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FACULTY OF SOCIAL SCIENCES

Institute of Economic Studies

Zdeněk Sýkora

On the Nature of Gender Differences in Attitudes to Risk

Bachelor thesis

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Author: Zdeněk Sýkora

Supervisor: PhDr. Lubomír Cingl

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Abstract

Despite a number of studies demonstrating that women are more risk averse than men, this strong consensus has recently been questioned. In this thesis we discuss what may be the reason for such contradicting outcomes. Firstly, we describe the most common elicitation methods and compare them from the perspective of reporting gender differences in risk attitudes. We also summarize current literature in the topic. Then we describe a design and analyze original dataset from a survey experiment conducted with university students, mainly investigating responses to a general risk question. We examine the role of variables that are different between genders and can explain risk preferences to see whether the gender difference is robust. We further focus on different dimensions of risk: we ask about risk taking in driving, financial, sports, career, and health domains. Our findings show that the gender differences in risk preferences are significant, ubiquitous, and can be detected by a simple survey measure, even after controlling for additional characteristics that are known to play role in attitudes to risk and differ between men and women. This applies for all studied domains except for the health one.

Keywords

Risk attitudes, gender differences, elicitation methods, experiment, risk dimensions

Abstrakt

I přes spoustu experimentů prokazujících, že ženy jsou více averzní k riziku než muži, se v poslední době vyskytly studie, které tato zjištění zpochybňují. V této práci diskutujeme, co může být důvodem pro takové rozporuplné výsledky. Nejprve popisujeme nejobvyklejší metody měření rizikových preferencí a porovnáváme je z hlediska vykazování genderových rozdílů. Také uvádíme shrnutí současné literatury na dané téma. Poté popisujeme experiment a analyzujeme původní soubor dat z experimentu provedeného se studenty vysokých škol, který se hlavně zabývá odpověďmi na otázku o obecných rizikových preferencích. Také zkoumáme roli proměnných, které se liší mezi pohlavími a mohou vysvětlit rizikové preference, abychom zjistili, zda genderové rozdíly jsou robustní. Dále se zaměřujeme na různé dimenze rizika: ptáme se na riskování v těchto doménách – řízení, finance, sport, kariéra a zdraví. Naše výsledky ukazují, že genderové rozdíly v rizikových preferencích jsou významné, všudypřítomné a mohou být odhaleny jednoduchým dotazováním dokonce i po kontrole doplňkových vlastností, které jsou známy tím, že hrají roli ve vztahu k riziku a že se liší u mužů a žen. Toto platí pro všechny zkoumané domény kromě zdraví.

Klíčová slova

Vztah k riziku, genderové rozdíly, elicitační metody, experiment, dimenze risku

Author´s e-mail: z.sykora92@gmail.com

Supervisor´s e-mail: lubomir.cingl@gmail.com

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Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

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Prague, July 29, 2015

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Signature

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Bachelor thesis proposal

Despite a lot of experiments demonstrating the differences in male and female attitudes to risk (Charness & Gneezy, 2012), there have recently been studies that call these findings into question (Filippin & Croseto, 2014). In this thesis I will discuss what may be the reason for such contradicting outcomes. Particularly I will focus on in which dimensions of risk gender differences can be shown and why it is so. One possibility is that the differences arise as an artifact of a specific feature of the elicitation procedure. Therefore I will also discuss evidence from methodologically distinct research from psychology. Furthermore, I will scrutinize the differences in male and female behaviour on the investment and financial markets to find out if there is any evidence from the real-world behaviour. Apart from that, I will discuss impact and implications of evolutionary and cultural development for different gender roles in society and also in risk-taking. Finally, I will conclude with possible implications of different male and female attitudes to risk for business and policy makers.

