeneity. The contradictory results are particularly interesting, since demographic variables are easily observable and, thus, quite extensively studied. The following section presents the most commonly used determinants of risk and the relevant research.

2.1.1 Age

General assumption concerning age is that elderly people have a negative attitude on risk attitudes (Wallach and Kogan, 1961; McInish, 1982; Brown, 1990). The common explanation is that upon retirement, investors start gradually reducing the risk level of their portfolio, since the savings are soon to be spent onto maintaining current life standards as a pensioner. Maintaining a high level of risk, would put the savings at risk, especially among American residents, whose pension depends on personal savings.

Among Finnish investors, Haarala (2008) finds evidence among that increasing age implies increasing risk aversion. However, she notes that her sample is from a time-period, when elderly people typically renew their fixed term deposits and might be biased, although she excluded all investors over 60 years from the sample. Halko and Kaustia (2009) also note that among their Finnish sample, the general willingness to take risk is negatively correlated with age. Dohmen et al. (2005) find some proof among German respondents that willingness to

take risk is negatively related to age, supporting the general assumption. However, they note that although age decreases the probability that an individual is willing to take risks in all five domains, but has a particularly large impact in the domain of sports and leisure, and a relatively small impact in financial matters. Donkers et al. (2001) find supporting proof in their study, where they estimate risk aversion with on lotteries in a large Dutch household survey. Their finding is that older people have a more negative attitude towards risk.

However, the results are not that straightforward. Among others, Grable and Joo (1997), Wand and Hanna (1997), and Grable & Lytton (1998) note that age has a positive or no effect on risk tolerance. For instance, Barsky et al. (2001) find contradictory evidence on their study focused on individuals between 51 and 61 years of age. Barsky et al. (2001) note that most of their respondents are in their least risk-tolerant category, many are substantially more risk tolerant. This result is consistent with Riley and Chow (1992), who point out that risk aversion decreases with age, until a pivot point of 65 years is reached. After that point, risk aversion starts increasing. Their finding suggests that risk-aversion is a parabolic function, having a vertex around the point of retirement. Hallahan et al. (2004) find supporting evidence on nonlinearity; they note that relationship between risk and age is nonlinear by conducting regressions, where they include age squared as a one parameter in their equation. However, they are still able to conclude that risk tolerance decreases with age. Furthermore, they note that 60+ individuals are a very heterogenic group in their dataset, suggesting sample bias as one explanation of their result.

Therefore, researching age's effect on risk aversion requires a clear assumption of what is considered as old or elderly and a sample size large enough to avoid sample bias. An ideal research should capture, whether an individual is a pensioner or still employed, which can't be determined based on age, since under current Finnish regulation, a person can generally retire between 62 and 68 years of age and taking into account partial retirement and earlier regulation, Finnish citizens at their mid-50s can be pensioners.

2.1.2 Gender

Gender has affects to attitude towards risk through overconfidence; although men and women both exhibit overconfidence, men are generally more overconfident (Lundberg et al., 1994) and, therefore, take more risk in financial matters (Prince, 1993). Embrey and Fox (1998) found similar results in their study on gender difference in investment decisions. According to Embrey and Fox, 62 percent of the studied women were not willing to take any risk at all and only 36% percent were able to take some risk. The comparable figures for men were 34 percent and 60 percent of men, which indicates a clear difference between genders. However, these findings are subject to criticism, since the average age of females in the sample was 60 (men 46), and thus the results may be more driven by age than gender. Barber and Odean (2001) study the trading behavior of men and women and find that men trade too much, i.e. take too much risk. Byrnes et al. (1999) find similar results; men can take excessive risk in situations, where risk taking might not even be rational.

Also the findings of Donkers et al. (2001) support the assumption that women are more risk-averse. They notice that females tend to have negative attitudes towards risk when measured with standard lottery questions, which is in turn supported by Dohmen et al. (2005), who find that men are more willing to take risk than women in all studied five domains, when measured with a general risk question as well as with a standard lottery question. Hallahan et al. (2004) note that among a group of explanatory variables (age, gender, marital status, education, income, wealth), gender has the most predictory power on risk tolerance. In Finnish retrospective, Haarala's study (2008) finds also gender related evidence, indicating that men are clearly more eager to take risk than women, which is supported by Halko and Kaustia (2009) in the general willingness to take risks. However, in the financial domain, when measured with a hypothetical investment decision, the men and women invested on average roughly the same amount. Furthermore, Grable and Joo (1999) and Hanna et al. (1998) find that gender is not a significant factor in predicting financial risk tolerance.

2.1.3 Education

Education can be considered as an investment, where an individual spends current cash flows to studying in order to gain higher cash flows in the future due to improved education. Like

all other forms of investment, investing in education entails a risk – the investor may not pass the education, if he/she lacks the anticipated ability that the program requires, resulting in loss of investment. Additionally, investing onto education is a long-horizon process, since it the market value of the education upon graduation is uncertain at the time of enrollment. Thus, less risk-averse investors should strive for higher education than those having higher degree of risk aversion (Sung and Hanna, 1996). Brunello (2002) shows that the time (in years) spent in studying, is negatively dependent on absolute risk aversion. Therefore, the probability of choosing the safer occupation is an increasing and statistically significant function of the degree of risk aversion (Guiso and Paiella, 2005). However, Shaw (1996) derives a model that suggests an element of circularity in this argument, as the relative risk aversion of an individual is shown to determine the rate of human capital acquisition.

Despite the criticism, majority of studies do find a positive correlation between education and risk attitude, see for instance Donkers et al. (2001), Haarala (2008) and Riley & Chow (1992). Hallahan et al. (2004) do not observe a clear relationship between education and risk tolerance, but they do find that education is correlated with wealth, which is, in turn, correlated with risk tolerance. Guiso and Paiella (2005) also observe a negative relationship between risky asset ownership and low class jobs, which generally require less education. The study by Dohmen et al. (2005) also supports the role of education; they find that parental education has a positive a role in risk-taking behavior. The relationship between parental education and risk attitudes is less consistent across domains. They note that overall, having a parent who has completed the *Abitur* increases willingness to take risks. A more highly-educated mother is associated with a higher willingness to take risks in all domains, except for car driving and health. This holds similarly for subjects with more highly-educated fathers. Furthermore, Halko and Kaustia (2009) do not find a significant correlation between general risk attitude and education, in their study of Finnish investors, investment advisors and students.

2.1.4 Experience

According to Grable and Lytton (1999) an increased knowledge in personal finance is associated with above-average financial tolerance. These findings are supported by

researchers such as Grable and Joo (1997), Grable and Lytton (1998) and Sung and Hanna (1996), who have suggested that a person's knowledge of personal finance and economic expectations may play a role in shaping risk preferences. Haarala (2008) found similar evidence on her studies on Finnish investors; when she added investment experience as an explanatory variable in her regressions, it turned out to be the variable having most explanatory power. Thus, it is reasonable to assume, that the more experienced (inexperienced) investors are more (less) willing to take risks.

2.1.5 Income and Wealth

Income and wealth are two related factors that are hypothesized to have a positive relationship on the preferred level of risk (Friedman, 1974; Cohn et al., 1975). Traditional search model predicts that more risk-averse individuals have lower reservation for wages and thus, are likely to be employed in lower than average jobs, which should result in lower than average income and wealth. Riley and Chow (1992) research the effect of different demographic factors on risk attitudes, with a sample of 17,000 American households. They employ a Relative Risk Aversion Index (RRAI), which is measured as 1-(investment in risky assets/total wealth). Riley and Chow find that increase in income and wealth decreases the risk aversion of households. Haarala (2008) finds supporting evidence on her studies on Finnish investors, with RRAI-method. She notes that income and wealth have somewhat positive effect on risk attitudes. After examining the effect of debt, Haarala notes that increasing debt has a clear positive effect on risk attitude, which can't be explained by age. Halko and Kaustia (2009) note that monthly income of EUR 4000 or above has a significant positive effect on risk attitude among investors. However they did not reach this conclusion in their general population of investors, investment advisors and students. Shaw (1996) argues in her empirical results that risk aversion lowers wage growth, consistent with Friedman, Cohn et al. and Haarala. Furthermore, Donkers et al. (2001) find on their study based on questions on lotteries in a large household that income is positively related to an individual's attitude towards risk. Also Hallahan et al. (2004) note a clear positive association between income, wealth and risk tolerance.

Guiso and Paiella (2005) argue that the probability of choosing a safer occupation is an increasing and statistically significant function of the degree of risk aversion. They back up

their statement by estimates, which imply a negative coefficient for the degree of risk aversion: increasing absolute risk aversion by one standard deviation lowers the probability of being self-employed by 1.2 percentage points. Their study also concludes that the risk-averse indicator has a negative effect on the risky asset ownership decision, with a highly significant coefficient, i.e. risk averse investors invest onto less riskier assets, which should, in the long run, have a negative effect on their wealth, assuming

However the more risk averse, the more safer occupation hypothesis, isn't straightforward; Diaz-Serrano and O'Neill (2004) find evidence among Italian sample that the most risk-averse individuals are most likely to be unemployed, rather than being employed at low wage jobs.

Table 1 summarizes the relevant research on determinants of risk. According to previous studies, I assume that generally men are more willing to take risks than women, higher educated are more risk tolerant and that those belonging to higher income or wealth classes are less risk averse. However, the results on age's effect on risk tolerance are somewhat contradictory. I employ these same determinants in the empirical part of my study as explanatory variables of customers' risk profiles. I try to tackle the contradictory results concerning age, by adding a quadratic age term to my regression analysis, following Hallahan et al. (2004).

Table 1: Summary of relevant literature on determinants of risk, adapted from Grable and Lytton (1999)

Determinant	Result	Researcher(s)	Year
Age	Willingness to take Risk decreases with age		
		Wallach & Kogan	1962
		McInish	1982
		Brown	1990
		Bakshi & Chen	1994
		Sung & Hanna	1996
		Donkers et al.	2001
		Hallahan et al.	2004
		Dohmen et al.	2005
		Haarala	2008
		Halko & Kaustia	2009
	Willingness to take risk increases with age or age has no impact		
		Grable & Joo	1997
		Wang & Hanna	1997
		Grable & Lytton	1998
		Barsky et al.	2001
	Willingness to take risk increases with age until certain point and starts decreasing afterwards		
		Riley & Chow	1992
Gender	Men take more risks than women		
		Prince	1993
		Lunberg et al.	1994
		Embrey & Fox	1998
		Byrnes et al.	1999
		Barber & Odean	2001
		Donkers et al.	2001
		Hallahan et al.	2004
		Dohmen et al.	2005
		Haarala	2008
		Halko & Kaustia	2009
	Gender does not explain risk tolerance		
		Hanna et al.	1998
		Grable & Joo	1999
Education	Educated are willing to take more risks		
		Riley & Chow	1992
		Sung & Hanna	1996
		Donkers et al.	2001
		Brunello	2002
		Hallahan et al.	2004
		Guiso & Paiella	2005
		Dohmen et al.	2005
		Haarala	2008
	Education does not explain risk tolerance		
		Shaw	1996
		Halko & Kaustia	2009
Experience	More experienced are willing to take more risks	Sung & Hanna	1996
		Grable & Joo	1997
		Grable & Lytton	1998
		Grable & Lytton	1999
		Haarala	2008
Income and Wealth	Individuals with higher income and/or wealth are more tolerant to risk than those with low income and/or wealth		
		Friedman	1974
		Cohn et al.	1975
		Shaw	1996
		Donkers et al.	2001
		Hallahan et al.	2004
		Guiso & Paiella	2005
		Haarala	2008
		Halko & Kaustia	2009
	The most risk tolerant are unemployed		
		Diaz-Serrano & O'Neill	2004

2.2 Risky Decision Making

In this section I analyze the link between risk attitudes and risk taking, i.e. portfolio composition. Risk attitudes are argued to play a significant role in determining the actual risky behavior of customers. Finance literature assumes that risk attitudes can explain the ratio of risk free assets and market portfolio in an investor's portfolio (see Markowitz, 1952;

Lintner, 1965). According to expected utility theorem, risk attitudes should indicate risk taking behavior, irrespective to the way the risk is elicited (Nosic and Weber, 2007). Thus, one should be able to predict the investors' portfolio composition by using any method available to attain the risk attitude of an investor.

2.2.1 Risk attitudes

Typically the methods used to determine the risk attitude of an investor are a general risk question and a lottery question. The general risk question asks the respondent to grade his risk tolerance within a scale, e.g. a scale from 0 to 10, where 0 means 'not willing to take risks' and 10 'fully willing to take risks'. In the general lottery question, the respondent is faced with a set of risky propositions, and asked to respond, whether he would accept the proposition or not. For instance Dohmen et al. (2005) ask:

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

In comparison with the general risk question, the lottery question incorporates a more concrete investment decision. It also gives explicit stakes and probabilities, holding *perceptions* of risk constant across individuals. By contrast, the general risk question potentially incorporates both risk *preference* and risk *perception*, i.e., individuals are free to think about the expected utility when choosing a value, but also to incorporate subjective beliefs about the stakes and probabilities typically involved in general risk taking. Economists typically use a lottery measure of risk preference, framed as a financial decision, as an indicator of risk attitudes in all other contexts, e.g., health based on the assumption that a single, underlying risk preference governs risk taking in all domains of life (Dohmen et al., 2005).

However some researchers suggest that the stable utilities and expectations do not exist at all. For instance the empirical studies of MacCrimmon and Wehrung (1990) and Guth et al. (1997) show that different elicitation methods do not yield identical risk attitudes, contradictory to the utility theorem. This can be one reason, why empirical studies are unable

to verify the relationship between risk attitudes and risky behavior. Amongst others, Fellner and Maciejovsky (2007) report that the elicitation of the risk attitudes affects the explanatory power of the risk attitude measurement method. Kapteyn and Teppa (2002) and Klos and Weber (2003) provide evidence that intuitive subjective measures of risk seem to be better predictors of portfolio choice than lottery questions. Dohmen et al. (2005) report similar results. They compare how general risk measure and standard lottery question can explain portfolio choice, participation in sports, occupational choice, smoking, migration, subjective wellbeing, and traffic violations. Their findings are that the standard risk question is able to measure all these domains, whereas the predictory power of lottery questions is context specific. Thus, using lottery question as an overall determinant of risk preference is questionable.

2.2.2 Risky investment behavior

Risky investment behavior can be reduced to a two factors; firstly, how much *risk* the investor is willing to take, and, secondly, how much return the investor is pursuing. According to supporters of traditional view, investor can obtain an optimal risky portfolio by applying rational models, such as *Modern Portfolio Theory* (Markowitz, 1952). However, this view assumes that the market is rational in some degree. Rubinstein (2001) argues that the market is at least minimally rational: although prices are not set as if all investors are rational, there are still no abnormal profit opportunities for the investors that are rational.

In reality, this is not the case, and also the rationalists take note of this. For instance Rubinstein (2001) accepts the assumption that investors are overconfident, which leads to excess trading, active management, under-diversification, and the disposition effect (tendency to hold losers and sell winners). The reasoning behind the deviation from the rational hypothesis is that individuals do face situations, where their perception of the investment situation at hand is distorted due to behavioral biases. The *behavioral finance* studies have shown that investors i.e. tend to overweight small probabilities and underweight high probabilities, which leads onto irrational decisions (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Wu, 1994). Furthermore, the research has shown that individuals are risk aversive (Shlomo and Thaler, 1995) and want to avoid realizing losses by either holding the depreciated assets longer than would be rational (Odean, 1996) or by attributing the

depreciated assets onto different mental accounts than the appreciated assets (Thaler, 1980; Shlomo and Thaler, 1995). Interestingly, investors are actually confident that they can beat the markets although the bulk of studies suggest otherwise (Odean, 1999; Barber and Odean, 2001).

2.2.2.1 Finnish Evidence on Risky Investment Behavior

The concept of investing at a personal level is relatively young in Finland, since the market was heavily regulated until the end of 1980's, limiting the amount of market participants and products available. For instance mutual funds were not available to the public until 1987, when the law on mutual funds was passed; and the first bond funds were introduced as late as in 1990s. The results of very restricted investment environment in Finland can bee seen in the quantity of investment assets of Finnish households, which were Billion EUR 130 in 2007. Compared to neighboring countries, with more developed investment cultures, Finland is lacking clearly behind. For instance the amount of household investment assets in Sweden was estimated at Billion EUR 300 in 2007 and Billion EUR 250 in Norway, making the difference to Finland more than two-fold according to the Federation of Finnish Financial Services (2007).

