Gender Specific Attitudes Towards Risk and Ambiguity:
An Experimental Investigation

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Abstract
On the one hand, empirical evidence shows that in financial markets women seem to behave more risk averse than men. On the other hand there is experimental showing that in risky decisions controlled for opportunity sets only the context matters. In investment and insurance contexts with given probabilities women seem to expose approximately the same risk aversion as men. However, in real-life decisions the probability information is rather ambiguous. Therefore also the framing of information may be important. We conducted a lottery experiment introducing three types of probability information: pure risk, weak ambiguity and strong ambiguity. Our main result is that gender differences may arise in ambiguity frames: women are more ambiguity averse than men in the investment context, but not in the insurance context.

Keywords: gender, risk, financial markets, risk aversion, ambiguity

1. Introduction

When dealing with financial decision making, one is often confronted with a gender stereotype, i.e. with the opinion that women are more risk averse than men. Obviously, this stereotype yields statistical discrimination of women. Female managers have to face "glass ceilings" in corporate promotion ladders more often than men since it is assumed that they are not taking decisions that are risky enough to result in high average returns (Johnson, Powell 1994). In addition, investment broker's advice to women is such that women stick to low-risk options, i.e. to options with rather low long-term returns. Given this fact, it is interesting to ask whether the stereotype reflects actual economic behavior or not. In order to clarify this matter, the paper presented here is dedicated to the question whether gender specific differences in risk behavior exist and how to explain them.

Recent survey data suggests that portfolios of single women are less risky than those of single men of equal economic status (Jianakoplos, Bernasek, 1998; Sundén, Surette, 1998). Experimental evidence suggests that women may be more risk-averse towards gambles (Hershey, Schoemaker, 1980) and that they seem to behave more risk averse in familiar as well as in unfamiliar gambles and in gain as well as in loss gambles (Powell, Ansic, 1997/1998). Recently, an experiment showed that context matters with respect to gender differences in risk attitudes (Schubert et. al., 1999). In this experiment women's and men's risk attitudes differ or coincide according to whether they have to decide on an abstract gamble (differences exist) or on specific investment or insurance problems (no differences exist). Given the result that for real-life contexts like financial decisions experiments do not yield gender differences in risk attitudes, one may suppose that differences in opportunity sets determine observable gender differences.

In addition, it seems plausible that also the framing of information is important. The above effect has been obtained for decisions in which precise probabilities for the different possible outcomes of alternatives were known. However, real-life decisions are often characterized by probability information which is rather ambiguous. Therefore, observable gender differences may be do not only to differences in opportunity sets but also to differences in ambiguity attitudes. One may suppose that differences increase with increasing degree of ambiguity. The experiment reported in the following is dedicated to the inquiry on the question whether – for

controlled opportunity sets – gender differences in ambiguity attitudes account for differences in investment or insurance decisions.

2. Experimental Design

The design of our experiment on gender differences in ambiguity attitudes is depicted in Table 1. Individuals were confronted with uncertain choices in investment or insurance problems. The individuals' certainty equivalents (CEs) were elicited by comparisons between outcome lotteries and certain outcomes for varying values of these certain outcomes. For each individual CEs were elicited for a given number of different lotteries L. Each lottery was presented as a two-outcome lottery.

TABLE 1: Experimental Design

Treatment	Investment			Insurance		
Information Frames	Risk	Weak Ambiguity	Strong Ambiguity	Risk	Weak Ambiguity	Strong Ambiguity
Subjects	Male: 42 Female: 46			Male: 44 Female: 37		

Three different types of information frames were considered. The corresponding lotteries are presented in Table 2. On the one side we looked at a "pure risk" case where precise probabilities for the lottery outcomes were given. On the other side two types of ambiguity mattered. The first type of ambiguity, the so-called weak ambiguity was characterized by the existence of (two) different known probability distributions for the lottery outcomes and by known probabilities for these distributions. In the second type, the so-called strong ambiguity no probability distribution for the different lottery outcomes was known. The only information that was available consisted in some ex-post evidence on the observable frequencies of the lottery outcomes.

