Which Measures Predict Risk Taking in a Multi-Stage Controlled Decision Process?*

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Abstract:

In this paper we assess the ability of different risk profiling measures to predict risk taking when individuals are involved in a process of discovering their willingness to take risks in a multi-stage decision process. The latter involves decisions under ambiguity, decisions after gaining experience and decisions after receiving outcome information on previous decisions. We find that in all decisions risk taking can be predicted by estimated individuals' risk tolerance but it is not related to the experience that participants report to have with investments. Although simulated experience as part of our study design improves the risk awareness and leads to higher risk taking, it cannot substitute the assessment of risk tolerance and in particular the assessment of individual's loss aversion that are part of our study design. In contrast, self-assessed risk tolerance measures are not suitable for predicting risk taking in any stage of the decision process. If the individual risk tolerance cannot be assessed and one has to rely on socioeconomic characteristics, only the gender can be used as a predictor of risk taking.

Key words: risk profiling, risk tolerance, risk attitude, risk preferences, risk taking, experience sampling

JEL Classification: D81; G11

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1 Introduction

An essential task in investment management is to determine the amount of risk an investor should take. Bearing too much risk boosts the expected return but may lead to an abortion of the investment when the investors incurs losses leading to a detriment effect on performance. In principle, investors could discover their ability to bear risks through own experience on the financial market, but this approach could be very costly. To assist investors and justify their recommendations as required by regulators, financial professionals employ various techniques to determine the optimal level of risk one should take.

In this study we aim to evaluate the suitability of such risk profiling techniques. Similar to other studies on the same topic (Corter & Chen, 2006; Gilliam et al., 2010; Grable & Lytton, 2003; Guillemette et al., 2012), we evaluate the measures based on their power to explain and predict individual risk taking behavior. Additionally, we consider the possibility that individuals are not always able to correctly anticipate their emotional reactions to possible outcomes when taking risks (Kahneman, 2009). We design a controlled multi-stage process of decisions that is similar to good advisory practice along which investors learn their optimal level of risk taking. If individuals are involved in a process of discovering their willingness to take risks, then the relationship between the assessed risk tolerance and risk taking may become unstable. Relating measures of risk tolerance with actual decisions taken in practice is suboptimal since the actual decisions can be seen as one snap-shot of the learning process, i.e. the assessed risk tolerance would match risk taking only by chance.

To shed some light on the relation between risk measures and risk taking, we study experimentally whether individual's risk taking changes over different stages of a decision process and how the ability of risk profiling questions for predicting risk taking behavior changes over these stages. According to the decision theory literature, decision situations differ in the amount and quality of information (see Ellsberg (1961) for a classical study) and the way information is presented (see for example Tversky & Kahneman (1981)). Additionally, the literature finds that risk taking can change with experience. The latter can be gained through feedback about the outcomes of previous decisions or through simulated outcomes on the market, which saves time and costs (Kaufmann et al., 2013). Using a within-subject experimental design, we analyze whether individual risk taking and the ability of different risk profiling questions to predict risk taking changes over the stages of the decision process. In particular, we analyze whether simulated experience can substitute risk profiling questions in explaining and predicting individual risk taking behavior.

We find that estimated individual risk tolerance explains risk taking in all stages of the decision process while risk awareness and investment experience cannot. Moreover, although simulated experience improves risk awareness and supports risk taking, it cannot be used as a substitute for risk tolerance when explaining and predicting risk taking. The latter requires in particular an assessment of

individuals' loss aversion. Interestingly, we find that self-assessed risk tolerance measures are not suitable for predicting risk taking in any stage of the decision process. If individuals' risk tolerance cannot be assessed and one has to rely on socioeconomic characteristics then only the gender can be used as a predictor of risk taking.

The results of our study have important policy implications. Regulators in most developed countries acknowledge the importance of using risk profilers and professional advisors employ various risk profiling methods to justify their recommendations. However, it is not clear whether the risk profilers used in practice are suitable for determining the optimal level of risk taking. Their external validity is sometimes tested based on real asset allocation decisions (Corter & Chen, 2006; Gilliam et al., 2010; Grable & Lytton, 2003; Guillemette et al., 2012). However, as stated above, it is unclear whether a particular asset allocation is a good assessment criterion as clients may be involved in a process of discovering their willingness to take risks. In this case, the contribution of each risk profiling question in explaining risk taking behavior may change and so its suitability does.

2 Literature Review and Research Hypotheses

Using different measures of individual risk tolerance, previous studies found that these measures are related to individual investment risk taking. For example, Barsky & Juster (1997) find that risk tolerance revealed in a hypothetical choice between uncertain income streams predict stock ownership. Yook & Everett (2003) find a significant positive correlation between the total score of several risk tolerance measures and the percentage of actual stock holdings in portfolios. Corter & Chen (2006) propose another risk tolerance measure and show that it is positively correlated with the riskiness of actual investment portfolios chosen. Wärneryd (1996) finds a significant relationship between the individual investment attitude based on risk-return considerations and the risk in portfolios of Dutch households. Gilliam et al. (2010) find a significant positive association between broadly used risk tolerance measures and equity ownership.

While these studies show that the evaluation of the individual risk tolerance is important for explaining investment risk taking, it remains unclear whether the explanation power remains stable over time since individuals change their risk taking behavior. We consider information- and experience-driven changes in investment risk taking. At the beginning, investors are expected to make investment decisions under ambiguity. Since the seminal work of Ellsberg (1961), several studies have shown that people are averse to ambiguity. Frisch & Baron (1988) argue that ambiguity arises from the perception of missing information relevant for a probability judgment, which supports the normative status of utility theory. From a theoretical perspective, ambiguity is important because it motivates a lower stock market participation as compared to the basic expected utility model (see for example Epstein & Schneider, 2010 among others). Antoniou et al. (2015) confirm the prediction of the theoretical ambiguity literature. In particular, they find that an increase in ambiguity is associated

with reductions in capital flows into equity mutual funds. Hence, providing information that makes probability judgments easier can increase risk taking. From this literature we conjecture that our participants take less risk in the first stage than in later stages of our experiment.

In the second stage of our experiment participants have to take the same decision as before but now they can acquire a three different descriptions of the returns of the risky asset. Previous studies have shown that even if individuals are provided with identical information, the presentation format can influence the utilization of information. In a classic demonstration of this phenomenon, Slovic et al. (1978) observe that the presentation of formally equivalent statistics influences risk taking behavior. Similar types of framing effects have been reported in the literature on decision-making (Tversky & Kahneman, 1981). Framing effects have been extensively used to modify risk relevant behavior, facilitate cooperative conflict resolutions and advance knowledge or attitudes (see Rohrmann (1992) for an overview). We focus on the last aspect and hypothesize that individuals have different abilities to utilize information in different formats, which may influence their risk taking behavior.

In the third stage of our experiment participants have to take the same decision as before but now they have to answer risk profiler questions. The effect, wherein individuals change their behavior in respond to being monitored has been widely discussed in health economics (Parsons, 1974) and consumer behavior research (Fitzsimons & Williams, 2000). In our study, we take into account the existence of assessment effects in the context of investment risk taking.