The young investment culture has had implications on risky investment behavior as well, when observed from the personal wealth level. According to the Statistics Finland Household wealth and debt study (2007), two thirds of household assets in 2004 comprised of housing. Furthermore, household investment assets, which comprised 17 percent of the total wealth, were little diversified. The majority of household investment assets were invested onto deposits (44%) and stocks (20%), whereas mutual funds were allocated only 12 percent (Statistics Finland, 2007). Finnish households' assets and liabilities survey from 2008 find similar evidence. The survey shows that in 1992 81.70 percent of Finnish households' assets consisted of deposits and only 0.22 percent of assets were invested onto mutual funds. By 2008 the weight of deposits had decreased to 50.47 percent and mutual funds had, in the mean time, gained a share of 12.42 percent implying that strong overweight in deposits continues persist among Finnish households (Federation of Finnish Financial Services, 2008). Thus, the average portfolio composition of a Finnish household is imbalanced and very conservative. In

comparison, Siegel (2008) suggests that even the most conservative investors should invest 71 percent of wealth onto stocks, if their investment period is more than 30 years.

EUR billion
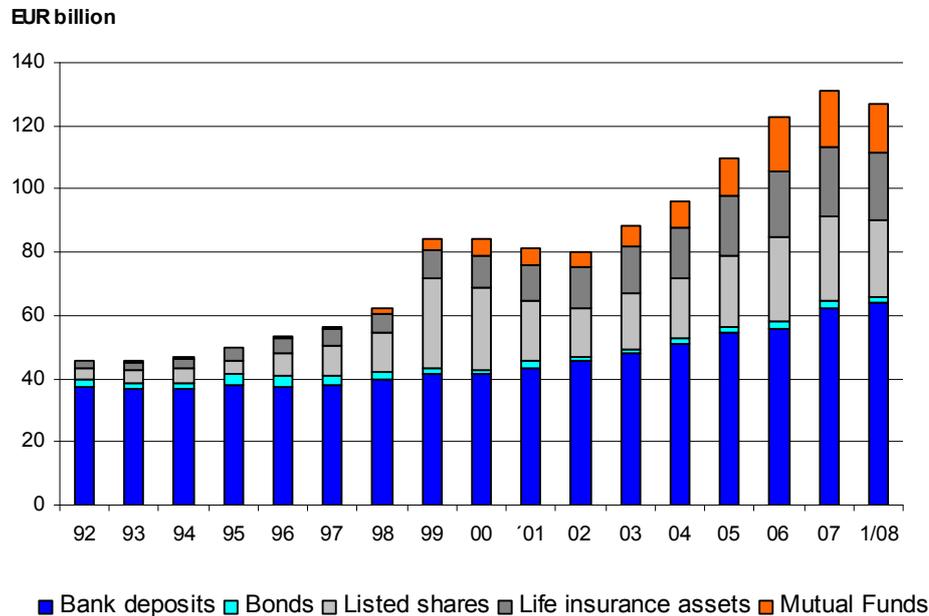
Figure 1: Finnish Households' Financial Assets 1992-2008 (Federation of Finnish Financial Services, 2008)

2.2.2.2 Finnish Studies on Risk Attitudes

The studies on risk attitudes of investors also reflect the relatively young investment culture in Finland. For instance, Järvinen and Saarikko (2000) study the attitudes of 224 private investors and find that on a 10 point scale the distribution of answers is more uniform, containing more respondents in the highest two risk categories, than in the lowest category. However, Järvinen and Saarikko (2000) conclude that on average the attitude towards risk is negative.

Haarala (2008) finds that the majorities of investors in her sample are very risk averse (25%) or risk averse (32%) and that only a small minority is very return oriented (3%) or return oriented (10%). She notes that on average the investors dislike risk, and tend to hold undiversified portfolios, where savings accounts play a key role. Haarala states that this behavior is likely due to the lack of awareness in the basic concepts of investments. For instance the correlation between risk and return is unclear, which leads onto risk avoidance,

which can be seen in the clearly negative attitude towards risk as well as in the overweight of low risk and low return investments made.

Furthermore, Halko and Kaustia (2009) find that in a population that is familiar with risky decisions the general willingness to take risk on a 0 to 10 point scale is on average 5.736 and in the domain of financial decisions 4.997 i.e. investors tend to have slightly positive attitude to take general risks, but are less willing to take financial risks. When the willingness to take risks is analyzed in the sub domain of wealthy investors, excluding students and investment advisors from the sample, the average willingness to take risks drops to 4.908 in the general risk question and to 3.955 in financial matters, which shows that investors are more risk averse than the rest of the sample. Halko and Kaustia (2009) assume that this result is due to the self selection bias in the financial industry. However, their result is consistent with the findings of Haarala (2008) and Järvinen and Saarikko (2000).

In reflection to international studies, private Finnish investors do not seem to act rationally. Statistical evidence (Statistics Finland, 2007; Federation of Finnish Financial Services, 2008; Haarala, 2008) suggests that their investment portfolios are imbalanced, compared to rational theories, such as introduced by Markowitz (1952) and on average, the investors avoid pursuing risk, although practitioners like Siegel (2008) advice that even the most risk averse should hold a significant equities in the long run. The low level of diversification is by no means a Finnish phenomenon as this kind of behavior has been observed in numerous international studies. For instance this conclusion was reached about American households by Bertaut and Haliassos (1992) in a study on the 1983, US Survey of Consumer Finances. In Scandinavia, Pålsson (1988) has reported that most Swedish households did not hold an optimal mix of assets (real saving and stocks) during the studied period, 1975-84, Gunnarsson (1997) reaches the same conclusion a decade later. However, the peculiarity among Finnish investors is the significant overweight in deposits (see Figure 1).

The prevailing studies also suggest private Finnish investors are by no means unaffected by behavioral biases. For instance the tendency of Finnish investors to avoid risks could be related to *Prospect Theories* (Kahneman and Tversky, 1979; Tversky and Kahneman 1992; Wu 1994), which assume that people tend to overreact to small probabilities and feel more uncomfortable, when faced with losses than gains, leading onto loss aversion. Furthermore,

Finnish investors might be faced with biased self-attribution; the relatively young investment culture and low level of experience in investments among the risk averse investors (Haarala, 2008) could be linked to *overconfidence* (Odean 1999; Barber and Odean, 2001). The risk averse investors might see themselves unskilled individuals, who should stick to traditional products such as deposits, because they are not confident enough to pursue higher returns with more complicated products.

3 Hypotheses

The aim of this study is to study how demographic variables, such as age, gender and education affect private Finnish investors' risk attitudes, and how investors' risk attitude affects their investment allocation.

Previous studies have shown that age is correlated with decreasing risk tolerance (Wallach & Kogan, 1962; McInish, 1982; Brown, 1990; Bakshi & Chen, 1994; Sung & Hanna, 1996, Donkers et al., 2001; Hallahan et al., 2004; Dohmen et al. 2005; Haarala, 2008; Halko & Kaustia, 2009). Although the results are contradictory (see Riley & Chow, 1992; Grable & Joo, 1997; Wang & Hanna, 1997; Grable & Lytton, 1998; Barsky et al., 2001), my first hypothesis is that:

Hypothesis 1: Risk tolerance decreases with age

The scientific community is more unanimous with the effect of gender (Prince, 1993; Lundberg et al. 1994; Embrey & Fox, 1998; Byrnes et al., 1999; Barber & Odean, 2001; Donkers et al., 2001; Hallahan et al. 2004, Dohmen et al., 2005; Haarala, 2008; Halko & Kaustia, 2009), education (Riley & Chow, 1992; Sung & Hanna, 1996; Donkers et al., 2001, Brunello, 2002; Hallahan et al., 2004; Guiso & Paiella, 2005; Dohmen et al., 2005; Haarala, 2008; Halko & Kaustia, 2009) experience (Sung and Hanna, 1996; Grable and Joo, 1997; Grable and Lytton, 1998, Grable and Lytton 1999; Haarala, 2008) and income/wealth (Friedman, 1974; Cohn et al., 1975; Shaw, 1996; Donkers et al., 2001; Hallahan et al., 2004; Guiso & Paiella, 2005; Haarala, 2008; Halko & Kaustia, 2009), which allows me to construct the following hypotheses:

Hypothesis 2: Men are more risk tolerant than women

Hypothesis 3: Higher educated are more risk tolerant than less educated

Hypothesis 4: More experienced are more risk tolerant than less experienced

Hypothesis 5: Higher income implies increased risk tolerance

Hypothesis 6: Higher wealth implies increased risk tolerance

The majority of aforementioned studies do not separate the effect of debt on risk tolerance. Debt can bee seen as negative saving and is, therefore, an essential part of investor's total wealth. Haarala (2008) analyzed, whether the investors see debt in similar fashion. She notes that debt has a clear positive effect on risk attitude. Since her dataset is a subset of my data, I test, whether her results hold for a larger set of respondents.

Hypothesis 7: Risk tolerance increases with debt

The next hypothesis is constructed based on the study of Nosic and Weber (2007), who find that risk taking behavior can be predicted by individual risk attitudes, if the risk attitude is elicited within the same domain as the behavior. Since my study elicits the risk attitudes in the domain of investments, I should be able to observe similar patterns. For instance those willing take a lot of risk, should be more likely to hold equities than those that are less willing.

Hypothesis 8: Risk taking behavior can be predicted by individual risk attitudes

These hypotheses are studied in respect to the risk attitudes and portfolio composition of OP-Pohjola Group's customers, who have filed an investor profile and investment plan during 2007 or 2007. The data is described in more detail in Section 4 and the hypotheses are analyzed in Section 5.

4 Data and Methods

4.1 Data

The researched data was obtained from OP-Pohjola Group's Investment Advice Tool (IAT), which is a questionnaire aimed at determining customer's attitude towards risk and using that knowledge to advice customers in their savings and investment needs accordingly. The tool was introduced in March 2007 and by December 2008 over 200,000 customers had completed the risk profiling. The IAT can be accessed through three channels; branch office, online bank and telephone bank. The vast majority of questionnaires are filed at branch offices, for instance Haarala's (2008) study shows that 99.2 percent of questionnaires made in January 2008 were made at branches.

In my study I limit the data to questionnaires filed at branches, where the customer has answered to *risk profile survey* and has completed an *investment plan* thereafter. The reasons for these limitations are following; firstly, I need to obtain information about the customers' risk attitudes as well as asset allocation, this information is available only for customers having completed risk profile and investment plan, secondly, need to make sure that the respondents have understood the questions as unanimously as possible; therefore I use only responses from the branch offices, where the information is collected in a standardized fashion by investment advisors. The standardized fashion is a by-product of Markets in Financial Instruments Directive (MiFID) by the European Parliament (2004), which requires financial institutions to collect 'information as is necessary for the firm to understand the essential facts about the customer (§19:1)' and to elicit 'the customers' preferences regarding risk taking, his risk profile and the purpose of the investment (§19:4).'

In the risk profile survey the investors' attitude towards risk is determined by following two questions:

> I. How would you describe yourself as a saver and an investor?
> 1. I aim for the best possible return in the long run and I am ready to take a lot of risks (*very return oriented*).
> 2. I aim for good long term returns and I am ready to take risks (*return oriented*)
> 3. I aim for good value growth and I am ready to take some risks (*moderately oriented*).
> 4. I aim for steady value growth and I am ready to take little risks (*risk averse*).
> 5. I aim for small value growth and I want the invested capital to be safe (*very risk averse*).

II. How do you react to fluctuations in value of your savings or investments?
1. I understand that volatility is a part of investment and, therefore, I accept even large fluctuations in the investment value (*very return oriented*).
2. I understand that volatility is a part of investment and, therefore, I accept that the value of my investments can fluctuate quite a lot during investment period (*return oriented*).
3. I understand that volatility is a part of investment and, therefore, I accept that the value of my investments can temporarily decrease to some extent (*moderately oriented*).
4. I dislike volatility, but I accept that the value of my investments can temporarily decrease a little (*risk averse*).
5. I do not accept fluctuations of my investments under any circumstances (*very risk averse*).

The first addresses customers' attitude towards risk and return targets of their investments (Optimism) and the latter addresses customers' attitude towards volatility of their investments (Confidence). Both questions are graded on a five point scale (5: very return oriented; 1: very risk averse) and the customers risk profile is determined as the less risky answer of the two.

The answers are controlled in such a way that they can not differ by more than a one point; i.e. if the customer selects option 5 to the first question, acceptable answer to the second question is option 4 or 5. If the customer answers otherwise, the IAT prompts an error message and asks the customer to revise his answers. Once the customer has answered to both questions, he is categorized to one of the following five risk profiles:

- Risk Profile 1 – Very risk averse
- Risk Profile 2 – Risk averse
- Risk Profile 3 – Moderate
- Risk Profile 4 – Return oriented
- Risk Profile 5 – Very return oriented

Having completed the IAT risk profile, the customer can proceed to create different plans, namely 'Savings plan', 'Pension Plan', 'Savings during Loan Amortization Plan' and 'Investment Plan'.

In my study, I concentrate on customers, who have completed Risk Profile and Investment Plan at the branch office during the period ranging from beginning of March 2007 to the end of December 2008. In order to align my data with previous studies, I discard plans made by minors (under 18) and corporations. With these restrictions, my dataset comprises of 85,063 investors.

Additionally, I enrich the data with age, gender, income and debt parameters, in order to be able to study the determinants of risk. These parameters are obtained from other OP-Pohjola Group's databases. I use 12 month average turnover as a proxy for income and 12 month average debt as a proxy for debt. Here turnover is defined as the amount of transactions incoming to customer's accounts at OP-Pohjola Group less the amount of transactions customer has made between internal accounts. In a typical situation, the vast majority of investors incoming transactions are salary, pension and government subsidies, thus the turnover is a reasonable proxy for investor's income. Similarly, the average 12 month debt is defined as the average amount of debt outstanding during the last 12 months. Since my study spans two years, I take the average turnover and average debt for plans made in 2007 from the year's end data in 2007 and repeat the process for plans made in 2008.

Finally the dataset was masked in such a way that no part of the data can be linked to an individual customer.

4.2 Differences to Previous Studies on Risk Attitudes

This setup differs from the previous risk attitude studies in three ways. Firstly, the majority of risk attitude studies use a lottery question in order to define customers' risk attitude (Barsky et al., 1997; Donkers, 2001; Guiso and Paiella, 2001; Guiso et al. 2002; Diaz-Serrano et al., 2004; Guiso and Paiella, 2005; Dohmen, 2005; Nosic and Weber, 2007). The IAT's setup is closer to a general risk question employed by Dohmen et al. (2005), who discover that the general risk measure is a good predictor of actual risk-taking behavior, predicting all observed behaviors whereas the standard lottery measure does not. Nosic and Weber (2007) also note that the risk attitude and risk perception elicited in an artificial lottery context are not related to portfolio choices, thus the lack of lottery question shouldn't affect the setup of my study, where the context is risk attitude and portfolio choice.

Secondly, the risk attitude and investment decisions are evaluated in a different way; the majority of studies first evaluate the risk attitude and investment decision simultaneously due to the lottery question setup (both are determined by the answer to the lottery question), whereas the IAT evaluates only the risk attitude, the investment decisions have already been

made before the IAT evaluation, thus the IAT enables me to measure the risk attitude in hindsight related to investment decision. And thirdly, previous studies accept contradictory answers to risk questions, whereas IAT accepts only answers, which follow the logic explained in previous chapter.

4.3 Methods

In this study, I analyze the hypothesis concerning determinants of risk with ordered logistic regression models. Risky decision making is also analyzed with ordered regression models and with Risky share (RS) method, which measures, how much the investor has allocated onto risky assets. The method is derived from Relative Risk Aversion Index (Riley and Chow, 1992). The results of ordered logistic regressions are checked with Ordinary Least Squares regressions (OLS).