TABLE 2: Lotteries

Risk Frame	Weak Ambiguity Frame	Strong Ambiguity Frame
L1: (40 SFr, 1/6; 10 SFr, 5/6)	L6: (40 SFr, 1/6; 10 SFr, 5/6) or (40 SFr, 3/6; 10 SFr, 3/6)	L10: (40 SFr, 2/6; 10 SFr, 4/6)
L2: (40 SFr, 2/6; 10 SFr, 4/6)	L7: (40 SFr, 2/6; 10 SFr, 4/6) or (40 SFr, 4/6; 10 SFr, 2/6)	L11: (40 SFr, 4/6; 10 SFr, 2/6)
L3: (40 SFr 3/6; 10 SFr, 3/6)	L8: (40 SFr, 3/6; 10 SFr, 3/6) or (40 SFr, 5/6; 10 SFr, 1/6)	Individuals had to indicate their subjective probability
L4: (40 SFr, 4/6; 10 SFr, 2/6)	L9: (40 SFr, 1/6; 10 SFr, 5/6) or (40 SFr, 5/6; 10 SFr, 1/6)	estimates. They were asked to do this on basis of 12 drawings
L5: (40 SFr, 5/6; 10 SFr, 1/6)	In each case the two lotteries have a probability of 1/2	of a ball from an urn which contained green and blue balls in the "objectively correct" proportion mentioned above.

In each treatment the subjects had to reveal their CEs for each of the aforementioned three information frames. In the strong ambiguity case we asked additionally for each person's subjective probability before indicating their CEs.

In both treatments subjects were told in advance that one of their choices would determine their experimental earnings. Further, all subjects completed a post-experimental questionnaire in which we yielded information on their disposable income. This information is necessary to exclude wealth effects due to income differences outside the laboratory as an explanation of gender specific choice behavior.

3. Results

Our experiment was conducted with undergraduates from different fields at the University of Zurich and the Swiss Federal Institute of Technology. To control for possible wealth effects we conducted a regression analysis. Regressions were run for each treatment, i.e. one for each information frame. To allow for differences in behavior over randomly selected subjects, a model with random intercepts varying over individuals was estimated by GLS[1]. In all regressions, individual CEs were taken as dependent variables and the lottery dummies, "Female" and "Income" served as independent variables. Income was measured as monthly income in thousands of Swiss Francs. In the case of strong ambiguity, we used as additional

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[1] We have chosen the Random Effects Model because the Lagrange Multiplier Test favored it over the Classical Regression Model.

independent variables the subjective probability for the high lottery outcome (subw) and an interaction dummy between "Female" and the subjective probability (femsubw). The regression results are reported in Table 3.

Our main findings are the following:

- In the *Investment* and in the *Insurance Context*, no significant gender difference in CEs occurs in case of "pure risk" (cf. Schubert et al., 1999)

- In the *Investment Context*, significant gender differences exist in the case of weak *and* strong ambiguity. Women state significantly *lower CEs* than men in case of weak and strong ambiguity. Women's lower CE values seem to express a higher ambiguity aversion of women as compared to men. These results support the above hypothesis of increasing gender differences with increasing ambiguity.

- In the *Insurance Context*, there is no gender difference in the weak ambiguity frame, yet there is a weakly significant *difference in the strong ambiguity case*. In this case women state significantly higher CEs than men, i.e. they seem to be less ambiguity averse than men.

- In both contexts, in case of strong ambiguity men and women *differ* significantly with respect to the influence of their *subjective probability estimates*. For investment problems corresponding to the chance of a high gain, women care more about their probability estimates than men, whereas for insurance problems, corresponding to a small loss, women care less about their probabilities estimates than men. Hereby, a small loss in an insurance context corresponds to a high gain in an investment context.

- The individual behavior is on average *consistent*, because with increasing Expected Value of the lotteries the corresponding CE also increases.

Summing up the results, one sees that our experiment gives some support to the hypothesis that women's and men's attitudes towards ambiguity are significantly different. In both ambiguity frames there is an overall gender effect in the investment context but not in the insurance context. This is not surprising since we know from other experiments (e.g. Cohen, Jaffray, Said, 1985) that gain and loss domain as well as ambiguity and risk premia are independent. Due to the competence hypothesis (Heath, Tversky, 1991) women's higher

ambiguity aversion with respect to investment decisions could stem from the fact that women themselves do not feel competent in investment decisions and therefore cannot take credit for winning but just take blame for losing. This seems not to hold for insurance decisions. Powell and Ansic's (1998) argumentation is in the same line. They argue that individuals have lower ambiguity premia in familiar situations than in unfamiliar ones. Also the well-known overconfidence phenomenon may support this interpretation (Barber, Odean, 1998). Due to lower confidence in their knowledge and information, women perceive more "uncertainty about uncertainty" than men.