In the fourth stage of our experiment participants can experience the return distribution by drawing samples from it before they have to take the same decision as before. Converging findings show that there are systematic differences between decisions based on experience and decisions based on description (Ralph Hertwig & Erev, 2009) particularly in the context of decisions involving rare events (Hertwig et al., 2004). Kaufmann et al. (2013b) show that communicating risk with the help of experience sampling and graphical displays leads to higher risk taking. Goldstein et al. (2008) suggest that using interactive methods allowing individuals to explore the probability distributions of potential outcomes can be beneficial for inferring preferences and predicting subsequent risk taking behavior. In line with this research, we hypothesize that experience sampling influences risk taking. In particular, we analyze whether experience sampling can substitute the assessment of the individual risk tolerance in explaining and predicting risk taking behavior.

In the next stage of our experiment the participants get a break of three days in which they can study carefully the design of the experiment and what they have done so far. Previous research suggest that decision-makers switch to simpler strategies if decisions have to be made under time pressure, which can explain preference reversals (Ordonez & Benson, 1997). In negotiations for example, individuals seem to reach a higher-quality agreement after a break as the latter allow them to assess strategies and behavior (Harinck & De Dreu, 2008). We hypothesize that giving individuals time to re-evaluate the decision problem may have an impact on their subsequent risk taking.

After the three days break the participants have to take the same decision as before and get informed about the outcome of the previous investment decisions. Then their satisfaction is assessed and they shall once more make the same investment decision. Given that all relevant information is available before a decision is made, the outcome of a decision cannot be used to improve subsequent decisions. However, Fischhoff (1975) demonstrates the existence of a hindsight bias, an effect of the outcome information on the judged probability for different outcomes. His explanation for observing this bias is that outcome information calls attention to that information that would make a decision good or bad. For example, bad outcomes call attention to the risks associated with the decision as an argument against taking the decision. We hypothesize that the information on the outcomes of previous decisions may affect the subsequent risk taking and take the effect into account when assessing the suitability of risk profiling questions.

3 Survey Design

As mentioned in the previous section, our study consists of six stages, which differ either in the information that individuals receive or in the tasks they have been asked to perform. Table 1 provides an overview of all stages. It specifies the information that is additionally provided in every stage and the tasks that the individuals were asked to perform after receiving the new information.

A common task in each stage is an investment decision. In each stage, individuals were endowed with financial wealth expressed in Experimental Currency Units (ECU) and asked to spilt the wealth between a risky and a riskless asset. The amount in ECU varied between individuals in dependence on their true financial situation, which was assessed in advance together with other demographic and socio-economic characteristics. The monetary value of all ECU endowments was 10 Euros. Investment decisions between stages were independent. Individuals were informed that one of their investment decisions will be relevant for their final payment and that the relevant decision will be determined randomly at the end.

Table 1: Survey structure

	New information provided	Tasks
Stage 1: Ambiguity	Information on the return of the riskless asset	• Make an investment decision (1)
Stage 2: Return information	Return distribution of the risky asset (described by graphics, scenarios and statistics)	• Make an investment decision (2)
Stage 3: Profile estimation		• Answer questions assessing risk tolerance, financial knowledge and experience • Make an investment decision (3) • Answer risk awareness questions (1st time)
Stage 4: Simulated experience	Experience the risk-return profile of different asset allocations through simulations	• Answer risk awareness questions (2nd time) • Make an investment decision (4)
Stage 5: Time break	3 days break	• Make an investment decision (5)
Stage 6: Feedback	Receive report of returns with all previous investment decisions	• State satisfaction / expectations • Make an investment decision (6)

In the first stage, individuals have been asked to make an investment decision under ambiguity, i.e. individuals knew only the expected return of the riskless asset. In the second stage of the experiment, individuals received information on the whole return distribution of the risky asset. The information has been provided in different formats. The graphical format used histograms, the verbal format was based on scenarios and the statistical format used descriptive statistics (see Appendix D). The individuals were allowed to use the format that they considered as most helpful but acquiring information was not mandatory. Subsequently, individuals have been asked to make an investment decision for a second time. In the next stage, no new information has been provided. Instead, individuals have been asked questions about their risk tolerance, financial knowledge and investment experience. As asking such questions may change the individual risk taking behavior, we asked individuals to make a third investment decision. Afterwards, individuals were asked questions assessing their risk awareness, i.e. their understanding of the risks and rewards associated with different investment decisions.

In the fourth stage, individuals received the opportunity to experience the riskiness of the risky asset. Our experience sampling tool is based on the same idea as the tool used by Kaufmann et al. (2013), i.e. individuals draw scenarios and observe how the return distribution emerge. Instead of drawing scenarios for one asset allocation, we allowed individuals to simultaneously observe the outcomes of two different asset allocations side-by-side (see Figure A-1 in the appendix). Both asset allocations use the same return realization of the risky asset. Simulations are restarted with every change in the asset allocation. To avoid framing effects, both return distributions were scaled in the same way. After observing the outcomes of at least two hundred scenarios, which required at least 10 drawings, individuals have been asked to answer our risk awareness questions for the second time and to make an investment decision.

In the fifth stage, the individuals have been informed that they will have a three-days break. In reality, clients receive factsheets with investment information. Similarly, individuals were given the option to download the description of the assets for further references. After a break of 3 days, the individuals have been asked to make their fifth investment decision.

In the sixth stage, individuals received a report on the realized returns with each of their five investment decisions. For each decision, the individuals were asked to state to which degree they are satisfied and to which degree they are positively or negatively surprised. Afterwards, individuals were asked to make a last investment choice.

3.1 Incentives

Participants received a base payments of 13.25 Euros and a payoff based on one of the five investment decisions. The relevant decision was selected randomly. The payoff in the selected decisions depended on the preferred exposure to the risky asset and the return of the risky asset, which was drawn from the

previously communicated distribution of the risky asset. Additionally, participants could gain or lose 2% (20 cents) of their initial endowment with every correct (incorrect) answer to the risk awareness questions. All questions that were relevant for the final payment were marked in red and the instructions stated that this indicates payoff relevance.

In the whole sample, the median completion time was 15 minutes, excluding the three-days break. The total payments varied between 21.75 and 27.65 Euros, and was on average 26.20 Euros, which corresponds to an hourly wage of 70 Euros. Assumed that the average individuals has to work 160 hours per month the 70 Euros correspond to a monthly net income of 11'200 Euro which covers all relevant real monthly net income classes of the individuals. The incentives to complete the study were therefore sufficiently high.

3.2 Participants

The survey was conducted online[1] in January 2014 with 439 Germans, aged between 18 and 65. The sample was provided by a professional market research agency and included individuals from a national panel of over 200'000 Germans. Socioeconomic questions were used to apply a quota sampling procedure for selecting participants from the general population to ensure the representativeness of the sample.

We used the time that individuals took to read the instructions and answer the questions to exclude those individuals that are most likely to provide random answers.[2] The filtered sample includes 320 individuals. A summary of their socioeconomic profiles is provided in Table B-1 in the appendix. Most of the individuals have no children, have a high school degree, work as employees without supervisory responsibility, have a monthly net income between 1'300-2'600 Euros and have a financial wealth between 2'500-10'000 Euros.

3.3 Question design

The questions used in our survey assess individual's risk tolerance, risk awareness and financial experience along with socio-economic and demographic characteristics as potential drivers of financial risk taking. The questions are provided in the appendix.

In line with the results of Morrison & Oxoby (2014) who find that loss aversion influences decisions involving risk beyond the effects of risk aversion, we assess risk aversion and loss aversion as separate descriptions of individual's risk tolerance. The estimation of individual's risk aversion is based on self-assessments. Individual's loss aversion is estimated with a table task, which is based upon the popular Holt & Laury (2002) procedure. In this task, individuals were asked to make 8 binary comparisons. In each comparison, they have been asked to select either the safe option or the risky

[1] Online studies allow an effective access to a sample of the general population. Moreover, they allow for tracking the time individuals spend on each question.
[2] We excluded all individuals that needed less than one and a half minutes for reading the instructions and less than fifteen minutes to finish the survey.

option. A control questions describing the individual's choice asks individuals to confirm or revise their decision.