4.3.1 Determinants of Risk

The variables affecting risk attitudes are first analyzed with Pearson's correlation coefficient in order to determine, how independent they are from each other. Thereafter, variables' effect on risk profiles is analyzed with ordered logistic regression model for each of the five investor profile types. Ordered logistic method is chosen, because the dependent variable (risk profile) can take five different values, which can be sorted in order (*N.B.* logistic regression method allows only two response categories). Ordered logistic regression makes no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance within each group. The relationship between the predictor and response variables is not a linear function in ordered logistic regression; instead, the ordered logistic regression function is used. Ordered logistic regression model makes the *proportional odds assumption*: the likelihood of an observation for being in a chosen risk profile category than being in a lower category is the same regardless of the chosen category (UCLA, 2009). Ordered logistic regression has the form reported in Equation 1.

$$\log it(p_1) \equiv \log \frac{p_1}{1 - p_1} = \alpha_1 + \beta' x$$

$$\log it(p_1 + p_2) \equiv \log \frac{p_1 + p_2}{1 - p_1 - p_2} = \alpha_2 + \beta' x$$

... *(1)*

$$\log it(p_1 + p_2 + ... + p_n) \equiv \log \frac{p_1 + p_2 + ... + p_n}{1 - p_1 - p_2 - ... - p_n} = \alpha_n + \beta' x$$

$$p_1 + p_2 + ... + p_n = 1$$

In the regression models, I use risk profile as the dependent variable and the following independent variables:

- Turnover 12m is a proxy of investor's income measured in EUR

- Total investment wealth is the sum of investor's short term, long term and equity investments measured in EUR

- Net investment wealth is the total investment wealth minus investor average outstanding debt measured in EUR

- Age is investor's age in years

- Age^2 is quadratic age term

- Gender is a dummy variable, which takes the value of one, if the investor is male

- Education captures the education level of the investor (0: N/A, 1: Elementary, 2: Vocational, 3: High School, 4: Polytechnic, 5: University)

- Experience captures the investors knowledge about the investment markets (0: N/A, 1: No experience, 2: Some experience, 3: Experienced)

- Short term bond investments describes the investor's allocation onto short term debt instruments measured in EUR

- Long term bond investments describes the investor's allocation onto long term debt instruments measured in EUR

- Risky share measures the weight of investors equity allocation in relation to total investment wealth measured in percentage

- LN(Turnover 12m) is a control measure for the distribution of turnover

- LN(Total investment wealth) is a control measure for the distribution of investment wealth

In order to check the robustness of the results, I run regressions, where the Euro denominated variables are sorted onto deciles in order to eliminate the effect of outliers. Additionally, I run Ordinary Least Square regressions and sub-dataset analysis as robustness checks on my models.

In practice the ordered logistic regression procedure means that each of the five risk profiles is explained in relation to other risk profiles. The aim is to determine, how each of the risk profiles are formed in relation to variables affecting risk attitudes and to research, which factors are the most significant when determining, whether an individual is likely to belong to a lower or higher risk profile category. The relevance of the regression is controlled with the Wald Chi-Square test statistic, which is the squared ratio of the Estimate to the Standard Error of the respective predictor. Wald Chi-Square is test statistics for the hypothesis that an individual predictor's regression coefficient is zero given the rest of the predictors are in the model.

4.3.2 Risky Decision Making

Risky decision making is measured with multiple methods. First, I calculate the risky share (RS), which is adapted from the Relative Risk Aversion Index (RRAI) introduced by Riley and Chow (1992). The RS statistic is calculated for each of the investor profiles categorized by age, gender, education, experience, income, total investment wealth and debt. The RS is derived from the coefficient of Arrow-Pratt relative risk aversion, which is the ratio of risky assets to wealth. Originally Riley and Chow derived RRAI following Friend and Blume (1975). Following their idea, I define the risky share as:

$$Risky\_share = \frac{Risky\_Assets}{Total\_Investment\_Wealth} \quad (2)$$

In this study, the risky assets are defined as equity holdings (including equity funds) and the total investment wealth as the sum of short and long term bond holdings added with equity holdings as reported by customers in their investment plans. As the share of equity increases the RS increases, thus high RS indicates a low level of risk aversion and vice versa. Once the RS is calculated, I compare it to the risk profiles of the customers. These two measures of risk

attitude should be correlated, as my hypotheses assume, i.e. a person having a low (high) degree of risk aversion, should have a positive (negative) attitude towards risk.

As a second measure I calculate ordered logistic regressions for each of the risk profiles, where I use variables which are supposedly linked to risk preferences, such as short term bond investments, long term bond investments, equity investments and risky share. The aim of these variables is to find out, how significant the actual asset allocation of the investor is in explaining the risk profile in contrast to the traditional demographic variables. According to my initial hypotheses, the investors having a high allocation in equities should be more willing to take risk, i.e. the ordered logistic regression should result in displaying equity holdings and risky share as key factors in explaining risk tolerance.

5 Analysis

In this part of my study, I employ descriptive and quantitative methods on the data in order to elaborate the properties of the data, and to find out, whether statistical dependencies, which support my hypotheses, exist. The following paragraphs describe the data in general, which is followed by variable specific analysis, where I continue to the results of the ordered logistic regressions. All relevant calculations were done with SAS 9.1 and the scripts can be obtained from the author, if required.

5.1 Descriptive Statistics

For the purposes of analysis, I took into account various demographic and financial variables of the data, whose general characteristics are reported in Tables 2 and 3. The initial customer data analysis indicates that the average respondent is 55 (median 58) of age, earns EUR 48,459 (median EUR 25,940). During his lifetime, the average customer has accumulated total wealth of EUR 206,986 (median EUR 91, 600) and has EUR 11,755 (median EUR 0) in debt. The majority of respondents assets are invested short term bond investments (on average EUR 68 589, 33 percent of total wealth) and onto housing (on average EUR 59 125, 29 percent of total wealth).

Compared to the Statistics Finland survey (2007), the average customer in my dataset is 40 percent wealthier, has 40 percent less debt, has less capital tied on housing (33 percent versus 57 percent) and has considerably greater investment wealth (EUR 101 941 versus EUR 25 580).

The differences to the Statistic Finland survey indicate that my dataset includes wealthier individuals than the average Finnish citizen. This result is likely due to the nature of my data, which is gathered from individuals, who have excess funds and are interested on investing them, whereas the Statistics Finland survey has been conducted on a general population, majority of which isn't interested on investing. It seems plausible to assume that less wealthy individuals would be as eager to file investment plans at branches as the wealthier ones.

According to Table 2, there seems to be a connection between risk level and variables age, gender, turnover, debt, equity investments and total wealth. For all of these variables there is an observable ascending or descending pattern, which holds for all risk categories. The individuals belonging to higher risk categories compared to the lower ones are more likely to be male, younger, have a higher turnover, have more debt, and have more equity investments and more total wealth. This relationship holds for all risk categories, when the average variable in profile *n* is compared to the variable in *n-1*. Furthermore, these findings are consistent with my hypotheses on determinants of risk.

Table 2: Demographic statistics of the sample.

This table reports the demographic characteristics of the whole sample, and for each of the risk categories. Risk profile 1 corresponds to the most risk averse investors and Risk profile 5 to the most risk tolerant. Variable age is measured in years, variable genders depicts the percentage of males in the sample, variable education is measured on a 0-5 scale (0=n/a, 1=elementary school, 2=vocational school, 3=upper secondary school, 4=polytechnic and 5=university level), experience is reported on a 1-3 scale (0=n/a, 1=no investment experience, 2=some investment experience, 3=experienced), the rest of the variables are reported in EUR.

Risk profile all (*n* 85 063)

Variable	Mean	Std Dev	Median
Age	55.43	16.20	58.00
Gender: male	0.51	0.50	1.00
Education	2.30	1.63	3.00
Experience	1.67	0.70	2.00
Turnover 12m	48 459	149 748	25 940
Debt 12m	11 755	37 789	0
Short term bond investments	68 589	601 464	25 000
Long term bond investments	13 014	103 504	0
Equity investments	20 338	305 189	0
Total investment wealth	101 942	705 122	37 000
Total wealth	206 986	820 558	91 600

Risk profile 1 (*n* 23 507)

Variable	Mean	Std Dev	Median
Age	62.24	15.15	64.00
Gender: male	0.41	0.49	0.00
Education	2.01	1.44	1.00
Experience	1.51	0.59	1.00
Turnover 12m	34 796	73 966	20 490
Debt 12m	3 860	18 594	0
Short term bond investments	82 030	860 760	31 900
Long term bond investments	9 224	102 827	0
Equity investments	2 935	32 544	0
Total investment wealth	94 189	870 019	38 750
Total wealth	179 694	974 992	86 424

Risk profile 2 (*n* 28 890)

Variable	Mean	Std Dev	Median
Age	55.41	15.82	58.00
Gender: male	0.47	0.50	0.00
Education	2.32	1.63	3.00
Experience	1.64	0.64	2.00
Turnover 12m	45 112	125 760	25 772
Debt 12m	8 981	30 436	0
Short term bond investments	64 049	487 354	25 351
Long term bond investments	14 118	75 839	0
Equity investments	12 793	145 057	0
Total investment wealth	90 960	531 320	37 200
Total wealth	194 022	659 630	92 222

Risk profile 3 (*n* 24 663)

Variable	Mean	Std Dev	Median
Age	51.56	15.47	53.00
Gender: male	0.59	0.49	1.00
Education	2.46	1.71	3.00
Experience	1.76	0.75	2.00
Turnover 12m	57 472	194 975	29 677
Debt 12m	16 235	44 508	0
Short term bond investments	65 595	469 623	20 000
Long term bond investments	15 867	100 558	0
Equity investments	31 338	260 966	2 500
Total investment wealth	112 799	606 074	36 223
Total wealth	226 740	702 499	95 404

Risk profile 4 (*n* 6 410)

Variable	Mean	Std Dev	Median
Age	47.50	15.13	48.00
Gender: male	0.71	0.45	1.00
Education	2.64	1.74	3.00
Experience	1.88	0.88	2.00
Turnover 12m	69 193	176 614	34 339
Debt 12m	30 249	63 681	2
Short term bond investments	53 273	290 712	13 000
Long term bond investments	12 622	195 446	0
Equity investments	59 017	534 982	5 300
Total investment wealth	124 912	665 976	32 150
Total wealth	271 331	872 296	103 876

Risk profile 5 (*n* 1 595)

Variable	Mean	Std Dev	Median
Age	47.32	15.26	48.00
Gender: male	0.74	0.44	1.00
Education	2.44	1.73	3.00
Experience	2.03	0.85	2.00
Turnover 12m	87 726	329 097	34 239
Debt 12m	34 758	63 977	483
Short term bond investments	60 610	564 614	10 000
Long term bond investments	6 357	33 142	0
Equity investments	87 953	1 533 302	4 000
Total investment wealth	154 920	1 666 822	25 000
Total wealth	279 989	1 814 073	85 300
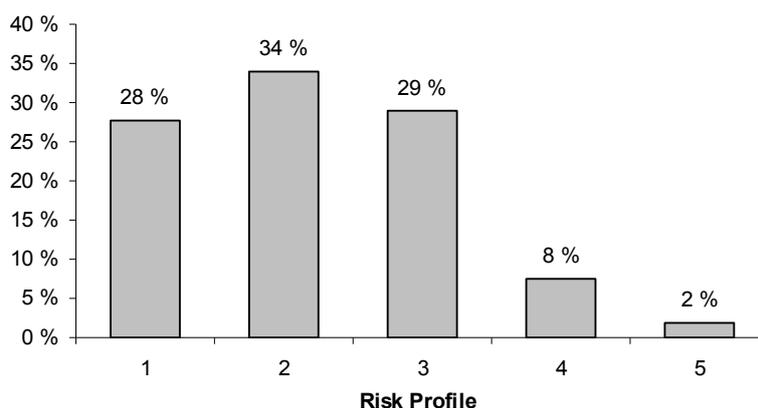
Figure 2: Distribution of Risk Profiles, *n* 85,063

Although the investors in the sample seem to be wealthier than the average, they also are quite reluctant to take risks. Figure 2 reports that 62 percent of the sample is very risk averse or risk averse, whereas only 10 percent is very return oriented or return oriented. On average the investors are in clearly in favor of avoiding risks, having and average risk profile of 2.22. These findings are consistent with Haarala's (2008) sample of 10,766 investors, where 57 percent were very risk averse or risk averse and 13 percent were very return oriented or return oriented. However, in comparison to Järvinen and Saarikko (2000) the results differ significantly. Järvinen and Saarikko found a more uniform distribution (47 percent of the sample was very risk averse or risk averse and 27 percent were very return orientated or return orientated). These differences might be attributed to small sample size of 224 respondents, and to selection bias as results were gathered in April 2000, at the peak of the IT-bubble.

Halko and Kaustia (2009) find in their sample of 337 respondents similar results to Järvinen and Saarikko, when the results are observed from the general risk question view point. Halko and Kaustia use a general risk question scaled from 0 to 10, and find that only fewer than 2 percent chose the lowest rankings (0 and 1) with an average willingness to take risks at 5.736. The above average tendency is likely related to their sample, where investment advisors and students were more willing to take risks as those categorized as investors. Interestingly, though, Halko and Kaustia employ a general risk question in the financial domain as well, which yields an average willingness to take risks of 4.997 in the full sample and 4.625 in the sub-domain of investors, i.e. the willingness to take risks is lower in the financial domain.

Furthermore, in comparison to Dohmen et al. (2005), the risk attitude distribution in my sample is clearly more risk averse. Dohmen et al. (2005) found that the majority of sample was generally willing to take some risk (mean 4.42 on a 0-10 scale), but in the financial domain, the willingness to take risk decreased considerably to 2.406, consistent with my results. The notable difference to Dohmen et al. (2005) is that in their sample, the risk attitude answers are distributed more evenly around the mean, whereas my risk attitudes responses are skewed to the left.
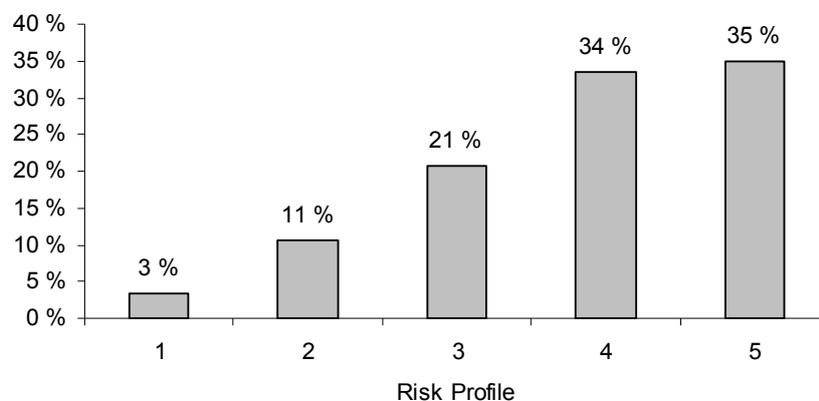
Figure 3: Average Risky Share in Risk Profiles, *n* 85,063

When the risk profiles distributions are analyzed in relation to the actual risk that the investors are taking (Figure 3), I find that the more positive attitude the investor on risk, the more funds he has actually allocated on average onto risky assets. Very risk averse have on average 3 percentage invested onto Equities, whereas the most return oriented have invested 35 percent. In comparison to the allocation suggestions of Siegel (2008), all risk profiles have Peculiar observation is that in the return oriented and very return oriented risk profiles (4 and 5) the propensity to invest onto risky assets is practically the same as the average (and median) amount invested differs only by one percent. These findings are consistent with the results of Haarala (2008).

5.1.1 Correlations Between Variables

Table 3 describes the correlations between the observed variables. The most significant observations that differ from zero include; age and debt, which are significantly negatively correlated; age and education, which in turn are significantly negatively correlated, i.e. the

elderly are less educated; age and experience, which are significantly correlated. Furthermore, turnover significantly positively correlated with debt and wealth, i.e. those who earn more, take leverage and accumulate more wealth. Additionally having debt and being male are positively correlated, i.e. men seem to take more debt.

The highest observed correlations are between wealth and asset classes. For instance total investment wealth and investment wealth have correlation of 0.892. This observation is due to the interlinking nature of wealth and asset classes as wealth is a linear combination of different assets.

Correlation analysis suggests that the majority of determinants of risk are not strongly associated with each others, thus they can be employed in regression analysis as explanatory variables. However, due to the strong association of total wealth and total investment wealth, I discard the total wealth in the further analysis and use only total investment wealth as a proxy for investors' wealth.

Table 3: Correlations between variables.

This table reports the Spearman's correlation coefficients between determinants of risk and asset classes, as well as their significances. The reader should note that although the majority of correlations are statistically significant at 0.01 percent level due to the large sample size. Correlations above 0.1 are highlighted in the table.