TABLE 3: Gender specific Risk and Ambiguity propensity controlling for Wealth Effect

	Risk		Weak-Ambiguity		Strong Ambiguity	
Frame	**Investment**	**Insurance**	**Investment**	**Insurance**	**Investment**	**Insurance**
Intercept	32.63**	19.31**	21.49**	16.16**	18.69**	2.09**
	(0.85)	(0.74)	(0.8)	(0.67)	(1.65)	(0.075)
Female	**-1.09**	**0.66**	**-1.6****	**0.22**	**-5.36****	**3.2***
	(0.722)	(0.77)	**(0.69)**	(0.94)	**(2.00)**	**(1.72)**
Income	0.00063		0.001**		0.0014**	
	(0.00047)		(0.000043)		(0.000053)	
L1	-15.96**	-10.26**	-3.11**	-4.94**	2.33**	0.77**
	(0.33)	(0.94)	(0.28)	(0.39)	(0.73)	(0.39)
L2	-12.56**	-7.17**	0.56**	-0.24		
	(0.33)	(0.94)	(0.28)	(0.39)		
L3	-8.76**	-3.99**	5.54**	4.58**		
	(0.33)	(0.94)	(0.28)	(0.39)		
L4	-4.61**	-1.03				
	(0.33)	(0.94)				
subw					1.12	25.5**
					(2.88)	(1.81)
femsubw					7.11**	-5.29*
					(3.41)	(2.72)
R²	0.7	0.26	0.48	0.40	0.19	0.51
Number of Individuals:	72	79	73	75	84	76

*Statistically significant at the 10-percent level.
** Statistically significant at the 5-percent level.
Standarderrors in parenthesis

Yet, our results in the strong ambiguity frame suggest that the gender difference phenomenon is more complex. Let us first consider the investment context. Here, on the one hand, there is a negative effect on CE by the dummy variable "female". On the other hand, there is a

positive effect by the variable "femsubw". Hereby the coefficient of the variable "female" can be interpreted as indicator for the gender difference in ambiguity tolerance whereas the coefficient of the variable "femsubw" may be seen as indicator for differences in the perception of ambiguity. Obviously, tolerance and perception effects are contradictory. Knowing from the experiment that the variable "femsubw" assumes on average the value 0.5, one may compose the aforementioned two effects into one overall gender effect which is still negative. This implies that women's lower ambiguity perception making them less ambiguity averse than men is overcompensated by a lower ambiguity tolerance so that on the whole women appear as more ambiguity averse than men. In the insurance context the two effects are reversed and cancel each other out. It would be interesting to investigate whether such canceling could also be the source of lacking gender differences in risk aversion resulting from the "pure risk" frame. One cannot exclude that in spite of approximately the same decisions in risky choice men and women differ in risk perception as well as in risk tolerance and that these differences compensate for each other. A striking hypothesis would be that women perceive higher risks (Schubert 1996) but are more risk tolerant. Some general investigations on perception-versus-attitude differences and their determinants seem to be worthwhile.

4. Discussion

The starting point of this paper was the stereotype that women are more risk averse than men with respect to financial decision making. Risk differences in observable portfolios of men and women seem to give support to the stereotype. However, the results of our experiments suggest that there is no general support of this stereotype. Whenever the probabilities for risky payoffs to occur are precisely known, there seems to be no gender difference in risk propensities. Yet, gender differences play a certain role if the probability information is ambiguous. In the case of ambiguity gender differences seem to be mainly due to the individuals' own competence perception or to differences in their risk perception. Yet, the aforementioned two aspects have still to be investigated more intensely for risk frames as well as for ambiguity frames.

Convincing theoretical models to explain gender differences in risk or ambiguity attitudes are missing until now. Most decision theoretic models do not deal with group specific differences like for instance gender differences. On the other hand, gender research does not explicitly

deal with decision-making processes. However, it seems promising to expand some of the decision-making models into the gender field. Models which seem most attractive are Rank-Dependent Expected Utility Models, Personality Trait Models, Perceived-Risk/Return Models, or Models from Evolutionary Biology. Yet, all of these models demonstrate advantages as well as disadvantages with respect to the explanation of gender differences in risk and ambiguity attitudes (Powell et al., 2000). Therefore, the question remains whether one of these models should be preferred or whether a convincing combination of different models could be developed. The Perceived-Risk/Return Model seems to offer the possibility to integrate cognitive as well as emotional determinants and -–via a Model of Conjoint Expected Risk (Luce, Weber 1986) – to take into consideration variables explaining differences in risk perception. Yet, in spite of this first-glance impression, more theoretical work on the explanation of gender differences in risk and ambiguity attitudes seems indispensable.

Thus, as indicated before, various open questions are still remaining. A main point that should be clarified is the relationship between probability information on the one side and the perceived risk on the other side. Only on basis of such additional research, a satisfying explanation of observable gender differences in financial decision making will be possible.

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