The question assessing individual risk awareness aim to evaluate subject's understanding of the return distribution of the risky asset. We used multiple choice questions with individually randomized answers. In addition to answering the questions, we asked individuals to state their confidence in the correctness of their answers.

In order to compare the different question types, we apply the same 7-point Likert scale to all questions[3]. For three questions it was not appropriate to use a Likert scale. In these cases we carefully ensured that the questions had seven answer possibilities with an equal psychological distance, i.e. we used numbers such as years for the financial experience questions, which exactly defined the steps between the answers. In the empirical analysis we treated the answers as an interval-based numerical dataset.[4]

4 Results

4.1 Changes in risk taking along the decision process

Our experimental design is based on the idea that individuals facing investment decisions are involved in a process of discovering their willingness to take risks. To test this conjecture, we first consider the individual changes in risk taking between two subsequent stages of the decision process. Summary statistics reported in Table 2 suggest that in all stages about half of all individuals change their risk taking. Except in the stage after the experience sampling, where individuals increase their risk taking by 4% on average, risk taking revisions do not have a clear direction.

Table 2: Risk taking revisions

	Individuals Changing Risk Taking	Level of Risk Taking Revisions			
		Mean (in%)	SD (in%)	Min (in%)	Max (in%)
Stage2-Stage1 (after ambiguity reduction)	0.559	-0.067	14.43	-57	50
Stage3-Stage2 (after risk profiling questions)	0.463	0.214	12.39	-55	55
Stage4-Stage3 (after experience sampling)	0.613	4.019	16.07	-90	65
Stage5-Stage4 (after break)	0.541	-1.299	13.09	-60	50
Stage6-Stage5 (after outcome feedback)	0.562	0.189	12.87	-50	55

Next we test whether the risk taking revisions are associated with individual characteristics observable in the corresponding stages. Relevant characteristics of the stages that differ among individuals are linked to (1) the demand of information on the risky asset, (2) an improvement in the risk awareness

[3] For the quantitative financial loss aversion question we used 8 answer possibilities. The last 2 possibilities were merged as only 3 individuals used the 7th possibility in their choices. The results of a robustness test with the combined answer possibilities shows that the results remain stable.

[4] According to the literature, Likert scales can be considered as an interval based measure, i.e. parametric analysis is appropriate (Carifio & Perla, 2007; Norman, 2010; Pell, 2005).

after the experience sampling, and (3) the average portfolio return with past investment decisions, expectations and satisfaction with these returns. Table 3 report summary statistics on risk taking revisions between two subsequent decisions. It also includes results of independent tests on the association of individual characteristics observed in different stages of the decision process and risk taking revisions.

Table 3: Risk taking revisions and individual characteristics

The table presents summary statistics of risk taking revisions as well as the percentage of individuals changing risk taking over two subsequent decisions. It also reports the results of independent tests on the association between risk taking revisions and individuals' characteristics in different stages. In the case of variables with two categories, the Pearson Chi2-Test is equivalent to the one-sides Fisher exact test.

		Level of Risk Taking Revisions						
		Mean (in%)	SD (in%)	Min (in%)	Max (in%)	Kruskal-Wallis Test (p-value)	Individuals Changing Risk Taking	Pearson Chi2-Test (p-value)
Acquire Information								
no		-0.48	14.56	-50	50		0.47	
yes		0.08	14.42	-57	50	0.510	0.59	0.036
Risk Awareness								
q1	deterioration	-2.78	17.06	-48	30		0.65	
(extreme returns)	no change	4.03	16.22	-90	65		0.62	
	improvement	6.33	14.75	-30	53	0.070	0.57	0.665
q2	deterioration	4.53	13.72	-20	30		0.68	
(low returns)	no change	4.10	15.95	-90	65		0.61	
	improvement	3.19	18.28	-48	65	0.872	0.62	0.790
q3	deterioration	4.05	12.61	-30	35		0.59	
(extreme low returns)	no change	4.82	15.59	-40	65		0.61	
	improvement	-6.95	24.41	-90	10	0.351	0.63	0.959
q4	deterioration	6.60	15.05	-20	50		0.76	
(extreme high returns)	no change	3.16	15.68	-90	65		0.59	
	improvement	9.26	19.24	-30	65	0.068	0.65	0.249
q5	deterioration	4.32	14.60	-48	35		0.66	
(volatility)	no change	4.21	16.08	-90	65		0.61	
	improvement	2.41	17.96	-40	60	0.420	0.56	0.690
q6	deterioration	8.27	16.39	-15	63		0.63	
(average return)	no change	3.73	16.32	-90	65		0.61	
	improvement	2.57	11.69	-30	35	0.464	0.65	0.874
Av. Outcome	non-positive	-17.94	14.52	-50	0		0.89	
	positive	1.27	11.95	-50	55	0.000	0.54	0.003
Expectations	comforted	1.61	11.24	-50	45		0.52	
	disappointed	-2.68	15.30	-50	55	0.001	0.65	0.016
Satisfaction	comforted	1.58	12.60	-50	55		0.54	
	disappointed	-3.22	12.94	-48	30	0.002	0.61	0.149

We observe that individuals acquiring information on the risky asset are more likely to change their risk taking. Additional Kruskal-Wallis tests, which are not reported, suggest that the description type (verbal, graphical, statistical) is not associated neither with the risk taking revisions nor with the level of risk taking in the second stage. Further, we observe that individuals who improve their awareness of extreme outcomes and extreme positive outcomes after the experience sampling take on average more risks. Finally, we observe that individuals change risk taking after receiving information on the outcomes of previous decisions. In particular, individuals receiving on average a bad (non-positive) outcome reduce their risk taking while individuals receiving on average a good (positive) outcome

with previous decisions take more risks. There are significantly more individuals changing their risk taking after bad outcomes (89%) than individuals changing their risk taking after good outcomes (54%). Similarly, individuals disappointed by their previous returns tend to reduce their risk taking, while individuals comforted with their previous returns tend to increase their risk taking.

So far we find that the stages of the decision process under consideration are associated with significant changes in individual risk taking. But do individuals learn something about their willingness to take risks by going through the various stages? To answer this question we asked individuals to state which investment decision they consider as the best one. We asked this question just before the outcomes of their investment decisions were revealed to them. Table 4 shows the distribution of preferred choices of individuals who changed their risk taking in some decision stage and individuals who did not.

Table 4: Preferred investment decisions

	1. Decision	2. Decision	3. Decision	4. Decision	5. Decision	N
No Revisions in Risk Taking	65.2%	8.7%	8.7%	4.4%	13.0%	46
Revisions in Risk Taking	19.7%	16.4%	18.6%	15.3%	29.9%	274

We observe that 86% (274) of all participants revise their risk taking at least once over the five decision stages. About one third of them state that their best decision is the last one. This view is shared only by 13% of the participants who do not change their risk taking. The association between risk taking revisions and choosing the last decision as the best one is statistically significant (Fisher's exact test, p-value: 0.02). We conclude that the provided decision stages were helpful for participants involved in a process of discovering their willingness to take risks.