Outline:

1. Introduction
2. Dimension of risk
3. Psychological bases
4. Investment and financial markets
5. Evolutionary and cultural development
6. Implications for business and policy makers
7. Conclusion

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Acronyms

BART	Balloon analogue risk task
BRET	Bomb risk elicitation task
DOSPERT	Domain-Specific Risk-Taking
H&L	Holt and Laury
NEO-FFI	Neuroticism-Extraversion-Openness Five-Factor Inventory
NEO-PI-R	Revised Neuroticism-Extraversion-Openness Personality Inventory
OLS	Ordinary Least Squares
SOEP	Socio-Economic Panel
STAT-T	Trait component of State-Trait Anxiety Inventory

1 Introduction

Risk plays a role in almost every important economic decision. Economics has a long tradition of analyzing risk as an important and fundamental element of decision-making. For example, the analysis of portfolio models is based on strategies to differentiate risk according to investor attitude. In macroeconomics, we can consider unemployment, exchange and interest rates, political stability, imports and exports as examples of the unstable economic variables that influence the overall economy. Understanding individual risk attitudes is closely linked to the goal of understanding and predicting economic behavior.

Experimental economics is currently one of the most dynamically developing disciplines of theoretical economics. Over the last two decades, a number of experimental papers published in the top economics journals started to growth significantly. In addition, Vernon Smith and Daniel Kahneman who are considered to be the pioneers of experimental economics receive the Nobel Prize in economics in 2002. Experimental economics is a tool for testing a validity of economic theories and a way how to improve them. It provides ceteris paribus observations of motivated individuals that are otherwise difficult to obtain. Experiments help to better understand how people actually make their decisions and to formulate more precise predictions about their behaviour. On the other hand, the usual criticism of the experiments conducted in labs is that the abstract things that are measured in experiments do not transcend into real life. Nevertheless, there are several studies disproving it. For example, Andersen et al. (2011) find that the individual´s wealth might be viewed as a closer substitute to experimental income that the individual is choosing over in the experimental lottery tasks.

In experimental economics there is a strong consensus that women are more risk averse than men that can be demonstrated by a large number of research studies and experiments (e.g. Charness & Gneezy 2011, Croson & Gneezy 2009, Hinz et al. (1997). On the other hand, recent work of Crosetto & Filippin (2014) reconsiders this consensus and finds that gender differences are less ubiquitous than usually depicted. They claim that economists and psychologists have developed a variety of experimental methodologies to elicit and assess individual risk attitudes, but the question is which of them are appropriate and can systematically elicit gender differences. Each experiment uses a different decision problem, which makes it hard to easily compare their results. Moreover, some of the experimental studies found gender differences without directly looking for them, and others were specifically designed to test for these differences. Crosetto & Filippin (2014) also state that gender differences in risk attitudes depend on the specific features of methods used to elicit risk preferences. It can mean, for example, that using questionnaires does not

have to show gender differences. We shed light on this and show that even simple survey question can report significant gender gap.

The aim of this bachelor thesis is to take a closer look on the nature of gender differences in attitudes to risk and examine previous studies dealing with this topic to find what may be the reason for contradicting outcomes. One possibility is that the differences arise from a specific feature of the elicitation methods. We describe the chosen elicitation methods and outline the advantages and disadvantages of each. After that, we compare them to see which are the most appropriate to measure gender differences in risk preferences, and we discuss which of these elicitation methods have really found gender differences so far.

We further focus on whether the consensus can be confirmed even by a survey measure and if so, whether the gender difference stems from other personal differences that exist between genders or not. Survey measures are not the most favourite method of economists for eliciting preferences, because they suffer from various biases and are not even incentive compatible. However, Dohmen et al. (2011) provide us a valuable instrument for research using survey data by validation of the general risk question on the German population, which means that we can present useful and externally valid results. In addition, Vieider et al. (2014) find a significant correlation between survey question and incentivized elicitation task in 30 countries around the world; therefore, it seems that the general risk question is a reliable method.

We use the data gained from an experiment conducted with university students investigating responses to a general risk question. The novelty of our work is that we combine the survey risk measure with additional variables of personality characteristics, including personality profile, trait anxiety and height, where gender differences may be found.

Apart from that, we focus on the dimensions of risk where gender differences can be shown. As in Dohmen et al. (2011), we include five additional questions to the general risk measure that use the same scale, and ask about risk taking in specific domains: driving, financial matters, sports, career, and health.