	Age		Gender: male		Education		Experience		Turnover 12m		Debt 12m		Short term bond investments		Long term bond investments		Equity investments		Total investment wealth		Total wealth	
Age			-0.055	<.0001	**-0.195**	<.0001	**0.152**	<.0001	-0.018	<.0001	**-0.237**	<.0001	0.035	<.0001	0.056	<.0001	0.021	<.0001	0.047	<.0001	0.063	<.0001
Gender: male	-0.055	<.0001			-0.004	0.2515	0.065	<.0001	0.081	<.0001	**0.115**	<.0001	0.027	<.0001	0.011	0.0017	0.030	<.0001	0.038	<.0001	0.057	<.0001
Education	**-0.195**	<.0001	-0.004	0.2515			0.020	<.0001	0.050	<.0001	0.088	<.0001	-0.005	0.1462	0.009	0.0128	0.024	<.0001	0.007	0.035	0.061	<.0001
Experience	**0.152**	<.0001	0.065	<.0001	0.020	<.0001			-0.016	<.0001	-0.006	0.0610	-0.001	0.7584	-0.002	0.5480	-0.009	0.006	-0.005	0.1241	-0.008	0.0220
Turnover 12m	-0.018	<.0001	0.081	<.0001	0.050	<.0001	-0.016	<.0001			**0.171**	<.0001	0.078	<.0001	0.054	<.0001	0.042	<.0001	0.092	<.0001	**0.119**	<.0001
Debt 12m	**-0.237**	<.0001	**0.115**	<.0001	0.088	<.0001	-0.006	0.0610	**0.171**	<.0001			-0.010	0.002	0.009	0.0090	0.010	0.0027	-0.003	0.3529	0.038	<.0001
Short term bond investments	0.035	<.0001	0.027	<.0001	-0.005	0.1462	-0.001	0.7584	0.078	<.0001	-0.010	0.0022			0.056	<.0001	0.051	<.0001	**0.883**	<.0001	**0.783**	<.0001
Long term bond investments	0.056	<.0001	0.011	0.0017	0.009	0.0128	-0.002	0.5480	0.054	<.0001	0.009	0.0090	0.056	<.0001			0.092	<.0001	**0.234**	<.0001	**0.224**	<.0001
Equity investments	0.021	<.0001	0.030	<.0001	0.024	<.0001	-0.009	0.0061	0.042	<.0001	0.010	0.0027	0.051	<.0001	0.092	<.0001			**0.490**	<.0001	**0.442**	<.0001
Total investment wealth	0.047	<.0001	0.038	<.0001	0.007	0.0345	-0.005	0.1241	0.092	<.0001	-0.003	0.3529	**0.883**	<.0001	**0.234**	<.0001	**0.490**	<.0001			**0.892**	<.0001
Total wealth	0.063	<.0001	0.057	<.0001	0.061	<.0001	-0.008	0.0220	**0.119**	<.0001	0.038	<.0001	**0.783**	<.0001	**0.224**	<.0001	**0.442**	<.0001	**0.892**	<.0001		

5.2 Determinants of Risk

In this section I analyze, how different determinants of risk affect on risk attitude (risk profiles) and on risky investment decision as individual factors. First I show, how the respondents are divided among different risk profiles parameter wise and secondly, how the parameter has affected actual investment decisions. This section is followed by ordered logistic regression analysis, which analyzes the importance of different attributes onto risk profiles.

5.2.1 Age

Figure 4 reports, how respondents are distributed in terms of age. On average the investors are 55 years old (median 58 years) and seem to be divided in a bell shaped curve, which resembles the age pyramid in Finland. However, when the distributions are observed profile by profile, the results indicate clearly that the most risk averse investors are concentrated in the older age categories, for instance, the median age in risk profile one is 64 years, whereas in the lest risk averse profiles four and five, the median age is 48 years.
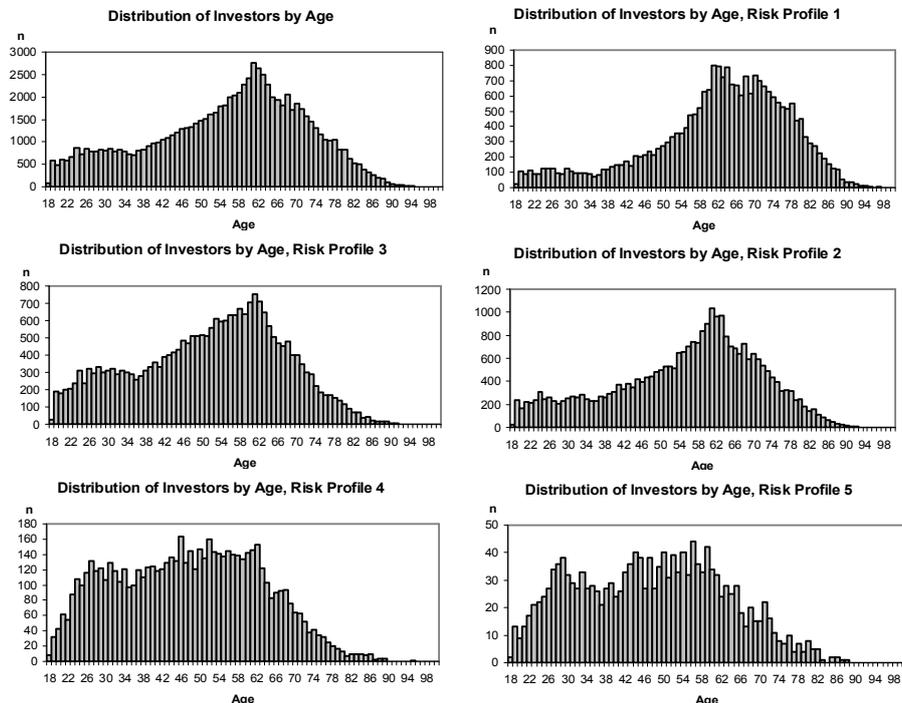
Figure 4: Risk profiles based on age, distributions

Figure 5 illustrates how the risk profiles are divided between ages 18 to 100. The main implication of Figure 5 is that it shows, how risk averse profiles one and two dominate among

investors aged 55 or above. The distributions are in line with the hypothesis of negative attitude towards risk with age and support the results of Wallach & Kogan, 1962; McInish, 1982; Brown, 1990; Bakshi & Chen, 1994; Sung & Hanna, 1996, Donkers et al., 2001; Hallahan et al., 2004; Dohmenet al. 2005; Haarala, 2008; Halko & Kaustia, 2009).

However, when I examine the actual risk taken by the investors, I find some evidence that risk-aversion is a parabolic function as suggested by Riley and Chow (1992) i.e. the willingness to take risk increases to a certain point and then starts decreasing (Figure 6). The aftermath of Figures 5 and 6 is that the negative attitude towards risk starts increasing after 55 years of age, but the actual risk taken by investors, measured with risky share, starts declining at the age of 69, over a decade later. This implies that although the investors start having reservations towards taking risk, they start adjusting their portfolio onto less risky position slower than one might assume. This finding is consistent with Dorn and Huberman (2005) and Glaser and Weber (2007), who conclude that overconfidence found in a questionnaire is not related to actual portfolio choice. For Finnish investors this seems to be the case. The difference between risk attitudes and actual investments might be attributed to mental accounting (Thaler, 1980), i.e. once the investors start adjusting their attitude towards risk they evaluate the risk of past investments in a different scale than coming ones.

Another factor, which might be related with slow adjustment to actual risk taken versus the change in risk attitudes, is that of Halko and Kaustia (2009); they noticed that investment advisors we're on average keener to take risks than investors. If one assumes that investors rely at least partly to the advice provided by investment advisors, they might be prone to take larger risks than they would have on their own. Also taxation might play a role in the slow adjustment, since deferring capital gains can incur decreased tax payments in some occasions.
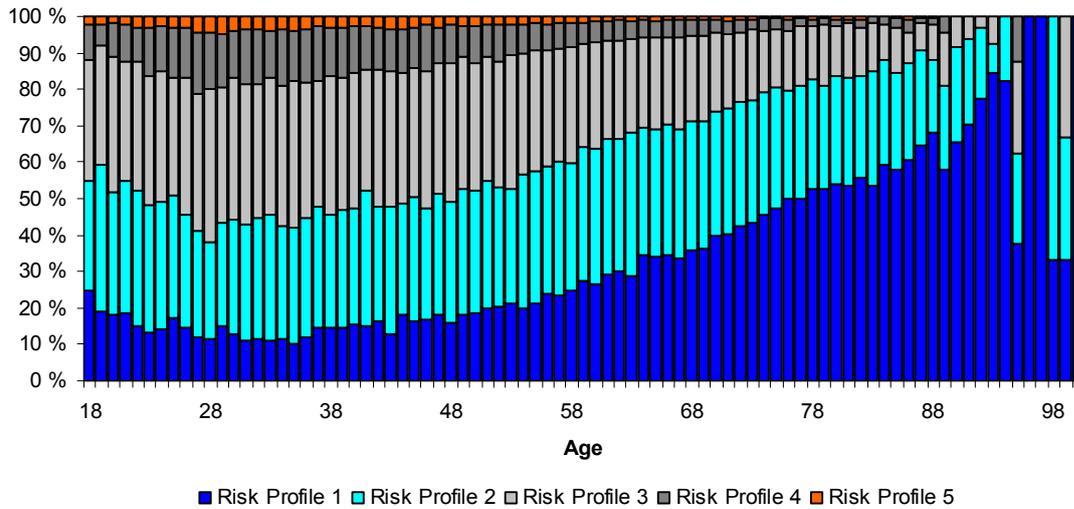
Figure 5: Risk profiles based on age, fractions (*N.B.* the results after the age of 92 are insignificant at 5% level, since the sample size descends below 100 observations per generation)
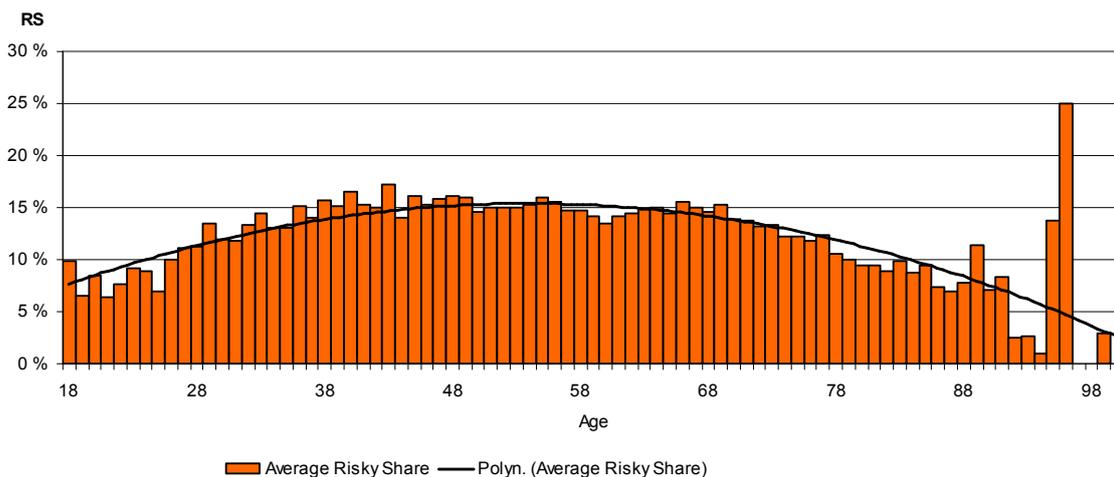
Figure 6: Average Risky share grouped by age (*N.B.* the results after the age of 92 are insignificant at 5% level, since the sample size descends below 100 observations per generation)

5.2.2 Gender

Gender related risk attitude studies suggests that women are more risk averse than men (see Prince, 1993; Lunberg et al., 1994; Embrey and Fox, 1998; Barber and Odean, 2001; Donkers et al. 2001; Hallahan et al., 2004; Dohment et al., 2005; Haarala, 2008; Halko and Kaustia (2009). My analysis on risk attitudes and actual risk taken supports the existing literature. The men dominate the very return oriented (74 %) and return oriented risk profiles (71 %), whereas women are slightly more represented in the very risk averse (59 %) and risk averse (53 %) risk profiles (Figure 7).

When I study the gender wise differences in the actual risk taken by the investors across different profiles, I notice that men have taken on average 2.0 % more risk than women across all risk profiles, except for the most risk averse ones (Figure 8). This finding is peculiar in the sense that investors belonging to the same risk profile should have the same attitude towards risk, thus one could assume that analyzing the actual investments made by gender should yield random results, where male investors would have invested more in some risk profiles and women in some risk profiles.

However, my findings show consistently that even with same risk attitudes, male investors actually take more risk and the difference seems to grow in the higher risk profiles, which supports the findings of Dohmen et al. (2005). They also note that within the same risk category, men were clearly more eager to invest more on a hypothetical asset than women; my results suggest that this is also the case with actual investments.
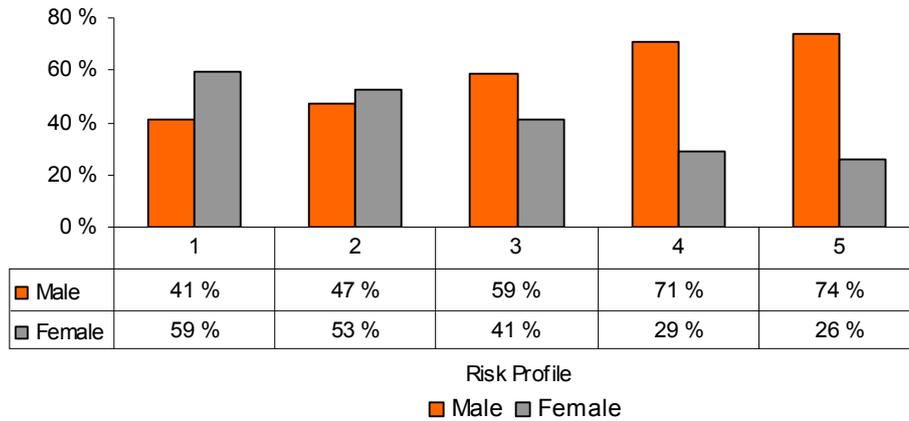
Figure 7: Gender differences in risk profiles
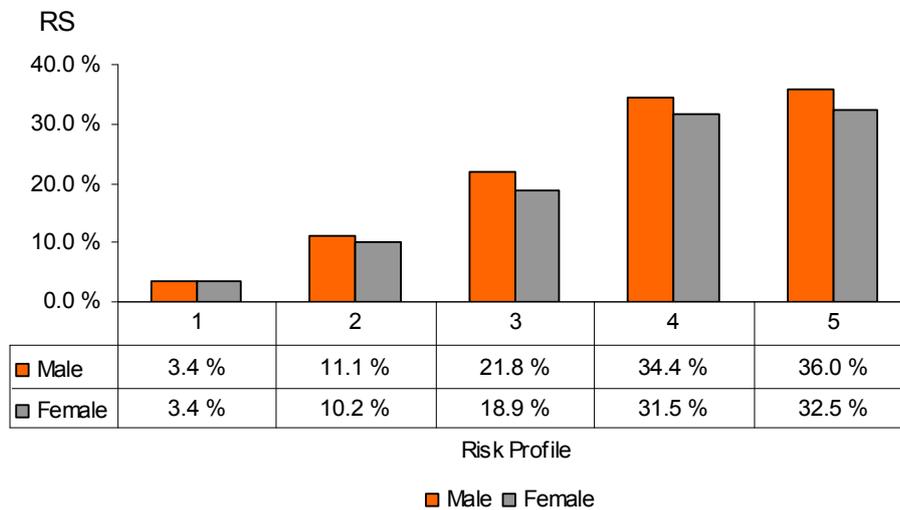
Figure 8: Gender related differences in actual risk taken, measured by average Risky Share

5.2.3 Education

The previous studies on the effect of education on risk attitude generally suggest that the higher educated, the more willing investors are at taking risk (see Riley and Chow, 1992; Sung and Hanna, 1996; Brunello, 2002; Hallahan et al. 2004; Guiso and Paiella, 2005; Dohmen et al., 2005; Haarala, 2008).

In my study I measure the investors' education by finding out the highest degree awarded ion a six point scale ranging from 'not available' to 'university level degree'. The majority of respondents have completed vocational school (35 %) or elementary school (21 %) a few (4 %) have a upper secondary degree; the majority of upper secondary school graduates having

advanced to completed a polytechnic (10 %) or university (11 %) degree, the remaining respondents (19 %) did not report their education. In general the level of education in the observed population is mediocre, which is likely due to the high average age of the sample, which I pointed out in correlation analysis. The possibility to obtain higher education in Finland wasn't available to the majority in the 40s or 50s, whereas nowadays roughly 70 percent of the generation is expected to attain higher education.

When I analyze, how investors are divided among risk profiles by education I find that those having completed only elementary school are overrepresented in the lower risk profiles (37 percent of the risk averse), whereas other levels of education are somewhat evenly divided among different profiles (Figure 9). Those having completed upper secondary school or vocational school have quite equal share in all risk profiles; and, those having completed polytechnic or university degree, i.e. higher education, have a smaller share in the most risk averse risk profile, but are more represented in the higher risk profile categories, consistent with Sung and Hanna (1996).