Overall, we find that individual risk taking changes significantly after receiving information on the risky asset although the direction of risk taking depends on individual preferences. In contrast, the individual risk taking increases significantly after improving risk awareness in the experience sampling task. Although the outcome of previous decisions should not change risk taking as outcomes cannot be accumulated over stages, there are significant differences in the risk taking revisions of individuals experiencing on average good or bad outcomes with their previous decisions. Finally, we find that individuals involved in discovering their willingness to take risks learn successfully over the different stages of the decision process.

4.2 Explaining risk taking in the decision modes

In this section we analyze the importance of individual risk tolerance, risk awareness and financial experience as drivers of investment risk taking. The evaluation of these factors is based on a factor analysis. The analysis shows that the answers to the twenty questions evaluating individuals' risk tolerance, risk awareness and financial experience can be summarized by 3 different factors, which are uncorrelated to each other (see Appendix C for more details).

In the following, we use these factors in ordinary least square regressions to test whether they can explain risk taking as expressed by the amount of wealth that individuals invest in the risky asset in each stage. Previous research suggest that demographic and socioeconomic characteristics influence individual's risk tolerance and risk taking (see for example Grable & Lytton, 2003; Sundén & Surette, 1998; Xiao, 1996). To take this into account, we use age, gender, number of children, education, job position, income and wealth as controls in each regression. As an additional independent variable, we include an indicator variable that capture whether the individual acquires information on the risky asset or not. In the last decision, we include the average return of the previous investment decisions as a further independent variable. A description of the independent variables is provided in Appendix B. The estimation results are reported in Table 5.

Table 5: Risk taking drivers

The table reports the estimation results of ordinary least square regressions with the percentage of wealth invested in the risky asset (0-100) as a dependent variable in each regression. Standards errors are given in parentheses. Age, gender, number of children, education, job position, income and wealth are used as controls. ***,**, and * indicate significance levels of 1%, 5%, and 10% respectively.

Decision 1								
Risk Preference	8.628***	9.651***					8.623***	9.622***
	(1.198204)	(1.095)					(1.209)	(1.098)
Risk Awareness			-1.166	0.514			-0.396	0.759
			(1.492)	(1.434)			(1.384)	(1.289)
Fin. Experience					-0.451	1.555	0.347	0.985
					(1.6044)	(1.331)	(1.486)	(1.201)
Acquire	9.159***	10.201***	9.652***	9.761***	8.849**	10.349***	9.486***	9.738***
Information	(2.490)	(2.304)	(2.839)	(2.796)	(2.743)	(2.570)	(2.652)	(2.519)
Controls	yes	no	yes	no	yes	no	yes	no
Adjusted R^2	0.2506	0.2297	0.1166	0.04133	0.115	0.04505	0.2457	0.2274
Decision 2								
Risk Preference	9.353***	10.228***					9.464***	10.218***
	(1.2338)	(1.137)					(1.244)	(1.139)
Risk Awareness			-0.1056	1.349			0.759	1.612
			(1.551)	(1.494)			(1.4244)	(1.337)
Fin. Experience					0.04716	1.651	0.971	1.005
					(1.665)	(1.388)	(1.529)	(1.245)
Acquire	10.295***	10.761***	10.157***	9.676**	10.108***	10.919***	10.127***	9.645***
Information	(2.564)	(2.392)	(2.951)	(2.913)	(2.848)	(2.680)	(2.728)	(2.611)
Controls	yes	no	yes	no	yes	no	yes	no
Adjusted R^2	0.27	0.2368	0.1234	0.04445	0.1234	0.04625	0.2666	0.2373
Decision 3								
Risk Preference	9.398***	10.172***					9.402***	10.196***
	(1.2339)	(1.140)					(1.245)	(1.145)
Risk Awareness			-1.138	0.231			-0.298	0.565
			(1.5512)	(1.497)			(1.425)	(1.344)
Fin. Experience					-0.487	0.344	0.389	-0.247
					(1.667)	(1.392)	(1.531)	(1.252)
Acquire	10.7677***	10.739***	11.2282***	10.515***	10.430***	10.735***	11.049***	10.273***
Information	(2.565)	(2.398)	(2.951)	(2.920)	(2.850)	(2.687)	(2.731)	(2.626)
Controls	yes	no	yes	no	yes	no	yes	no
Adjusted R^2	0.271	0.2341	0.1248	0.04179	0.1234	0.0419	0.2662	0.2297
Decision 4								
Risk Preference	9.635***	10.719***					9.857***	10.67***
	(1.3872)	(1.248)					(1.3926)	(1.245)
Risk Awareness			1.283	2.741			2.0013	2.686
			(1.680)	(1.600)			(1.5607)	(1.443)
Fin. Experience					0.7789	1.722	1.9091	1.146
					(1.8448)	(1.504)	(1.7153)	(1.354)
Acquire	12.646***	13.157***	11.31***	10.772***	12.154***	12.677***	12.137***	11.559***
Information	(2.882)	(2.628)	(3.224)	(3.076)	(3.1483)	(2.914)	(3.0074)	(2.778)
Controls	yes	no	yes	no	yes	no	yes	no
Adjusted R^2	0.2279	0.2284	0.09951	0.05763	0.09824	0.05283	0.2298	0.2339
Decision 5								
Risk Preference	9.176***	10.137***					9.087***	10.153***
	(1.262)	(1.144)					(1.272)	(1.147)
Risk Awareness			-0.993	0.880			-0.503	0.873
			(1.5404)	(1.4811)			(1.426)	(1.330)
Fin. Experience					-1.837	0.093	-0.974	-0.41
					(1.687)	(1.389)	(1.567)	(1.248)
Acquire	10.414***	11.54***	10.2578***	10.3709***	9.291**	10.93846***	10.414***	10.947***
Information	(2.623)	(2.408)	(2.9557)	(2.847)	(2.880)	(2.692)	(2.747)	(2.561)
Controls	yes	no	yes	no	yes	no	yes	no
Adjusted R^2	0.2431	0.2335	0.1046	0.04461	0.107	0.04356	0.2391	0.2299
Decision 6								
Risk Tolerance	9.4223***	10.143***					9.3997***	10.1586***
	(1.3302)	(1.184)					(1.341)	(1.186)
Risk Awareness			-0.099	1.437			0.428	1.430
			(1.617)	(1.522)			(1.502)	(1.375)
Fin. Experience					-1.625	0.076	-0.660	-0.441
					(1.772)	(1.428)	(1.651)	(1.2905)
Acquire	9.992***	10.346***	9.368**	8.824**	8.905**	9.743***	9.607**	9.397***
Information	(2.763)	(2.492)	(3.103)	(2.925)	(3.024)	(2.768)	(2.896)	(2.647)
Average Return	2.862***	2.911***	3.215***	3.371***	3.204***	3.379***	2.869***	2.899***
	(0.352)	(0.331)	(0.374)	(0.356)	(0.373)	(0.355)	(0.354)	(0.333)
Controls	yes	no	yes	no	yes	no	yes	no
Adjusted R^2	0.1957	0.2137	0.0545	0.0342	0.0573	0.0315	0.1908	0.2116

We observe that among the three factors capturing individuals' risk tolerance, risk awareness and financial experience, only the risk tolerance factor explains risk taking behavior in each stage. Its impact on risk taking is stable over different decision modes and robust to demographic and socio-

economic characteristics used as controls. The influence of the factors capturing individuals' risk awareness and financial experience on risk taking is statistically not significant. Interestingly, we observe significant and robust differences in the risk taking associated with the demand for information on the risky asset. Individuals who acquire information on the risky assets invest about 10% more in the risky asset than individuals who do not acquire information on the risky asset. Although individuals cannot accumulate returns of subsequent investment decisions, their risk taking in the last stage changes with the average outcome of their previous investment decisions.