We also examine how personality traits can explain risk preferences and whether it is a personality that makes the gender differences or not. Particularly we use the Neuroticism-Extraversion-Openness Five-Factor Inventory (NEO-FFI) and the trait component of the State-Trait Anxiety Inventory (STAI-T). It is useful to explain economic decisions with personality traits, because as Borghans et al. (2008) suggest individual differences in personality shape the constraints of individuals, and hence their choices. Personality factors may affect the arrival and processing of information. For example, individuals who are more open to experience may acquire information more cheaply. People with greater ability to imagine outcomes reduce the intrinsic uncertainty in their

environments and may be less or more risk averse. Similarly with anxiety, Aimone & Ball (2012) provide evidence that anxiety robustly impacts economic exchange in ways that lead to significantly diminished earnings. Finally, women and men usually score differently in these personality traits.

We find that women are less willing to take risks than men in all studied domains except the health one. The female dummy variable is statistically significant in a majority of regressions and is robust to the inclusion of variety of explanatory variables, which confirms the consensus of gender differences in risk preferences. We observe a statistically significant effect of smoking only, not surprisingly, in the health domain. We also find that the relationship between the NEO-FFI variables and risk attitudes is less consistent across domains. Trait anxiety cannot be considered as a good predictor for risk taking in all domains except the health one. After our analysis, we compare the results with those in Dohmen et al. (2011) and find that the results are mostly consistent.

The thesis is structured as follows. Chapter 2 defines the basic terms and expressions that are necessary to understand this bachelor thesis. In Chapter 3 we compare different elicitation methods used to measure risk preferences and also describe their essence. Chapter 4 deals with the heterogeneity of results in papers published about gender differences in attitudes to risk. In Chapter 5 we give an introduction to the theory of risk dimensions. In Chapter 6 we analyze our own data and present the regression results. Chapter 7 summarizes our findings and highlights the most important results of our analysis.

2 Definitions

Before we start with the actual topic of this work, we set the definitions of the terms and expressions that are important to understand, because we will use them in a large part of this work.

2.1 Risk attitude

To define risk attitude is not as simple as it seems to be. Both words have relatively clear definition given by many scientists, but together it is a little bit more difficult. Hillson & Murray-Webster (2007) define it as a chosen state of mind with regard to those uncertainties that could have a positive or negative effect on objectives. To simplify, we can say that it is a chosen response to an uncertainty that matters, influenced by perception. Based on these definitions we can divide risk attitudes into a spectrum from risk aversion, through risk neutrality, to risk seeking. To be able to understand these terms, we first need to define expected utility function.

2.1.1 Expected utility

Expected utility theory says that the decision maker chooses between risky or uncertain options by comparing their expected utility values that are defined as the weighted sums obtained by adding the utility values of outcomes multiplied by their corresponding probabilities.

The risk attitude is directly related to the curvature of the utility function, where risk neutral person has a linear utility function, while risk seeking person has a convex utility function, and risk averse person has a concave utility function.

The axioms of expected utility theory are accepted by most researchers as adequate principles of rational behaviour under uncertainty. Nevertheless, this theory was questioned a few times. Friedman & Savage (1948) developed their own utility function and argue that a single individual could have different utility functions depending on their initial wealth. The implication of an individual who is risk seeking and risk averse at the same time implies that its utility function has different curvatures. Markowitz (1952) criticizes the previous theory because the final concavity of their function assumes that individuals with the highest incomes would never gamble. He proposed measuring utility based on a reference level instead of in absolute values that implies to individuals that small gains would provide an increasing utility, while big gains would provide a decreasing utility.

2.1.2 Risk aversion

People are said to be risk-averse if their utility of the expected value of a gamble is greater than their expected utility from the gamble itself.
Hillson & Murray-Webster (2007) describe a risk averse person, from a psychological perspective, as a person who feels uncomfortable with uncertainty, has a low tolerance for ambiguity, and seeks security and resolution in the face of risk. Risk neutral person is neither risk-averse nor risk seeking, but rather seeks strategies and tactics that have high certain pay-offs. Person who is risk seeking tends to be adaptable, resourceful, enjoying life, and not afraid to take action.