Furthermore, when I analyze the actual investments made, I observe an ascending pattern in the average risky share, suggesting that the higher educated do not only have a more positive attitude towards risk, but actually take more risk, consistent with previous studies of Riley and Chow, 1992; Donkers et al., 2001;Guiso and Paiella, 2005; Haarala, 2008 (Figure 10).

Risk Profile

	1	2	3	4	5
■ University	6 %	12 %	14 %	18 %	14 %
■ Polytechnic	5 %	9 %	12 %	15 %	14 %
■ Upper secondary school	2 %	4 %	4 %	5 %	4 %
□ Vocational school	35 %	36 %	34 %	32 %	34 %
■ Elementary school	37 %	20 %	13 %	9 %	11 %
■ N/A	14 %	19 %	22 %	21 %	24 %
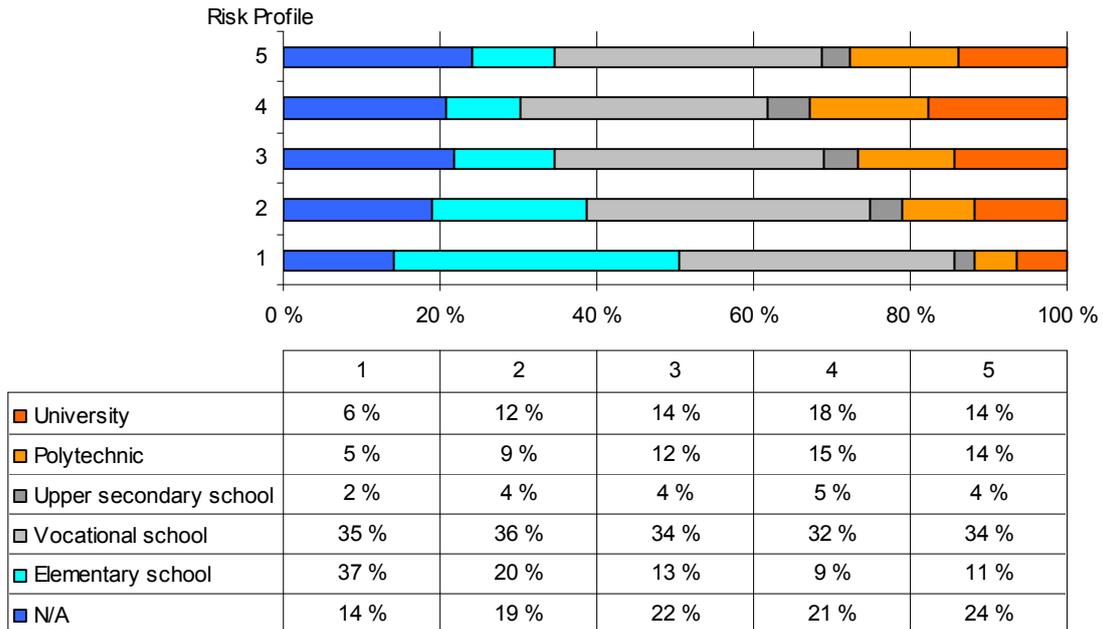
Figure 9: Risk profiles sorted by education

	N/A	Elementary school	Vocational school	Upper secondary	Polytechnic	University
■ Risky Share	13.13 %	10.31 %	13.33 %	13.13 %	16.81 %	19.69 %
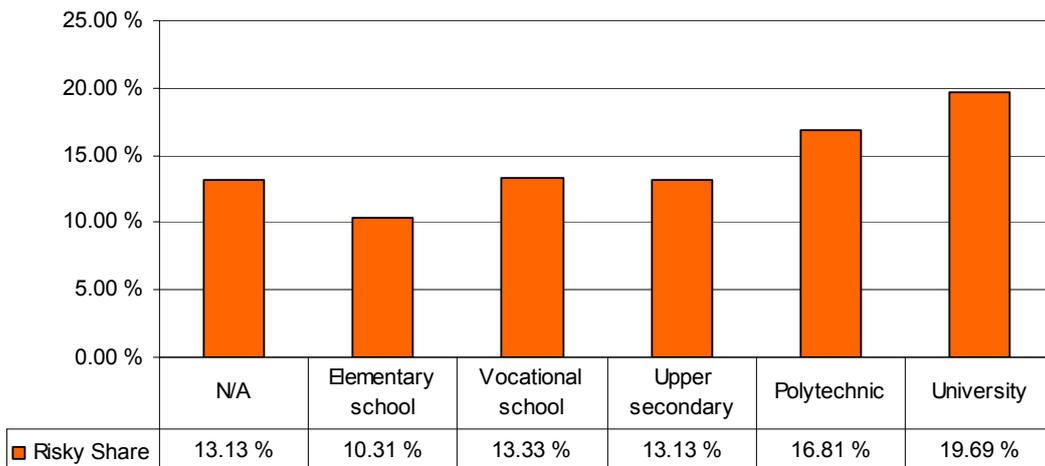
Figure 10: Education related differences in actual risk taken, measured by average Risky Share

5.2.4 Experience

As explained before, the majority of the sample are aged and less educated, thus next I turn my analysis onto investment experience of the investors. The previous studies on experience suggest that the more experienced an investor is, the more willing he is to take risk, due to better understanding of the market mechanisms (see Sung and Hanna, 1996; Grable and Joo, 1997; Grable and Lytton 1998; Grable and Lytton 1999; Haarala, 2008).

Distribution analysis of the experience level in my sample shows that the vast majority have 'some experience' (49 %) or 'no experience' 37 %), leaving 10 percent characterized as 'experienced' and 3 percent as 'not willing to answer'. Figure 11 depicts how these experience levels map to different risk profiles, which reveals that the experienced have a clearly more positive attitude towards risk than those having no experience at all, consistent with previous studies. However, in this particular data one must recall that experience was strongly correlated with age, so observing experience has a limited explanatory power, since it acts also as a proxy for age.

When I analyze the actual risk taken by experience, I find that those, who have some experience on investing, have taken threefold the risk compared to those having no experience. Furthermore, those characterized as experienced have invested twice as much onto risky assets as those having some experience, which indicates that the experienced do not only have more positive attitude towards risk but also take considerably more risk than the inexperienced (Figure 12). Interestingly those not reporting their experience at all have actually taken more risk than the experienced ones. The experience related differences in actual investments made might be related to overconfidence; inexperienced investors might not be confident enough to acquire risky products which might seem complicated and therefore opt for traditional products, such as deposits (Odean 1999; Barber and Odean, 2001).

Risk Profile

	1	2	3	4	5
■ Experienced	4.76 %	6.96 %	13.61 %	25.07 %	32.73 %
■ Some Experience	41.62 %	52.26 %	54.46 %	47.07 %	42.13 %
□ No Experience	53.41 %	38.68 %	26.46 %	18.95 %	20.25 %
■ N/A	0.20 %	2.09 %	5.47 %	8.91 %	4.89 %
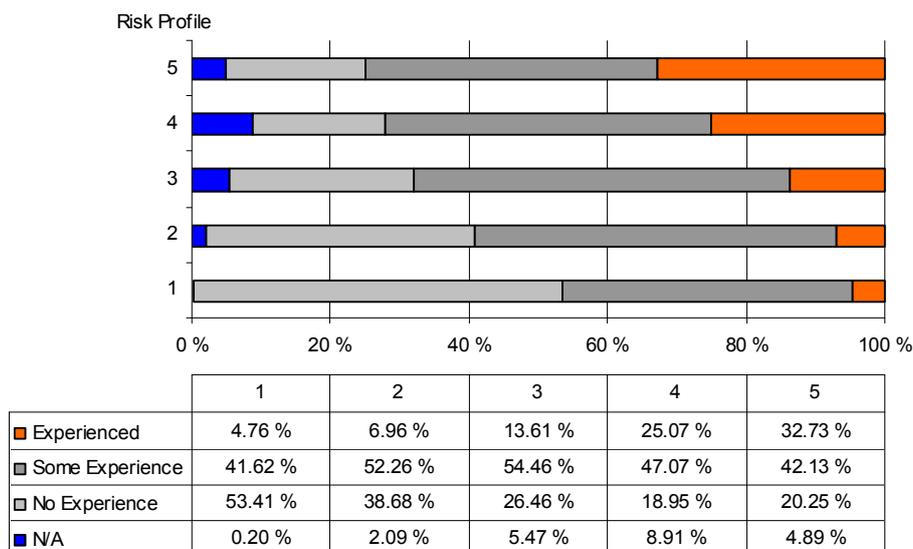
Figure 11: Risk profiles sorted by experience

	N/A	No Experience	Some Experience	Experienced
■ Risky Share	36 %	5 %	16 %	31 %
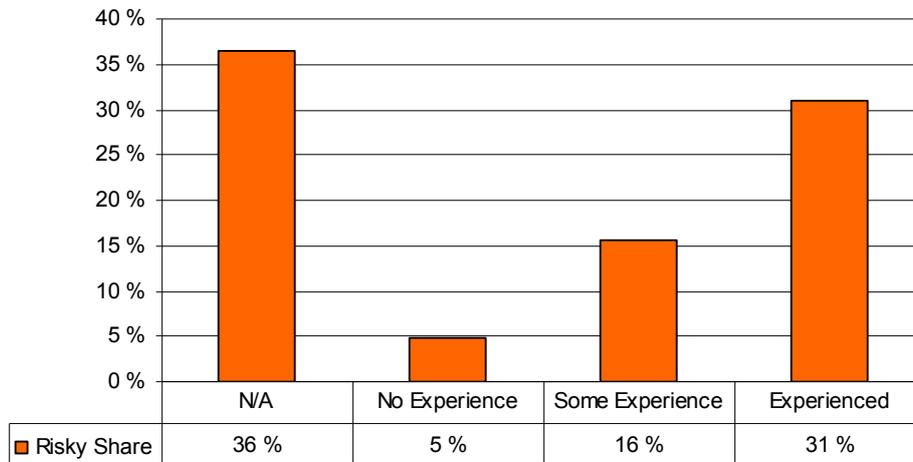
Figure 12: Experience related differences in actual risk taken, measured by average Risky Share

5.2.5 Income

The previous studies on income and wealth generally agree that individuals with higher income are more tolerant to risk than those with low income (see Friedman, 1974; Cohn et al., 1975; Shaw, 1996; Donkers et al. 2001; Hallahan et al., 2004; Guiso and Paiella, 2005; Haarala, 2008; Halko and Kaustia, 2009). I study the impact of income, wealth and debt separately. In this section I go through the effect of income separately as measured by 12m average turnover, i.e. the one year average amount of transactions incoming to customers' accounts at OP-Pohjola Group less internal transactions. I grouped the data onto deciles in order to make the results more easily accessible.

Figure 13 reports, how income deciles are divided among different risk profiles. The main findings of this analysis show that 8th, 9th and 10th decile, i.e. the ones having higher income, have a larger share of the higher risk profiles, whereas the lower earning 4th, 3rd and 2nd deciles have a larger share of the lower risk profiles. The 1st, 5th, 6th and 7th deciles seem to be quite evenly represented among all risk profiles. The reason why the 1st decile isn't the most risk averse group is that it consists of investors having turnover less than EUR 3,500, which indicates that these customers conduct the majority of their business at other banks and, thus, their income is actually something else than my dataset suggests.

The same problem can be seen in Figure 14, which reports the actual risk taken categorized by income deciles. The deciles through 2nd to 10th show an ascending pattern, indicating decreasing risk aversion with income and the 1st decile is an outlier. However, despite the 1st decile, my findings are consistent with the previous studies in such a manner that those having the highest income have the most positive attitude towards risk and actually take most risk.

Risk Profile

	1	2	3	4	5
> 93,944	7 %	9 %	12 %	16 %	18 %
< 93,944	8 %	10 %	11 %	14 %	13 %
< 56,282	8 %	10 %	12 %	13 %	12 %
< 40,850	8 %	11 %	11 %	11 %	10 %
< 31,885	8 %	11 %	11 %	10 %	9 %
< 25,940	10 %	11 %	10 %	8 %	9 %
< 21,289	12 %	11 %	9 %	7 %	7 %
< 16,665	15 %	10 %	7 %	5 %	6 %
< 11,623	15 %	9 %	7 %	7 %	7 %
< 3,500	11 %	10 %	10 %	9 %	10 %
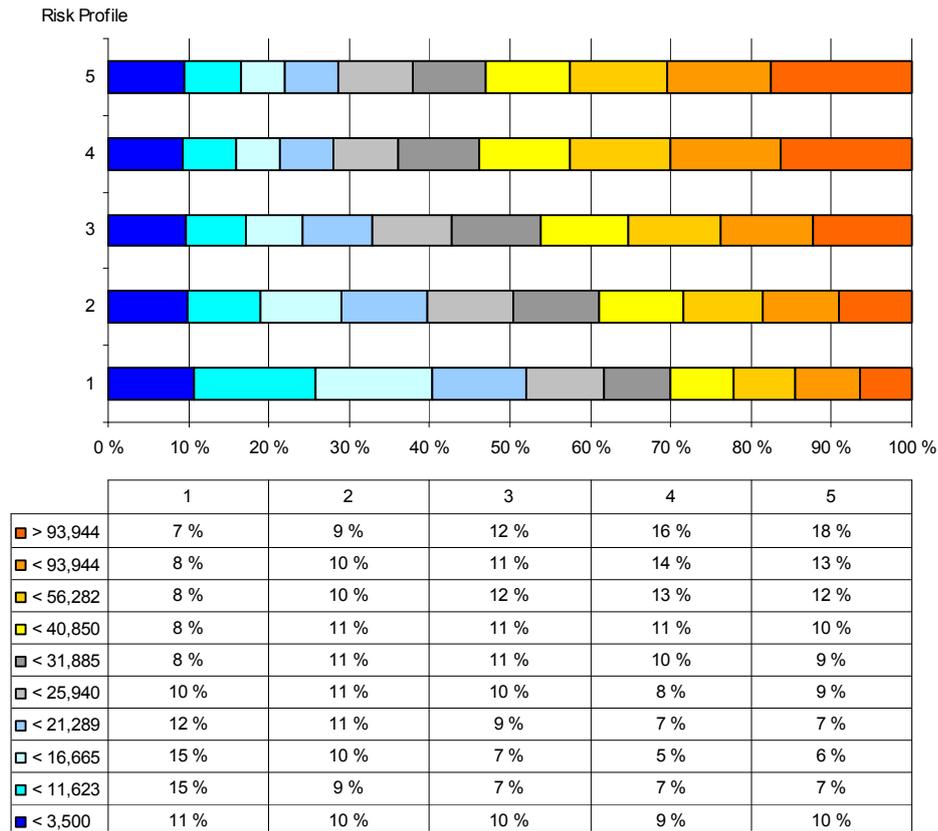
Figure 13: Risk profiles sorted by income deciles (12m average turnover in EUR). Deciles are ordered from left (1st) to right (10th)
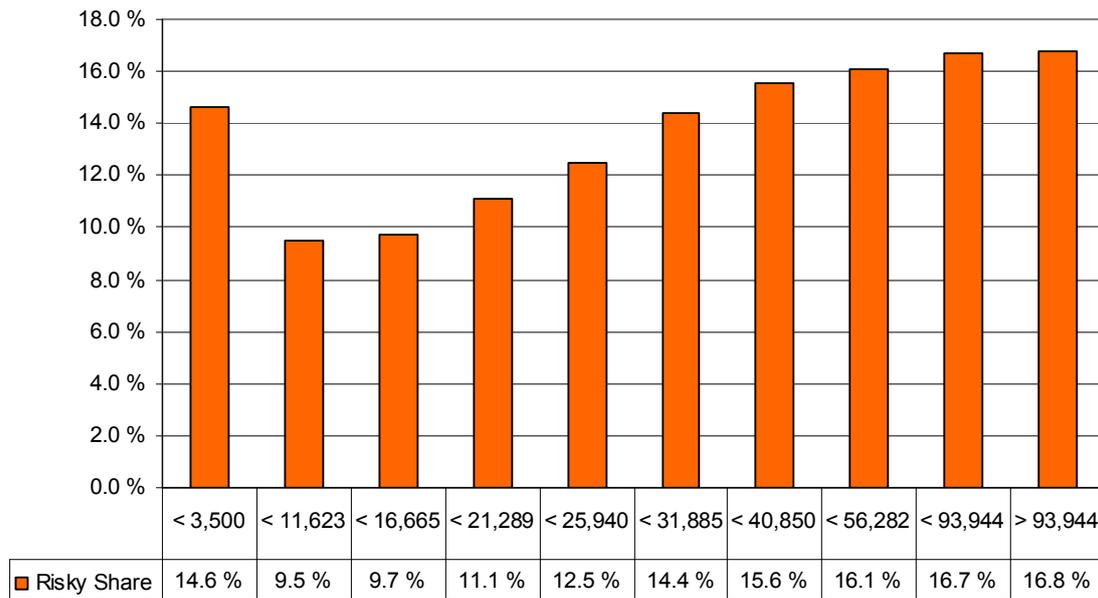
Figure 14: Income related differences in actual risk taken, measured by average Risky Share. Deciles are ordered from left (1st) to right (10th)

5.2.6 Wealth

In addition to income, I study the effect of wealth on risk attitudes and risky investment behavior separately. In the framework of my study I define wealth as the amount of assets that are allocated onto investments. The analyzed wealth is thus the customers total investment wealth, which is the sum of short and long term bond holdings added with equity holdings. Housing, land, forest and other assets are discarded from this analysis, since getting reasonable asset values for these asset classes is challenging within the scope of this study. Again, to ease the interpretation of results, I group the wealth onto deciles and address them from the viewpoint of risk profile distributions and actual risk taken.