4.3 Predicting risk taking in the various stages of the decision process

In the following we analyze which combination of single questions has the strongest power to predict risk taking behavior. We apply a cross-validation analysis.[5]

Table 6 reports the estimated coefficients of the variables with a significant predicting power. The risk awareness assessed before (after) the experience sampling is used to predict the first (last) 3 investment decisions. The average return on the past investment decisions is used only in the prediction of the last decision.

Table 6: Predicting power of single questions

The table reports the estimates of cross-validation analysis with the percentage of wealth invested in the risky asset (0-100) as a dependent variable in each regression. Standards errors are given in parentheses. ***,**, and * indicate significance levels of 1%, 5%, and 10% respectively.

	Decision 1	Decision 2	Decision 3	Decision 4	Decision 5	Decision 6
General Risk Taking						3.5532* (1.3725)
General Fin. Risk Taking						
Current Fin. Risk Taking						
Past Fin. Risk Taking						
General Fin. Loss Aversion						
Verbal Fin. Loss Aversion	6.525*** (1.082)	6.438*** (1.115)	6.375*** (1.102)	7.537*** (1.204)	8.334*** (1.125)	5.040*** (1.268)
Quant. Fin. Loss Aversion	5.632*** (1.096)	5.088*** (1.108)	7.905*** (1.102)	8.04*** (1.204)	4.317*** (1.140)	3.941*** (1.086)
Fin. Investing for Thrill						
Professional Exp. In Finance						
Consumption of Fin. News						
Financial Knowledge						
Statistical Knowledge						
Fin. Trading Experience						
Trading Frequency		3.539*** (1.064)				3.576** (1.174)
Risk Awareness 1						
Risk Awareness 2						
Risk Awareness 3						
Risk Awareness 4						
Age class		-2.754** (0.998)				
Female						
Number of Children						
Education						
Professional Status						
Monthly Income		2.674** (1.009)				
Wealth						
Average Past Return						8.137*** (0.971)
Acquire Information	3.956*** (1.011)	4.316*** (1.007)			4.637*** (1.051)	2.745** (1.042)
Adjusted R^2	0.2789	0.3491	0.2995	0.2978	0.2889	0.4363

[5] The analysis uses a recursive feature elimination that cancels step by step the least important predictors out of a model. First, a model with all predictors is trained on a training set. The model is then used to predict the test set. The least important predictor is then dropped out of the model and the whole procedure is repeated for all the subsequent subsets of predictors. In order to avoid any selection bias (e.g. over-fitting to predictors and samples), the train and test data sets are resampled with a 10-fold cross-validation. After the resampling iterations, the most appropriate number of predictors is determined based on the resampling output. The predictors with the best rankings across all the resampling iterations are then used to fit the final model.

We observe that risk taking in all stages is best predicted by individuals' loss aversion. Its assessment is however critical. While a general loss aversion formulation is not helpful in predicting risk taking, a verbal question specifying returns and a quantitative version based on a lottery question are able to predict risk taking in all decision modes. In contrast, risk aversion measures based on self-assessment cannot be used to predict risk taking. Another important predictor of risk taking is the returns of past decisions. Although the odds of the outcomes do not change over time and returns cannot be accumulated, the participants take significantly more (less) risks after observing positive (negative) average returns with their past investment decisions.

In the context of the assessed risk tolerance, demographic and socio-economic characteristics have limited predicting power. To shed some light on this issue we repeat the cross-validation analysis while we exclude risk preference and investment experience questions.

Table 7 reports the estimation results.

Table 7: Predicting power of demographic and socioeconomic characteristics

The table reports the estimates of cross-validation analysis with the percentage of wealth invested in the risky asset (0-100) as a dependent variable in each regression. Standards errors are given in parentheses. ***,**, and * indicate significance levels of 1%, 5%, and 10% respectively.

	Decision 1	Decision 2	Decision 3	Decision 4	Decision 5	Decision 6
Age Class		-3.416**			-2.921*	
		(1.161)			(1.162)	
Female	-3.044**	-3.843**	-3.772**		-4.173***	-3.401**
	(1.145)	(1.160)	(1.171)		(1.165)	(1.078)
Number of Children						
Education						
Professional Status						
Monthly Income						
Wealth	-2.703*					
	(1.201)					
Average Past Return						10.463***
						(1.078)
Acquire Information		4.739***	4.995***	5.535***	4.861***	
		(1.160)	(1.171)	(1.288)	(1.170)	
Adjusted R^2	0.03476	0.09189	0.07211	0.0519		0.252

We observe that among the demographic and socioeconomic characteristics the gender is the most reliable variable in predicting risk taking. Females are less willing to take risks. As in the previous analysis, age can be a good predictor of risk taking in certain situations, while income loses predicting power. The effect of previous returns on subsequent risk taking remains strong.

We conclude that assessed individuals' loss aversion is the most powerful predictor of risk taking in all stages and in the context of all other questions that we use with a potential impact on risk taking. In particular, we find that self-assessed knowledge, experience, and risk aversion are not useful in predicting individual risk taking. Finally, recommending less risky investment can be optimal for female individuals if there is no possibility to assess their risk tolerance.

5 Discussion and implications

Several studies find that estimated risk tolerance is associated with risk taking as inferred from actual stock holdings in portfolios (Yook & Everett, 2003); Corter & Chen, 2006; Gilliam et al. ,2010) or from other risk charakterteristics of portoflios (Corter & Chen, 2006; Wärneryd, 1996). Our results support this finding. Additionally, we found strong evidence that individuals' risk tolerance is a more powerful predictor of risk taking than investors' investment experience and risk awareness measures. More importantly, we found that the association between risk tolerance and risk taking remains significant over different decision stages related to reduced ambiguity, extended experience and feedback on previous decisions.

With respect to the impact of these decision stages on risk taking, we find that reduced ambiguity influences risk taking, but it does not necessary increase it as found by Antoniou et al. (2015). However, we find that extending experience with the risky asset through simulations increases risk taking, which is in line with the results of Kaufmann et al. (2013) and Bradbury et al. (2014). Furthermore, we observe that the average return of previous decisions influences the subsequent risk taking although the odds of the possible outcomes remain the same and returns cannot be accumulated. As suggested by Fischhoff (1975) this behavior can be explained with a stronger focus of the risks (returns) after negative (positive) returns. It is also possible that individuals use outcomes to judge the quality of their previous decisions as suggested by Baron & Hershey (1988). In this case, positive (negative) outcomes would increase (decrease) the confidence in the decision quality and individuals would increase (decrease) subsequent risk-taking as we observe in our experiment.

Risk tolerance measures are usually multidimensional. We analyzed the predicting power of the components and found that individual's loss aversion is the most powerful predictor of risk taking in all decision modes. This supports previous findings that loss aversion measures are more powerful in explaining risk taking than Arrow-Pratt-measures (Guillemette et al., 2012). However, we also found that self-assessed risk tolerance has no predicting power. Among the questions assessing investment experience, we found that only the question related to the trading frequency can predict risk taking in some decision modes. Overall, we found a positive relationship between investment experience and risk taking, which is similar to the results of Corter & Chen (2006).

Several studies suggest that risky asset ownership can be explained by demographic and socioeconomic variables (see for example Grable & Lytton, 2003; Sundén & Surette, 1998; Xiao, 1996). We found that among the assessed demographic and socioeconomic characteristics only gender can predict risk taking in most decision modes but only if the individual risk tolerance cannot be assessed. If the risk tolerance are assessed, gender loses its predicting power. This observation is in line with the results of Wärneryd (1996) and Grable & Lytton (2003).

Our results have important implications for the design of risk profilers. In order to predict risk taking, the latter should include questions assessing the individual risk tolerance and in particular a question

on loss aversion. Gender is a useful predictor of risk taking only if risk preferences cannot be assessed. In contrast, self-assessed investment experience is not a reliable predictor of risk taking but the stated trading frequency can be used as a proxy for investment experience when predicting risk taking.

An important predictor of risk taking is the average past returns. The latter influence the desired risk taking beyond the level based on the assessed risk tolerance. Hence, in addition to assessing individual's risk tolerance a risk profiler should either take into account investor's irrationality or the first should be corrected by additional measures. Otherwise, investors would revise their risk taking for no good reason.

6 Conclusions

The optimal amount of risk an investor should take is one of the most important issues in portfolio management. Since answering this questions through investment experience can be very costly, several studies suggest risk profiling measures and prove their suitability by showing that they can explain risk taking.

This paper studied whether and how the suitability of different risk profiling measures vary if individuals are involved in a process of discovering their willingness to take risks. This process included situations with reduced ambiguity, extended experience and feedback on the outcomes of previous decisions. The results show that individuals learn successfully about their willingness to take risks and that risk taking is significantly associated with individuals' risk tolerance but not with their risk awareness and investment experience outside of this study. Although simulated experience improves risk awareness and supports risk taking, it cannot substitute the assessment of the individual's risk tolerance and in particular the assessment of the individual's loss aversion. In contrast, self-assessed risk tolerance measures are not suitable for predicting risk taking in any stage of the decision process.

The results shed light on the suitability of different investors' characteristics and measures such as experience sampling to predict risk taking. They also suggest that risk profiler should either take into account investor's irrationality or they should be supported by additional measures helping investors to avoid unreasonable risk taking revisions.

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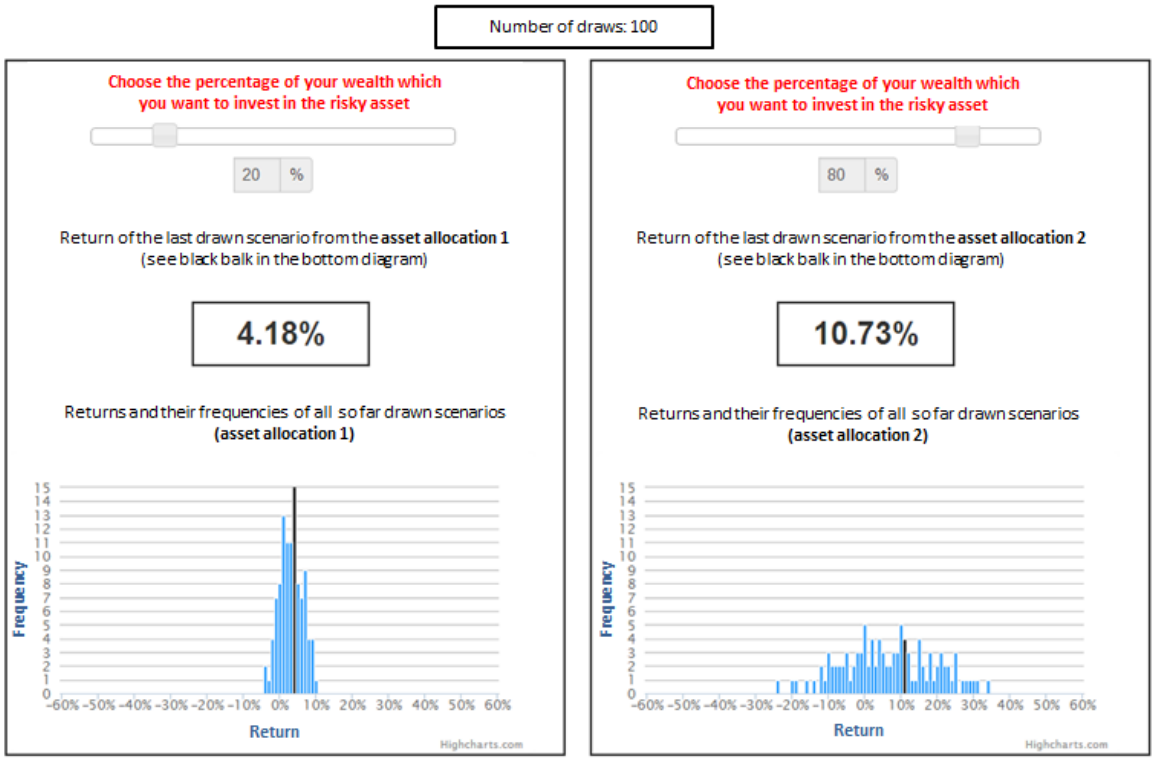
Appendix

A Experience sampling

Figure A-1: Illustration of the experience sampling



B Socioeconomic and demographic characteristics

Table B-1: Sample description

	N	Percentage	Variable Type
Age:			categorical variable
18-24	54	16.88%	0
25-34	44	13.75%	1
35-44	70	21.88%	2
45-54	82	25.63%	3
55-64	70	21.88%	4
Gender:			indicator variable
Male	147	45.94%	0
Female	173	54.06%	1
Number of children			ordinal variable
0	201	62.81%	0
1	62	19.38%	1
2	43	13.44%	2
3	10	3.13%	3
4	4	1.25%	4
Education:			categorical variable
Primary School	10	3.13%	0
Secondary School	65	20.31%	1
High School	96	30.00%	2
Bachelor	39	12.19%	4
Master	45	14.06%	5
PhD	11	3.44%	6
Other Education	53	16.56%	7
No Education	1	0.31%	8
Professional Status:			categorical variable
Self-Employed/In Family Business	37	11.56%	0
Employee in Top Management	18	5.63%	1
Employee with Leadership Position	65	20.31%	2
Employee without Leadership Position	108	33.75%	3
Apprentice	47	14.69%	4
Unemployed	45	14.06%	5
Monthly Income:			categorical variable
0 - 1'300 Euro	60	18.75%	0
1'300 - 2'600 Euro	94	29.38%	1
2'600 - 3'600 Euro	74	23.13%	2
3'600 - 5'000 Euro	54	16.88%	3
5'000 - 18'000 Euro	11	3.44%	4
> 18'000 Euro	1	0.31%	5
No Answer	26	8.13%	
Wealth:			categorical variable
0 - 500 Euro	47	14.69%	0
500 - 2'500 Euro	44	13.75%	1
2'500 - 10'000 Euro	59	18.44%	2
10'000 - 30'000 Euro	46	14.38%	3
30'000 - 65'000 Euro	32	10.00%	4
65'000 - 175'000 Euro	30	9.38%	5
>175'000 Euro	11	3.44%	6
No Answer	51	15.94%	

C Factor analysis

We used 20 questions to assess potential drivers of risk taking. We apply factor analysis, to take into account the correlation in the answers. Kaiser-Meyer-Olkin factor adequacy test as well as the Bartlett's test of sphericity confirm that the data set is adequate for factor analysis. Questions with item-total correlations less than 0.3 were excluded for the further analysis. Furthermore the Cronbach's alpha test shows that each of the individual scales (dimensions) has a high reliability, with values between 0.67 and 0.85.