Figure 15 reports, how the wealth deciles are divided among different risk profiles. Surprisingly the lowest wealth deciles (1st to 4th) are not overweighted in the lowest risk profiles, but seem unified distributed compared to the income results. The 1st and 2nd deciles actually increase their share in the higher risk profiles, which might again be explained by relationships to other financial institutions, but perhaps by also by age. The younger investors are more willing to take more risk, but likely lack the amount of wealth. The latter argument can be supported by examining wealth deciles from 5th to 8th as they all exhibit a declining share in risk attitude. Haarala (2008) reported a similar pattern in her studies.

However, when the risk attitudes are contrasted to actual investments made, the findings turn somewhat contradictory (Figure 16). The 1st wealth decile was the most representative in the highest risk attitude group, but when observed from the actual investment point of view, it ranks the lowest, suggesting that the bulk of these investors' investments might be situated outside OP-Pohjola Group.

Furthermore, the actual investments made trough 2nd to 8th decile have taken pretty similar risk positions although their views on risk attitudes somewhat different. The only consistent pattern is amongst 9th and 10th deciles, i.e. the wealthiest groups, who have a positive attitude towards risk and actually invest the most onto risky assets. Thus, although *income* had a clear positive effect on risk attitudes and risky investment amongst, I find no consistent pattern that increasing *wealth* would have a positive effect onto risk attitudes or risky investment behavior.

Risk Profile

	1	2	3	4	5
■ > 93,944	7 %	9 %	12 %	16 %	18 %
■ < 93,944	8 %	10 %	11 %	14 %	13 %
■ < 56,282	8 %	10 %	12 %	13 %	12 %
□ < 40,850	8 %	11 %	11 %	11 %	10 %
■ < 31,885	8 %	11 %	11 %	10 %	9 %
□ < 25,940	10 %	11 %	10 %	8 %	9 %
□ < 21,289	12 %	11 %	9 %	7 %	7 %
□ < 16,665	15 %	10 %	7 %	5 %	6 %
■ < 11,623	15 %	9 %	7 %	7 %	7 %
■ < 3,500	11 %	10 %	10 %	9 %	10 %
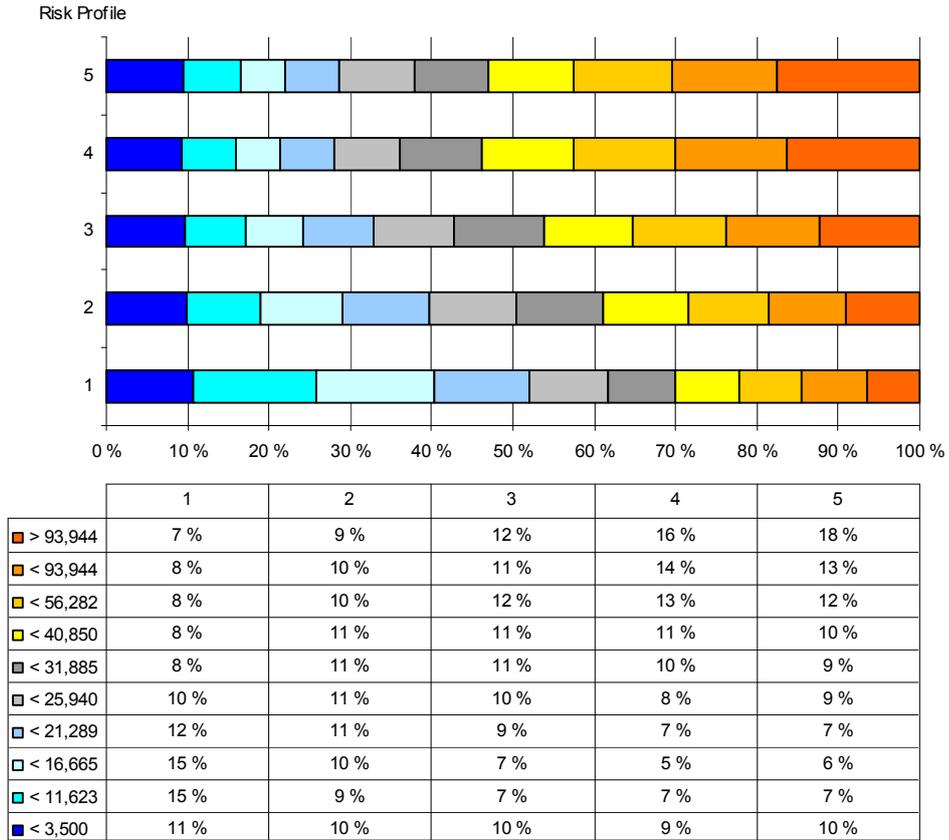
Figure 15: Risk profiles sorted by total investment wealth deciles (EUR). Deciles are ordered from left (1st) to right (10th)

	< 3,600	< 10,000	< 18,000	< 26,700	< 37,000	< 50,000	< 69,998	< 100,000	< 168,583	> 168,583
■ Risky Share	8.1 %	12.5 %	12.3 %	11.2 %	11.2 %	11.2 %	13.3 %	14.1 %	17.5 %	25.7 %
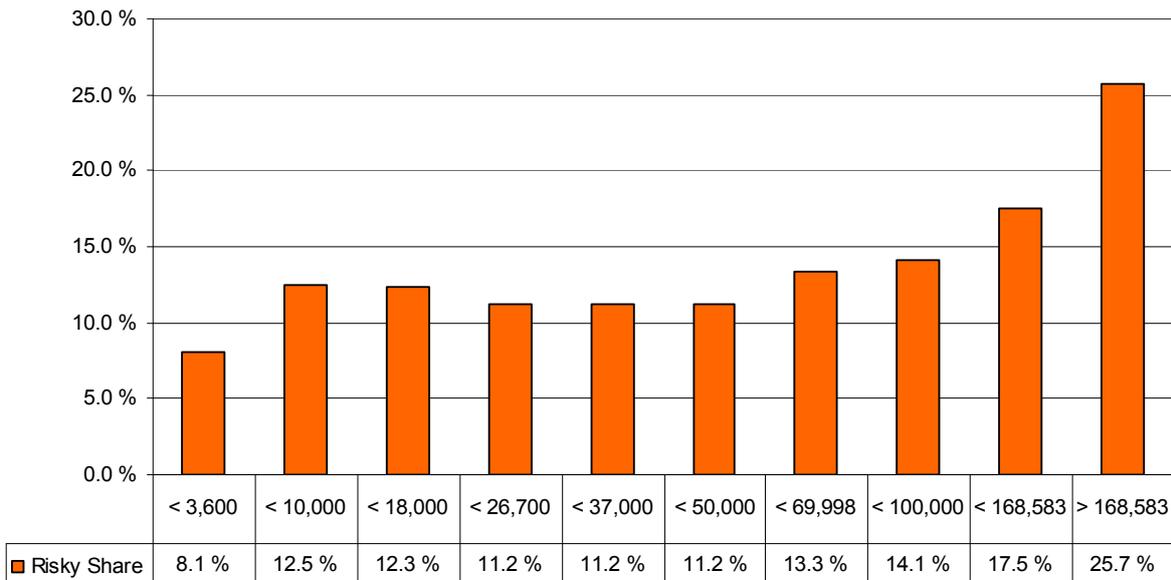
Figure 16: Total Investment wealth related differences in actual risk taken, measured by average Risky Share. Deciles are ordered from left (1st) to right (10th)

5.2.7 Debt

Previous studies have not generally analyzed debt as a separate factor affecting risk attitudes, but have neglected it or have merged debt onto wealth. Haarala (2008) studied the effect of debt and reported that willingness to take risks is related to debt. In my study, I examine the effect of investors' 12 month average debt on risk attitudes and actual risk taken[2]. In order to make the results understandable, I group the data onto four groups; the one that has no debt, covering 70 percent of the sample and three groups of 10 percent that have debt.

When I analyze, how investors are divided onto risk profiles sorted by debt, I find that those that have taken debt have a clearly more positive attitude towards risk, and the attitude to take risk increases, the more debt the investor has taken (Figure 17). When I analyze the actual risk positions, the results are similar – actual risk taken increases with debt, although the difference between those not taken debt and those that have taken debt is smaller (Figure 18). In contrast to Haarala (2008), my analysis shows a more consistent pattern between risk attitudes and actual risk taken.

However, before jumping to conclusions, one should bear in mind that debt was well correlated with age, gender and turnover (income). As reported earlier, the elderly were not willing to take risks and this attitude is also shown in the willingness take debt. Being male and having debt were positively correlated, which might attribute part of the observed results to the behavior of males being more actively seeking risk than females.

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[2] 12m average debt includes the sum of all debt that the customer has at OP-Pohjola Group, ranging from mortgages to consumer debt

An alternative explanation would be that households take shared debt under the males account, i.e. mortgage, which show in my data as 'male debt', although the debt is actually shared. The correlation between turnover and debt, and the lack of correlation between wealth and debt is interesting phenomenon. It indicates that incoming cash flows are considered as a good starting point to be leveraged, but wealth is not, although one would assume that existing wealth would serve better as collateral than income.

Risk Profile

	1	2	3	4	5
■ > 37,666	3 %	8 %	14 %	24 %	28 %
■ < 37,666	6 %	9 %	13 %	15 %	17 %
■ < 4,319	6 %	9 %	11 %	11 %	11 %
■ 0	84 %	73 %	62 %	49 %	44 %
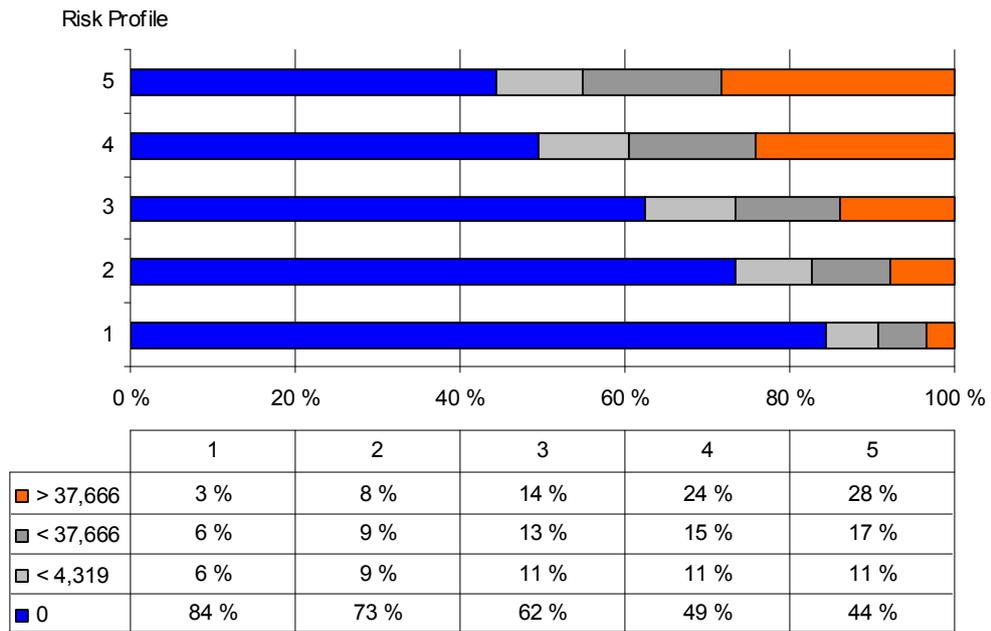
Figure 17: Risk profiles sorted by 12 Month average debt deciles (EUR). Please note that 70 percent of the data didn't have any debt, thus there are only four debt classes. Deciles are ordered from left (1st) to right (10th)

|	0	< 4,319	< 37,666	> 37,666
■ Risky Share	12.6 %	13.9 %	15.7 %	19.1 %
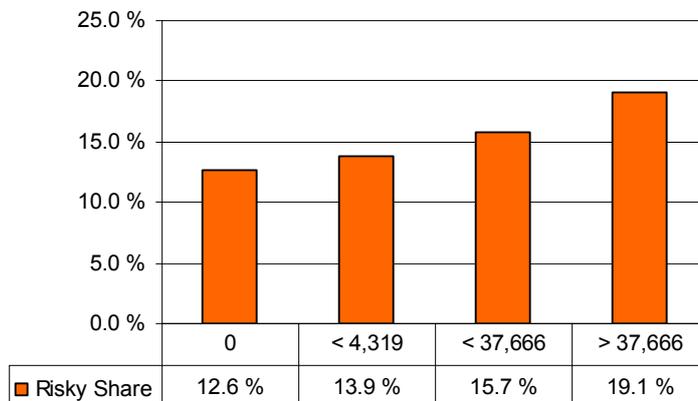
Figure 18: Debt related differences in actual risk taken, measured by average Risky Share. Deciles are ordered from left (1st) to right (10th)

5.3 Regression Analysis

In the previous section I conducted descriptive analysis on general attributes affecting risk attitudes. However, so far it is unclear, which factors actually influence risk attitudes, and to which degree. In this section I address the problem by analyzing the combined effect of previous section's variables on risk profiles by conducting ordered logistic regressions, which enable me to rank explanatory variables onto order of importance. In all of the regressions, I set the investors' Risk Profile as the dependent variable and as an explanatory variable I use the aforementioned variables and their transformations, explained more detail in Section 4:

As a robustness check, I run separate regressions with income, wealth, debt, short and long term bond investments, and equity investments grouped onto deciles, in order to eliminate the effect of possible outliers in the data. Furthermore, I use Ordinary Least Squares (OLS) regressions as a control method, to verify the results of ordered logistic regressions. Finally I check my results by dividing the data onto two subsets based on gender and run the ordered logistic regressions once more.

5.3.1 Ordered Logistic Regression

First I run the basic models, which try to capture the importance of traditional *determinants of risk* added with actual investments, such as short and long term bond holdings and equity holdings, in order to determine, whether the actual investments are more decisive in determining the risk attitude. I run the regressions by adding a single variable at a time and observe, how the Akaike Information Criterion (AIC) increases, when a variable is added. The significance of results is measured with Wald-Chi Square-test coefficient. Table 4 reports the obtained results in detail.

Table 4: Results of Ordered Logistic Regressions.

This table reports the ordered logistic regression results between the level of risk profile and different attributes of risk, and actual investments. I report the maximum likelihood estimates and their respective Wald Chi-Square test coefficients in parenthesis. *** denotes significance at 0.001 level; ** denotes significance at 0.01 level. Standard interpretation of an ordered logistic coefficient is that for a one unit increase in the predictor the dependent variable is expected to change by its respective regression coefficient in the ordered logistic scale, when other variables in the model are held constant. Akaike Infromation Criterion (AIC) reports the goodness of a fit of the model. The model with the smallest AIC is considered the best.