The factor loadings are determined for the risk awareness questions before and after the experience sampling separately. In both cases, we apply a varimax rotation to receive factors that are not correlated among each other. Table C-1 includes the factor loadings for the questions before and after the experience sampling.

Table C-1: Factor loadings with a varimax rotation

	Factors (before experience sampling)			Factors (after experience sampling)		
	Risk Preference	Financial Experience	Risk Awareness	Risk Preference	Financial Experience	Risk Awareness
General Risk Taking	**0.73**	0.18	-0.11	**0.73**	0.19	-0.11
General Fin. Risk taking	**0.87**	0.29	-0.09	**0.87**	0.29	-0.04
Current Fin. Risk Taking	**0.65**	0.15	-0.01	**0.65**	0.15	-0.02
Past Fi. Risk Taking	**0.56**	0.34	-0.16	**0.56**	0.34	-0.17
General Loss Aversion	**0.4**	0.16	0.03	**0.4**	0.16	0.05
Verbal Loss Aversion	**0.74**	0.11	-0.16	**0.75**	0.11	-0.09
Quantitative Loss Aversion	**0.49**	0.11	0.13	**0.5**	0.11	0.17
Financial Investing for Thrill	**0.6**	0.49	-0.12	**0.61**	0.48	-0.08
Professional Exp. In Finance	0.07	**0.59**	-0.14	0.08	**0.58**	-0.14
Consumption of Fin. News	0.3	**0.67**	-0.02	0.3	**0.66**	-0.01
Financial Knowledge	0.33	**0.74**	0.01	0.32	**0.75**	-0.02
Statistical Knowledge	0.16	**0.47**	0.27	0.15	**0.48**	0.18
Trading Experience	0.15	**0.74**	0.14	0.14	**0.75**	0.13
Trading Frequency	0.44	**0.63**	0.02	0.43	**0.64**	0.01
Risk Awareness 1	0	0.07	**0.72**	0	0.09	**0.77**
Risk Awareness 2	-0.16	0	**0.73**	-0.1	0.02	**0.68**
Risk Awareness 3	-0.08	-0.03	**0.62**	-0.12	-0.08	**0.75**
Risk Awareness 4	0.05	0.02	**0.89**	0.14	0.04	**0.88**
SS loadings	3.81	3.05	2.45	3.82	3.08	2.55
Proportion Variance	0.21	0.17	0.14	0.21	0.17	0.14
Cumulative Variance	0.21	0.38	0.52	0.21	0.38	0.53
Proportion Explained	0.41	0.33	0.26	0.4	0.33	0.27
Cumulative Proportion	0.41	0.74	1	0.4	0.73	1

D Instructions

Please carefully read the following instructions. It will take you approximately 10 minutes. The time is considered in the 45 minutes needed to complete the survey.

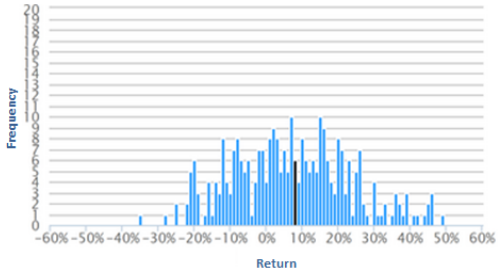
- In this study you will make 5 investment decisions.
- The investment decisions are totally independent from each other. They can – but they do not have to – deviate from your past investment decisions.
- The endowment which is given to you for each of the 5 investment decisions is specified in the currency ECU (Experimental Currency Unit)
- You can split this endowment in a risk-free and a risky financial asset.
- Your chosen asset allocation will then be invested virtually for 1 year.
- The risk-free asset pays a return of 2% p.a.
- The return of the risky asset is randomly drawn from a unknown return distribution and can be positive as well as negative.
- For your final payment at the end of the study, one of the five investment decision outcomes will be randomly chosen.
- Your initial endowment is 10 Euro. Depending on how you are choosing your asset allocation, and how good/bad the return of the risky asset will be, your final payment (additional to the participation fee of Research Now) at the end of the study can be between 6 to 15 Euro.
- In order that you better recognize the payment relevant questions they are marked with a red side balk.
- Examples of possible outcomes:

  Example 1: Suppose your endowment is 10'000 ECU. You choose to invest 60% in the risky asset. Suppose that the randomly drawn return of the risky asset is -16%. Then you will realize a loss of 880 ECU (-0.16 x 6000 ECU + 0.02 x 4000 ECU), which correspond to a negative return of -8.8% respectively. Your endowment of 10'000 ECU will go down to 9'120 ECU.

  Example 2: Suppose your endowment is 10'000 ECU. You choose to invest 60% in the risky asset. Suppose that the randomly drawn return of the risky asset is +16%. Then you will realize a gain of 1040 ECU (+0.16 x 6000 ECU + 0.02 x 4000 ECU) which correspond to a positive return of +10.4% respectively. Your endowment of 10'000 ECU will go up to 11'040 ECU.

Definitions:

In order to make sure that you can make an optimal decision, we kindly ask you to familiarize yourself with the following definitions:

Definition	Description	Example
Earnings	Can be a loss or a gain	-3'000/+3'000 Euro
Invested capital	Amount of money which is invested in order to get a higher amount back.	10'000 Euro
Return	1. Earning per invested capital 2. Typically quoted as a percentage number	$\frac{-3'0000(loss)}{10'000(Invested\ Capital)} = \mathbf{-30\%}$ $\frac{+3'0000(gain)}{10'000(Invested\ Capital)} = \mathbf{+30\%}$
Return distribution	Shows the frequency of single return outcomes.	
Risk	Possibility to realize gains and losses. This also means that risk is the possibility to realize positive and negative returns.	
Financial asset	Contracts where you agree with somebody that you will give him your money and he will give it back based on conditions that you agree on in advance.	1. Bonds which pay a fix interest rate 2. Stocks which pay a dividend depending on the company's performance
Asset allocation and investment decisions respectively.	How the invested capital is allocated to the financial assets in which you can invest.	e.g. 60% in bonds and 40% in stocks

Control questions:

Please answer the following two questions. For each questions only one answer is correct.
The return of the risk-free financial asset is:

- 0% p.a.
- 2% p.a.
- 4% p.a.

An outcome can be:

- A loss or a gain
- Only a gain
- Only a loss

Risk Preference Questions:

General Risk Tolerance

In general, I am a risk loving person. Not True at all 1-2-3-4-5-6-7 Absolutely true

General Financial Risk Tolerance

My risk tolerance when I am investing money is generally high. Not True at all 1-2-3-4-5-6-7 Absolutely true

Current Financial Risk Tolerance

My current willingness to take risk in financial decisions is low. Not True at all 1-2-3-4-5-6-7 Absolutely true

Past Financial Risk Tolerance

My risk tolerance in financial decisions was high in the past. Not True at all 1-2-3-4-5-6-7 Absolutely true

General Financial Loss Aversion

When I am confronted with an important financial decision then I do concern more with the possible losses than with the possible gains. Not True at all 1-2-3-4-5-6-7 Absolutely true

Verbal Financial Loss Aversion

For a 50-percent chance to earn a high amount of money with a financial investment I would be willing to risk an equal amount of money. Not True at all 1-2-3-4-5-6-7 Absolutely true

Quantitative Financial Loss Aversion

You have the choice to invest 500 ECU in a risky or in a risk-free asset. The wealth will be invested for one year. With an equal probability (each with 50%) the risky asset will result in a positive return of +50% p.a. (i.e. 250 ECU) or in a negative return. The risk-free asset will result in a positive return of +2% p.a. (i.e. 10 ECU).