Dependent variable = Risk Profile

Independent variable	1	2	3	4	5	6	7	8	9	10	11
Turnover 12m	1.366E-6 (516.38)***	1.346E-6 (501.00)***	6.67E-07 (194.09)***	7.70E-07 (240.67)***	6.25E-07 (173.68)***	4.47E-07 (97.57)***	4.22E-07 (87.00)***	5.57E-07 (145.73)***	4.37E-07 (89.46)***	4.18E-07 (82.78)***	5.40E-07 (134.82)***
Total investment wealth		2.454E-8 (7.61)*	0.00001 (2971.57)***	6.84E-06 (1361.94)***	6.58E-06 (1265.75)***	5.76E-06 (983.46)***	5.65E-06 (948.38)***	5.54E-06 (913.29)***	7.13E-06 (1356.64)***	8.28E-06 (1622.97)***	4.73E-06 (643.33)***
Net investment wealth			-0.00001 (2960.79)***	-6.75E-06 (1333.23)***	-6.49E-06 (1237.78)***	-5.69E-06 (963.92)***	-5.58E-06 (930.07)***	-5.46E-06 (890.84)***	-5.52E-06 (900.30)***	-5.48E-06 (890.74)***	-4.65E-06 (639.88)***
Age				-0.0312 (5726.87)***	0.0368 (256.68)***	0.0402 (303.53)***	0.0381 (272.17)***	0.021 (80.52)***	0.0195 (69.81)***	0.0191 (66.34)***	0.00657 (7.72)*
Age^2					-0.00066 (901.15)***	-0.00069 (984.86)***	-0.00066 (893.89)***	-0.00055 (614.97)***	-0.00055 (609.51)***	-0.00055 (599.61)***	-0.00044 (382.07)***
Gender: male						0.6216 (2327.38)***	0.6281 (2372.39)***	0.5734 (1950.20)***	0.5565 (1827.10)***	0.548 (1767.27)***	0.503 (1468.87)***
Education							0.0621 (243.69)***	0.0488 (148.92)***	0.0422 (110.55)***	0.0406 (102.43)***	0.0189 (21.69)***
Experience								0.6359 (4455.66)***	0.6387 (4491.90)***	0.6377 (4473.65)***	0.4378 (2038.47)***
Short term bond investments									-1.69E-06 (781.05)***	-2.88E-06 (951.62)***	-8.89E-08 (7.25)*
Long term bond investments										-2.57E-06 (467.63)***	5.21E-07 (39.64)***
Risky share											3.1226 (10137.28)***
Convergence criterion (CONV=1E-8)	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
AIC (intercept and covariates)	229 181.14	229 177.57	226 101.21	220 223.82	219 312.66	216 965.03	216 722.21	212 422.23	211 511.6	211 173.88	201 361.21
Number of Observations	85 063	85 063	85 063	85 063	85 063	85 063	85 063	85 063	85 063	85 063	85 063

Consistent with previous studies exogenous variables, such as experience, gender are major attributes explaining risk attitudes. However, variables related to the actual investments do take a role in defining risk profile; having a high allocation of equities in investors' portfolio is clearly the most significant factor increasing risk tolerance in the best fitting full sample model 11 reported in Table 4, whereas owning debt instruments, especially short term debt have a negative impact on risk tolerance, i.e. investors who belong to higher risk profiles are more likely to have a high allocation of their wealth in equities and investors who belong to lower risk profiles are more likely to own short term debt. These findings suggest that risk attitudes elicited in the financial domain are able to predict actual investment behavior, supporting the domain related findings of Nosic and Weber (2007) and Dohmen et al. (2005).

Furthermore, in age related analysis I find that the addition of variable Age squared changes the sign of variable Age as positive, whereas Age squared takes a negative sign. This suggests that the relation between age and risk attitudes is not linear, but rather a non-linear, concave function. This finding supports the results reported by Riley and Chow (1992) and Hallahan et al. (2004).

In the wealth and income related analysis the new Net investment wealth variable takes a negative sign in models 3-11, suggesting that the more net wealth an investor has, the less likely the investor is willing to take more risk. Since the Total investment wealth takes a positive sign in each of the regressions, the underlying factor explaining the negative sign in Net investments is debt that the investor has taken, i.e. investors having taken debt are more likely to take more risk than the investors that do not use any leverage. This finding is consistent with Haarala (2008).

Surprisingly the Turnover variable didn't seem to have an important role in defining the investors' risk attitude; In Table 4, model 11 (the best fitting model, with full sample size) Turnover ranked 7th among the significant factors, whereas Total Investment Wealth ranked 4th. Since I assume that these variables should go hand-in-hand, I checked, whether the heterogeneous variance causes the deviation by taking logarithmic transformations of these variables. However, unreported analysis with transformed values shows that the importance of transformed variables is unchanged, i.e. the distribution of turnover or investment wealth does not affect the results.

Generally the findings reported in Table 4 support my hypotheses on determinants and risk, as well as the results from the variable-by-variable analysis. Notably, in all models reported in Table 4, the majority of parameters were statistically significant on <0.0001 –level and the signs of coefficients support the initial hypotheses.

5.3.2 Robustness Checks

As a control measure, I run OLS regressions, with similar models. The results of OLS regressions are reported more detail in Table 5. The conclusions that one can draw from OLS robustness check is that the order and magnitude of significance of variables both in Ordered Logistic Regressions, and in OLS regressions is the same; share of wealth invested onto equities, experience in investments and being male are the variables having the most effect on risk profile. Furthermore, in both regression types, the signs of variables are the same, with the exception of Long term bond investments, which in Table 4 has a positive sign in model 9 and a negative sign in model 10, whereas in OLS regressions reported in Table 5, the sign of the variable is positive in both models. However, the t-statistic in OLS model 10 is insignificant (0.36), which can explain the deviation. Overall the OLS models support very strongly the results obtained with Ordered Logistic Regression.

Having sorted out the importance of traditional determinants of risk on risk profiles, I run the ordered logistic regressions with EUR denominated variables Turnover, Total investment wealth, Net investment wealth, Short term bond investments, Long term bond investments, Equities and Debt sorted onto deciles, in order to eliminate the effect of outliers. In these unreported analyses I was able to improve the fit of the model, measured with AIC to 198 310.45 (compare to 201 361.21 of model 11 in Table 4). However, the improved fit is due to the transformation of the EUR variables to deciles. Notably, the results concerning the sign and significance of the variables in the 'decile model' are consistent with the analysis in Table 4, i.e. equity investments, investment experience and being male continue to dominate as the most significant factors in the models.

Table 5: Results of Ordinary Lest Squares Regressions

This table reports the enhanced ordered logistic regression results between the level of risk profile and different attributes of risk, and actual investments. I report the maximum likelihood estimates and their respective Wald Chi-Square test coefficients in parenthesis. *** denotes significance at <0.0001 level; ** denotes significance at <0.001 level and * denotes significance at 0.01 level. Standard interpretation of an ordered logistic coefficient is that for a one unit increase in the predictor the dependent variable is expected to change by its respective regression coefficient in the ordered logistic scale, when other variables in the model are held constant. Akaike Infromation Criterion (AIC) reports the goodness of a fit of the model. The model with the smallest AIC is considered the best.

Dependent variable = Risk Profile / **Model**

Independent variable	1	2	3	4	5	6	7	8	9	10	11
Intercept	2.19522 (614.80)***	2.19413 (610.87)***	2.14445 (590.45)***	3.03841 (251.26)***	2.34653 (80.75)***	2.15413 (74.52)***	2.0901 (71.60)***	1.89404 (66.13)***	1.90071 (66.49)***	1.9008 (66.49)***	2.11558 (78.81)***
Turnover 12m	5.23E-07 (23.04)***	5.17E-07 (22.69)***	2.95E-07 (12.99)***	3.27E-07 (14.88)***	2.87E-07 (13.08)***	2.21E-07 (10.21)***	2.10E-07 (9.71)***	2.52E-07 (11.93)***	2.51E-07 (11.91)***	2.51E-07 (11.91)***	2.23E-07 (11.28)***
Total investment wealth		1.35E-08 (2.78)*	0.00000512 (56.98)***	0.0000035 (39.21)***	0.00000339 (38.12)***	0.00000298 (33.76)***	0.00000293 (33.26)***	0.00000282 (32.76)***	0.00000294 (34.20)***	0.00000294 (34.20)***	0.00000222 (27.46)***
Net investment wealth			-0.0000051 (-56.90)***	-3.47E-06 (-38.89)***	-3.36E-06 (-37.80)***	-2.95E-06 (-33.52)***	-0.0000029 (-33.02)***	-2.79E-06 (-32.47)***	-2.76E-06 (-32.22)***	-2.76E-06 (-32.22)***	-0.00000219 (-27.24)***
Age				-0.01584 (-77.25)***	0.01374 (11.96)***	0.01495 (13.20)***	0.01404 (12.39)***	0.00566 (5.08)***	0.0055 (4.95)***	0.0055 (4.95)***	-0.00148 (-1.42)
Age^2					-0.0002832 (-26.16)***	-0.0002918 (-27.34)***	-0.0002777 (-25.95)***	-0.0002183 (-20.83)***	-0.0002177 (-20.81)***	-0.0002177 (-20.81)***	-0.00015228 (-15.52)***
Gender: male						0.31781 (49.71)***	0.31984 (50.08)***	0.28863 (46.18)***	0.28704 (46.02)***	0.28704 (46.02)***	0.23482 (40.06)***
Education							0.02957 (14.83)***	0.0238 (12.22)***	0.02281 (11.73)***	0.02281 (11.73)***	0.00782 (4.28)***
Experience								0.29461 (65.37)***	0.29571 (65.74)***	0.29571 (65.74)***	0.19398 (44.96)***
Short term bond investments									-2.05E-07 (-18.73)***	-2.03E-07 (-17.55)***	-3.42E-08 (-3.13)*
Long term bond investments										1.26E-08 (0.39)	1.68E-07 (5.53)***
Risky share											1.41655 (109.20)***
F-value	531.01	269.39	1265.82	2508.03	2159.42	2263.69	1976.73	2350.62	2137.01	1923.3	3077.65
R^2	0.0062	0.0063	0.0427	0.1055	0.1126	0.1377	0.1399	0.1811	0.1844	0.1844	0.2847
Adjusted R^2	0.0062	0.0063	0.0427	0.1055	0.1126	0.1376	0.1399	0.181	0.1843	0.1843	0.2846
Number of Observations	85063	85063	85063	85063	85063	85063	85063	85063	85063	85063	85063

Having presented the ordered logistic regression and OLS regression tables, I also run an unreported regression ('full model'), which included additional factors, such as housing, investment apartment, other property, land, forestry, other wealth and wealth reserved for unexpected expenditure in order to verify my results that equity allocation, experience and are actually the most significant factors affecting risk attitudes. The results of the full model did not change the significance of the reported factors or the goodness of a fit, showing that adding additional wealth related factors do not seem to change my results.

Finally, I conducted a sub-group analysis, where I divided the dataset onto two roughly equally sized groups based on gender in order to see, whether equity allocation and investment experience are gender independent factors. The results of the analysis are reported in Table 6.

In the sub dataset analysis, equity allocation continues to be the most significant factor and experience the second most significant factor in explaining Risk Profile. However, the gender specific analysis does reveal some differences. Firstly, the significance of Equity investments is considerably higher with male respondents (Wald-Chi square was 6,118 for males and 3,896 for females), suggesting that risk averse males invest more heavily on equities than females. Secondly, in the experience related case the situation is the opposite; females seem to be more influenced by personal experience in investments that males, i.e. females need to attain more experience before taking additional risk than males. This finding may be reflected in the education variable as well.

In all the full sample models reported in Table 4 and in the Male model education has a positive impact on risk attitude, whereas for women the sign is negative. Thus, the higher educated women actually seem to be less willing to take risk, which is contradictory to the results of previous results concerning the effect of education (see Riley and chow, 1992; Sung and Hanna, 1996; Donkers et al., 2001; Brunello 2002, Hallahan et al., 2004). However, the aforementioned studies did not make any distinction between males and females.

The explanation for the different effect of education on women might be the areas of studies. It is very rare that from elementary school onwards females and males decide to study the same subjects in equal shares. In the Finnish system, females are a majority in higher educational subjects that are emotionally oriented, such as nursing or teaching, whereas males

tend to study mathematically oriented subjects, such as engineering. Therefore, using attained educational level as a parameter might be too noisy and more detailed information, which would include the nature of studies taken, should be used instead. However, despite the differences in Educations, all the other variables follow the results obtained with the full sample models.

Table 6: Ordered Logistic Regression analysis based on Gender.

This table reports the ordered logistic regression results between the levels of risk profile and different attributes of risk, and actual investments. The regressions are divided onto two groups based on gender. I report the maximum likelihood estimates and their respective Wald Chi-Square test coefficients in parenthesis. *** denotes significance at 0.001 level; ** denotes significance at 0.01 level. Standard interpretation of an ordered logistic coefficient is that for a one unit increase in the predictor the dependent variable is expected to change by its respective regression coefficient in the ordered logistic scale, when other variables in the model are held constant. Akaike Infromation Criterion (AIC) reports the goodness of a fit of the model. The model with the smallest AIC is considered the best.

Dependent variable = Risk Profile	Model	
Independent variable	Male	Female
Turnover 12m	6.413E-7	3.98E-07
	(110.76)***	(28.32)***
Total investment wealth	3.94E-06	6.55E-06
	(335.79)***	(305.06)***
Net investment wealth	-3.9E-6	-6.26E-06
	(332.64)***	(297.06)***
Age	0.000019	0.0126
	(0)	(13.09)***
Age^2	-0.00037	-0.0005
	(146.26)***	(233.77)***
Education	0.0381	-0.00121
	(44.89)***	(0.0442)
Experience	0.3504	0.5637
	(775.33)***	(1367.37)***
Short term bond investments	-4.75E-08	-3.23E-07
	(3.0303)	(11.68)***
Long term bond investments	8.28E-07	7.15E-08
	(42.19)***	(0.3358)
Risky share	3.1267	3.0748
	(6118.56)***	(3896.09)***
Convergence criterion (CONV=1E-8)	satisfied	satisfied
AIC (intercept and covariates)	107 748	93 323
Number of Observations	43 494	41 569

5.4 Results

My aim was to study the relevant determinants of risk affecting risk attitudes of private Finnish investors and to enhance those variables by adding actual investments to the equation, in order to find out, whether risk attitudes could be linked to actual investments. I addressed these questions by forming eight hypotheses, which were analyzed within the dataset of 85,063 Finnish investors. The results of my hypotheses are summarized in Table 7.

Table 7: The results of the study summarized

Hypotheses	Result	Previous Studies
Hypothesis 1: Risk tolerance decreases with age	**+++**	+ and -
Hypothesis 2: Men are more risk tolerant than women	**+++**	+
Hypothesis 3: Higher educated are more risk tolerant than less educated	+	+
Hypothesis 4: More experienced are more risk tolerant than less experienced	**+++**	+
Hypothesis 5: Higher income implies increased risk tolerance	+	+
Hypothesis 6: Higher wealth implies increased risk tolerance	**+++**	+
Hypothesis 7: Risk tolerance increases with debt	**+++**	+
Hypothesis 8: Risk taking behavior can be predicted by individual risk attitudes	++	+

I found that risk tolerance is clearly decreasing with age and is significantly one of the major factors affecting investors risk attitude (see Figure 5 and Table 4). This finding is consistent with Wallach and Kogan, 1961; McInish, 1982, Brown, 1990; Donkers, 2001; Dohmen et al., 2005; Haarala, 2008; Halko and Kaustia, 2008). However, when I added the variable age squared to the equations, I found evidence of age having a parabolic relation to risk attitude, suggesting that risk tolerance increases until a certain point has been reached and thereafter starts decreasing, consistent with Riley and Chow, 1992 and Hallahan et al. 2004. Furthermore, when I studied the link between age and actual risk taken (see Figure 6), I found supporting evidence that investors take more and more risk, up to a certain point, after which the risk position start gradually decreasing, i.e. the relation between risk and age is nonlinear. Overall the risk attitude decreased within age, but the actual risk position taken adjusted to the risk attitude slower.

For the gender effect, I found significant effect on the variable level, as well as in the ordered logistic regressions. Male investors had a more positive attitude towards risk (Figure 6), took more risk than women having the same risk attitude (Figure 7) and overall, being male had a

clearly higher likelihood of belonging to a higher risk profile group than women (see odds ratios of gender reported in Table 4). These finding support the previous research (Lundberg et al., 1994; Prince, 1993; Embrey and Fox 1998; Byrnes et al., 1999; Barber and Odean, 2001; Donkers et al., 2001; Dohmen et al. 2005; Hallahan et al., 2004). However, unlike Hallahan et al. (2004), I can not attribute gender as the single most significant attribute affecting risk tolerance, since my best fitting model described in Table 4 shows that age is only the 4th most significant factor after Equity investments, age and experience.

The results on education's effect on risk tolerance were clearly less decisive than the aforementioned two; I observed that those having attained polytechnic or university degree were more representative in the higher risk profiles, whereas those having attained only elementary school were more representative in the lower risk profile categories. Furthermore, in the regressions reported in Table 4 I observed that education had a positive effect on risk attitudes in each of the models, but the odds ratio was very low. For instance in the best fitting full sample model, the odds ratio was merely 0.0189 (Table 4). When I analyzed the effect of education based on gender, the results show that for males, education has a positive effect on risk attitudes, but for females, education actually has a negative impact (Table 6). I assume that this difference might be attributed to the differences in studied subjects between males and females. Thus, my data gives only vague support to the education related findings of Riley and Chow, 1992, Sung and Hanna, 1996, Brunello, 2002; Hallahan et al. 2004, Guiso and Paiella, 2005, Dohmen et al., 2005, Haarala, 2008.

The experience related evidence is stronger. Investors characterized as 'experienced' had the most favorable attitude towards risk (see Figure 11) and actually invested the most onto risky assets (see Figure 12). In the regression analysis, experience was characterized as the 3rd most significant factor affecting risk attitudes (Table 4). This is in line with Haarala (2008), who found experience as the variable having the most explanatory power in her regression analysis. Furthermore, these findings support the research work of Sung and Hanna, 1996, Grable and Joo, 1997, Grable and Lytton, 1998 and Grable and Lytton, 1999. All these studies argue that increased knowledge in personal finance has a role in shaping risk tolerance. More experienced investors truly do seem to be willing to take risks and actually do take more risks.

Income (measured as 12m turnover) related evidence shows that those investors belonging to the highest three income deciles (income above EUR 56,282 per year) have a more positive attitude towards risk, whereas those belonging to the lowest income deciles had a more negative attitude towards risk. When I analyzed the actual risk taken, the more an individual earned, the more he had invested onto risky assets. These results support the previous studies, suggesting that individuals with higher income should be more risk tolerant (see Friedman, 1974; Cohn et al., 1975; Shaw, 1996; Donkers et al. 2001; Hallahan et al., 2004; Guiso and Paiella, 2005; Haarala, 2008; Halko and Kaustia, 2009). However, when I run ordered logistic regressions, the income had consistently positive effect on risk attitudes, but the significance of the variable on risk attitudes ranked at 7th (see Table 4, model 11). Thus, income can be seen as a factor having a positive effect on risk attitudes, but it is significant only among the wealthier investors.

Wealth (measured as total investment wealth) related results are similar to those of income, with the exception that in wealth distribution analysis I found out that the most risk averse investors were among the middle wealth deciles, which might be explained as such that the young investors haven't incurred that much wealth and therefore, the low wealth deciles are less risk averse than the middle ones, which mainly consist of the elderly and very risk averse investors (see Figure 15). When I analyzed the actual investments made, the risk taken by low and middle deciles was low and didn't form a clear pattern. The only distinct observation was that the two highest deciles (9th and 10th) had invested considerably more than the others on risky assets (see Figure 16). In ordered regression analysis, wealth had a positive sign across all regressions implying positive effect on risk attitude, and when I observed the variable from significance point of view, it turned out to be the 4th most significant variable in the best fitting full sample model (see Table 4, model 11), i.e. the role of wealth in the overall determination of risk attitudes gives support to the previous studies (see Friedman, 1974; Cohn et al., 1975; Riley and Chow, 1992; Hallahan et al., 2004).

Unlike many previous studies, I analyzed debt as a separate factor, apart from wealth. This decision yielded feasible results both in the variable by variable analysis, as well as in the ordered logistic regression analysis. I was able to show, that those taking debt do actually take consistently more risk and, furthermore, those belonging to the highest debt decile, had a

significantly more positive attitude towards risk than the others (see Figures 17 and 18). In the ordered logistic regression analysis, when I analyzed debt and wealth as a combined variable 'Net investment wealth' debt showed consistent positive influence on risk attitude both in the full sample models and gender based subgroup analysis (see Table 4 and 6). In unreported analysis, where the investors' 12m debt was analyzed as a single factor, the findings were consistent with the results obtained from models with 'Net investment wealth' as a proxy for debt. My debt related findings support those of Haarala (2008).

The analysis of predicting risky decision behavior by individual risk attitudes was conducted by running ordered logistic regressions, where risk profiles, determined by two questions elicited in the financial domain, where analyzed with multiple variables. The regressions were run in two phases; first I run ordered logistic regressions and secondly, I run OLS-regressions as a control measure. Additionally, the robustness of the results was verified by running regressions with transformed variables and by conducting a sub-sample analysis. All regressions show consistently that age, gender, experience and debt are linked with risk attitudes (see Tables 4-6). The addition of actual contents of investors' portfolios onto the regression models show that investors' allocation into equities is significantly linked to risk profiles; having a high allocation in equities increases the likelihood of belonging to a higher risk profile as the clearly most significant factor (see Table 4, model 11). However holding short or long term bond instruments did not have as strong implications on risk profiles. To conclude, the less risk averse investors can be said to be more likely to hold a significant amount of their wealth in equities, but the more risk averse investors can not be said to be more likely to hold the majority of their assets in short term bonds, although holding short term bond instruments had a consistent negative effect on risk attitudes.

5.5 Limitations of the Study

Because my data is gathered from a large population, with a straightforward survey, it forms a couple of limitations to the study.

The foremost limitation is the lack of longitude, which might have an effect on the answers to risk attitude questions. Since the risk attitude of the respondent is determined by a survey, it might lead into biased results, because the investor's anticipation of risk is partly determined by how the investors interpret the risk questions. One can argue that especially among different generations, the cohort effect might be strong; it is not feasible to think that people born in different decades. For instance those born before World War II may not understand the concept of risk in the same way as those born in 70's or 80's. Thus, the descendants of risk averse investors might have a totally different attitude on risk than their parents or grand parents had when they were young. The existing literature already supports this view, among others, Grable and Joo (1997), Wand and Hanna (1997), and Grable & Lytton (1998) note that age has a positive or no effect on risk tolerance. Barsky et al. (2001) among the aged, the attitude towards risk isn't automatically very risk averse, but exhibits a great deal of heterogeneity. This suggests that increasing risk aversion with age may not be a permanent phenomenon.

Secondly, this study assumes that an individual has only a single risk attitude, which he uses in each of the decisions made. However, one could argue based on mental accounting and the results of previous risk attitude decision studies that the risk attitude depends on the domain and asset type, i.e. an investor might invest some of his assets conservatively onto deposits and simultaneously invest some onto derivatives, or take risks in car driving, but invest carefully. This result was obtained by Dohmen et al. (2005), who note that the willingness to take risks is domain specific. Therefore, the results of my study are likely applicable only in the financial domain.

Thirdly, the determinants of risk in this study are based on proxies, i.e. they are not able to risk attitudes completely, which can be seen in the observed correlations for instance between debt and age, income and gender. If proxies were to be avoided, each one of the studied investors should respond to a questionnaire, which would address factors such as optimism and confidence directly (see Nosic and Weber, 2007). This kind of questionnaire would require a great effort to conduct in order to obtain similar quantity of samples as in my data.

However, despite these limitations, I believe that the results that I have obtained, add to the current scientific community around risk attitudes and risky investment decisions in the financial domain.

6 Conclusions

I study different risk attributes generally thought of affecting investors' risk attitudes and add actual investments made by these investors to the analysis in order to answer two main questions; (1) How exogenous variables, such as age, gender and education affect investors' risk attitudes (determinants of risk); (2) How investors' risk attitude affects their investment allocation (risky decision making). I address these questions by examining a pool of private Finnish investors (N=85,063), which includes demographic statistics, attitudes towards risk, as well as actual investments. The data is collected from OP-Pohjola Group's branch offices between March 2007 and December 2008.

The main findings are following. First, the attitude of Finnish investors towards risk is very risk averse, when measured with a 5 point risk profile scale and their actual investments, majority being in deposits or in short term bonds, reflects this attitude. Second, the traditional determinants of risk weren't the only strong predictors of risk attitude; having a high allocation in equities and having debt were also significant signs of positive risk attitude. A clear indicator that risk attitudes can explain actual risky behavior. Third, age is a strong predictor of risk aversion, consistent with previous studies. I found that age is non-linearly linked with risk attitudes; the risk attitudes of investors increase until a certain pivot point (e.g. retirement) after which the risk attitude starts declining.

However, although aging seems to make investors risk averse, this does not immediately affect their actual risk position, which takes a shape of a parabolic function and starts adjusting to the changed risk attitude over a decade after. For unknown reasons, downgrades in the risk attitudes do not lead to immediate adjustments in risk positions. Mental accounting might be one reason causing this phenomenon and another might be differences in the risk attitudes of investment advisors and investors. For instance Halko and Kaustia (2009) find that on average investment advisors are less risk averse than investors, which might slow down the adjustment of risk level of the portfolio for those investors relying on investment

advisory provided by the bank. Taxation might also play a role in the slow adjustment; deferring capital gain realizations can incur tax benefits.

Furthermore I found that experience and gender have a significant effect on risk attitudes, consistent with previous studies (see Prince, 1993; Lundberg et al. 1994; Sung and Hanna, 1996; Grable and Joo, 1997; Embrey & Fox, 1998; Grable and Lytton, 1998, Grable and Lytton 1999; Byrnes et al., 1999; Barber & Odean, 2001; Hallahan et al., 2004; Dohmen et al., 2005). The more experienced take more risk, and males take generally more risk. For males the risk attitude is on a general level more positive and when measured by actual risk taken, they take more risk than women, even when compared to women having similar attitude towards risk. Fifth, I find that debt is also a significant factor affecting risk attitudes. Surprisingly, debt was strongly correlated with income, but not wealth, suggesting that those earning more are also keener to take more risk.

These findings raise the following ideas for further research. First of all it would be interesting to study, why the attitude towards risk is quite negative among private Finnish investors, especially among the elderly. Is the negative attitude towards risk something that will persist among the younger generations, when they grow old or is it just a temporary phenomenon? Smaller scale studies suggest that the risk aversion isn't nearly as high among university students (see Halko and Kaustia, 2009). A longitudinal research, which would assess how investors' risk attitudes change within time, would lighten this area.

Secondly, the actual level of risky investments is very low in Finland (compare to Siegel, 2008), even among the least risk averse investors, a study assessing the acquisition order of financial products and possible barriers affecting the acquisition of more risky products might bring useful information to the scientific community, as well as to the practitioners. Thirdly, the link between risk attitudes and actual risk taken is somewhat clear, if the risk attitude is unchanged or is adjusted upwards. My evidence suggests that downward adjustments are reflected slowly in the actual investments. Thus it would be interesting to study, which factors cause the slow downward adjustment.

7 References

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8 Appendix

Appendix A: IAT risk profile questions

Olen kiinnostunut
- säästämään eläkepäivien taloudellista turvaa varten
- säästämään oman asunnon hankintaa varten
- säästämään lapsille/lapsenlapsille
- säästämään auton, veneen, kesämökin tms. hankintaa varten
- säästämään tulevia tarpeita varten
- sijoittamaan jo kertyneitä varoja.

Miten kuvailisit itseäsi säästäjänä ja sijoittajana?
- Tavoittelen parasta mahdollista tuottoa pitkällä aikavälillä ja olen valmis ottamaan paljon riskiä.
- Tavoittelen hyvää pitkän aikavälin tuottoa ja olen valmis ottamaan aika paljon riskiä.
- Tavoittelen hyvää arvonnousua ja olen valmis ottamaan jonkin verran riskiä.
- Tavoittelen tasaista arvonnousua ja olen valmis ottamaan vähän riskiä.
- Tavoittelen pientä arvonnousua ja haluan sijoitusteni pääoman olevan turvassa.

Miten koet säästöjesi tai sijoitustesi arvon heilahtelut?
- Tiedän, että arvonheilahtelut kuuluvat sijoitustoiminnan luonteeseen, joten hyväksyn suuretkin arvonheilahtelut sijoitusteni arvossa.
- Tiedän, että arvonheilahtelut kuuluvat sijoitustoiminnan luonteeseen, joten hyväksyn, että sijoitusteni arvo voi heilahdella kohtalaisen paljon sijoitusaikana.
- Tiedän, että arvonheilahtelut kuuluvat sijoittamisen luonteeseen, joten hyväksyn, että sijoitusteni arvo voi sijoitusaikana tilapäisesti laskea jonkin verran.
- Sijoitusten arvonheilahtelu on epämiellyttävää, mutta hyväksyn, että sijoitusteni arvo voi sijoitusaikana tilapäisesti myös hieman laskea.
- En hyväksy sijoitusteni arvonheilahteluja missään olosuhteissa.

Mikä on koulutustaustasi?
- peruskoulu
- lukio
- ammatillinen koulutus
- ammattikorkeakoulu
- yliopisto

Kuinka pitkä sijoituskokemuksesi ja -tuntemuksesi on seuraavien tuotteiden osalta?

Tuote	Sijoituskokemus vuosina
Säästämisen ja sijoittamisen tilit	_____
Rahamarkkinavälineet	_____
Joukkovelkakirjalainat	_____
Strukturoidut tuotteet (esim. indeksilainat)	_____
Korkorahastot	_____
Osake- ja yhdistelmärahastot	_____
Osakkeet	_____
Warrantit	_____
Johdannaiset	_____
Säästö-, sijoitus- ja eläkevakuutukset	_____
Muu, mikä	_____

Appendix B: IAT Investment Plan questions

Miten pitkäksi aikaa voit sijoittaa varasi?
- Yli 7 vuotta tai toistaiseksi
- Yli 6 vuotta
- Yli 5 vuotta
- Yli 4 vuotta
- Yli 3 vuotta
- Yli 2 vuotta
- Yli 1 vuosi
- Alle 1 vuosi

Miten säännöllisesti seuraat rahoitusmarkkinoita ja sijoittamiseen liittyvää uutisointia?
- Päivittäin
- Viikoittain
- Kerran kuukaudessa tai harvemmin

Miten itse haluat vaikuttaa sijoituspäätöksiin?
- Käytän aikaa sijoitusteni hoitamiseen ja haluan itse aktiivisesti vaikuttaa sijoituspäätöksiin.
- Haluan valmiin sijoitusrahasto- tai vakuutusratkaisun, jossa asiantuntija huolehtii sijoituksistani.
- Olen kiinnostunut henkilökohtaisesta varainhoitajasta.

Miten pitkäaikainen kokemus sinulla on sijoittamiseen liittyvistä asioista?
- Olen aloittelija eikä minulle ole lainkaan sijoituskokemusta.
- Minulla on hieman aikaisempaa sijoituskokemusta.
- Olen kokenut sijoittaja ja minulla on jo usean vuoden sijoituskokemus.

Mikä on pääasiallinen tulonlähteesi?
- Palkka tai eläke
- Pääomatulot
- Muu tulonlähde, mikä

Mikä on nettotulojesi määrä/kk?
- alle 1000 euroa
- 1 000 – 3 000 euroa
- 3 000 – 5 000 euroa
- 5 000 – 8 000 euroa
- yli 8 000 euroa

Minkä suuruiset ovat säännölliset menosi/kk?
- alle 500 euroa
- 500 – 1 000 euroa
- 1 000 – 2 000 euroa
- 2 000 – 5 000 euroa
- yli 5 000 euroa

Appendix C: IAT Investment Plan – Investor's wealth form

Kuinka suuri sijoitusvarallisuutesi on ja miten se jakautuu tällä hetkellä?

Täydennä kenttiin nykyinen sijoitusvarallisuutesi. Kokoamme omaisuusluokkatason yhteenvedon sijoituksistasi.

Sijoitusvarallisuus	Osuuspankissa	Muualla
Lyhyet korkosijoitukset		
Pankkitilit	_____	_____
Sijoitusvakuutukset, lyhyen koron osuus	_____	_____
Lyhyen koron rahastot	_____	_____
RM-instrumentit (yrityksille)	_____	_____
Yhdistelmärahastot, lyhyen koron osuus	_____	_____
Pitkät korkosijoitukset		
Korkotuottoiset säästövakuutukset	_____	_____
Sijoitusvakuutukset, pitkän koron osuus	_____	_____
Joukkovelkakirjalainat	_____	_____
Pitkän koron rahastot	_____	_____
Yhdistelmärahastot, pitkän koron osuus	_____	_____
Osakkeet		
Osakerahastot	_____	_____
Sijoitusvakuutukset, osakkeiden osuus	_____	_____
Pörssiosakkeet	_____	_____
Johdannaiset	_____	_____
Yhdistelmärahastot, osakkeiden osuus	_____	_____

Yllättäviin menoihin varatut säästöt
(Vähennä yllättäviin menoihin varatut säästöt pankkitilien saldosta.) _____

Muu omaisuus

Asunnot
Oma asunto _____
Sijoitusasunto _____

Muu kiinteä omaisuus
Loma-asunto _____
Maa- tai metsäomaisuus _____
Muu kiinteä omaisuus _____

Muu sijoitusomaisuus _____