In the following table you can see in each row a comparison between the risky and the risk-free asset whereat the negative return oft he risky asset varies. Please choose at which comparison you like to invest in the risk-free asset (of course you can also always prefer the risky asset). After you made your choice please press the “Next” button.

Risky asset		Decision		Risk-free asset
50% probability to get a return of	50% probability to get a return of	I prefer the risky asset	I prefer the risk-free asset	100% probability to get a return of
50% p.a. (250 ECU)	-8% p.a. (-40 ECU)			+2% p.a. (10 ECU)
50% p.a. (250 ECU)	-15% p.a. (-75 ECU)			+2% p.a. (10 ECU)
50% p.a. (250 ECU)	-22% p.a. (-110 ECU)			+2% p.a. (10 ECU)
50% p.a. (250 ECU)	-29% p.a. (-145 ECU)			+2% p.a. (10 ECU)
50% p.a. (250 ECU)	-36% p.a. (-180 ECU)			+2% p.a. (10 ECU)
50% p.a. (250 ECU)	-43% p.a. (-215 ECU)			+2% p.a. (10 ECU)
50% p.a. (250 ECU)	-50% p.a. (-250 ECU)			+2% p.a. (10 ECU)

Are you sure? In comparison to the risk-free asset (+2%) you prefer the risky asset (50% chance to get a return of +50% p.a. (i.e. +250 ECU)) as long as the possible negative return is not higher than -8%. p.a; beginning at a possible negative return of -15% p.a. you prefer the risk-free asset. Is this really your final decision.

Financial Investing for Thrill

I already invested very often money because of the thrill if its value will go up or down.
Not True at all 1-2-3-4-5-6-7 Absolutely true

Professional Experience in Finance

I collected the big part of my professional experience in the financial sector (investment advisory, insurance, asset management, trustee, tax counseling, auditing, accounting).
Not True at all 1-2-3-4-5-6-7 Absolutely true

Consumption of Financial News

I am very interest in economic news.
Not True at all 1-2-3-4-5-6-7 Absolutely true

Financial Knowledge

I can explain to a friend very well at which things he/she has to look after in the case of risky financial assets.
Not True at all 1-2-3-4-5-6-7 Absolutely true

Statistical Knowledge

I can explain to a friend very well what a probability distribution is.
Not True at all 1-2-3-4-5-6-7 Absolutely true

Financial Trading Experience

Since how many years do you trade financial asset by yourself?

- I have never traded financial assets by myself

- I buy and sell financial assets since about 1 to 3 years.
- I buy and sell financial assets since about 4 to 6 years.
- I buy and sell financial assets since about 7 to 9 years.
- I buy and sell financial assets since about 10 to 12 years.
- I buy and sell financial assets since about 13 to 15 years.
- I buy and sell financial assets since more than 15 years.

Trading Frequency

How many times do you reallocate your financial assets, i.e. how often do you buy and sell financial assets?

- Not at all
- About every second year
- About once a year
- About twice a year
- About four times a year
- About every month
- At least once a week

Risk Awareness And Confidence Questions

Risk Awareness 1

The asset allocation with the highest probability for a strong negative and a strong positive return is:

- 10% risk-free asset / 90% risky asset
- 40% risk-free asset / 60% risky asset
- 80% risk-free asset / 20% risky asset
- 35% risk-free asset / 65% risky asset

How confident are you with your answer?:
Not sure at all 1-2-3-4-5-6-7 Absolutely sure

Risk Awareness 2

Which asset allocation does not allow you to get a return higher than 2%?

- 5% risk-free asset / 95% risky asset
- 0% risk-free asset / 100% risky asset
- 100% risk-free asset / 0% risky asset
- 75% risk-free asset / 25% risky asset

How confident are you with your answer?:
Not sure at all 1-2-3-4-5-6-7 Absolutely sure

Risk Awareness 3

The asset allocation with the greatest risk for negative return in the worst out of 100 cases is:

- 50% risk-free asset / 50% risky asset
- 40% risk-free asset / 60% risky asset
- 10% risk-free asset / 90% risky asset
- 45% risk-free asset / 55% risky asset

How confident are you with your answer?:

Not sure at all 1-2-3-4-5-6-7 Absolutely sure

Risk Awareness 4

The asset allocation with the greatest potential for positive returns in the best out of 100 cases is:

- 60% risk-free asset / 40% risky asset
- 20% risk-free asset / 80% risky asset
- 5% risk-free asset / 95% risky asset
- 15% risk-free asset / 85% risky asset

How confident are you with your answer?
Not sure at all 1-2-3-4-5-6-7 Absolutely sure

Risk Awareness 5

The asset allocation with the smallest variation of returns is:

- 20% risk-free asset / 80% risky asset
- 45% risk-free asset / 55% risky asset
- 80% risk-free asset / 20% risky asset
- 30% risk-free asset / 70% risky asset

How confident are you with your answer?
Not sure at all 1-2-3-4-5-6-7 Absolutely sure

Risk Awareness 6

The asset allocation with the highest expected return is:

- 5% risk-free asset / 95% risky asset
- 10% risk-free asset / 90% risky asset
- 40% risk-free asset / 60% risky asset
- 25% risk-free asset / 75% risky asset

How confident are you with your answer?
Not sure at all 1-2-3-4-5-6-7 Absolutely sure

Descriptions on the Risky Asset

Now you have the possibility for the third time to split your wealth of 120'000 ECU between the same risk-free and risky asset like at the beginning of the study. The wealth will be invested for one year. The return of the risk-free asset is guaranteed and equals to 2%. The return of the risky asset will be randomly drawn.

Return distribution of the risky asset:

- Graphical description

In the following graphic you see the realized returns and their frequencies of 280 randomly drawn scenarios for the risky asset. Higher bars mean higher frequencies.

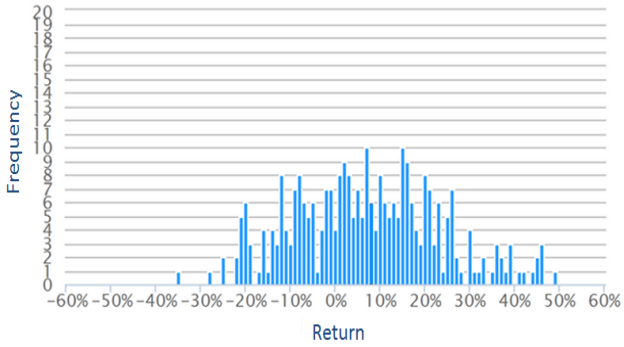


Figure D-1: Example of a return distribution used in the graphical description of the risky asset

- Verbal description

The average return for the risky asset over all possible scenarios is +7% per annum. In 70 out of 100 scenarios one can expect that the return falls between -10% and +24% per annum, and in 30 out of 100 scenarios the return is lower than -10% and higher than +24% per annum.

The positive or negative deviation from the average return is the same, and has the same probability. For example, a return of -3% has the same probability as a return of +17%.

- Statistical description

The returns are normally distributed with a mean of +7% and a standard deviation of 16%. The normal distribution has the property that returns close to +7% are more probable than those further away, and that the probability of a return of -3% has the same probability as a return of +17%.

Which percentage of your wealth would you invest in the risky asset?