2.2 Loss aversion

It is a concept of prospect theory and Kahneman et al. (1991) use definition of loss aversion as follows: "the disutility of giving up an object is greater that the utility associated with acquiring it." The theory of loss aversion was first introduced by Kahneman & Tversky (1979). They used for testing something as trivial as a coin toss and offered a gamble to their students in which they might lose $20 if it is tails and asked them how much they would have to gain on winning in order to accept this gamble. They required an average payoff of at least $40 if they won. It proves that a pain of loss is much higher than potential pleasure generated by a gain.

We should also mention a recent example from sport events. Almost everybody knows the life story of cyclist Lance Armstrong. He once pronounced: "I like to win, but more than anything, I can't stand this idea of losing. Because to me, losing means death." This example clearly shows that some people are terrified of losses therefore they try to avoid them at all costs.

2.3 Ambiguity aversion

Ellsberg (1961), who is considered to be the first man who define theory of ambiguity aversion, said in 1961: "Decision makers tend to prefer taking gambles with known-risk probabilities over equivalent gambles with ambiguous probabilities." The fact that most people are ambiguity averse was first introduced through the so called Ellsberg paradox. It is based on picking up between two urns containing 50 white marbles and 50 black marbles (the first urn) and 100 marbles, but the ratio of white to black marbles is unknown (the second one). You win the gamble if you draw a black marble in one pick without looking. The question is which urn you draw. Ellsberg found that people overwhelmingly choose to draw the marble from the urn with known probabilities which shows that people prefer risk to uncertainty. And from this we can define ambiguity aversion as a preference for known risks over unknown risks.

3 Elicitation methods

In this chapter we compare different methods used to study gender differences in attitudes to risk. It is said in many studies such as Charness & Gneezy (2011) and Crosetto & Filippin (2014) that the differences in the methods used to measure the risk preferences can act as an additional source of heterogeneity, and we will go over this argument in this part.
We focus on the most frequently used methods to elicit risk preferences and also describe their essence.

3.1 Multiple price list method

We start with the most common method used to measure risk preferences called multiple price list method. The most influential and cited form of this method was introduced by Holt & Laury (2002). In fact, many researchers refer to the multiple price list method as the Holt and Laury method measuring risk aversion (henceforth, H&L).

The substance of H&L is based on ten choices between the paired lotteries, as in Table 1. Two lotteries for each decision are aligned in rows, lotteries in the left and right columns are labelled Option A and Option B, respectively. The subjects then make choice for each row which lottery they prefer to play. The payoffs of lotteries in Option A and Option B remain constant, but the probability associated with each payoff is the only thing that changes between decision rows. The lottery pairs are ordered by increasing expected value. In the first decision, the probability of the high payoff for both options is 1/10, so only an extreme risk seeker would choose Option B. The subjects are expected to switch at some point from the safe to the risky option. This switching point is then used as the measure of the individual's risk preference. A risk neutral person is considered to choose Option A four times before switching to B. The degree of risk aversion depends on the amount of safe options that were chosen, more safe options mean higher degree of risk aversion. Even the most risk averse subject should switch to Option B in the last row, because it yields a sure payoff of $3.85. Subjects who never choose the risky option or switch from Option B to A are also present time to time, and such behaviour is regarded as inconsistent. Those inconsistent choices are not included in modelling a conclusion.
Experimenters who implement H&L method typically inform subjects that after all decisions are made, one lottery will be selected at random, and the chosen one will be played for real. Subjects are then paid according to this outcome.

It has been argued that H&L is more difficult to understand than other methods, for example, in Charness & Viceisza (2012), and it is one of the disadvantages of H&L

method. A significant number of subjects fail to understand the procedure. This reduces the reliability of the risk preference measure and can potentially bias the results.

Table 1: The 10 lotteries of the original H&L

	Option A				Option B			
1	1/10	2 $	9/10	1.6 $	1/10	3.85 $	9/10	0.1 $
2	2/10	2 $	8/10	1.6 $	2/10	3.85 $	8/10	0.1 $
3	3/10	2 $	7/10	1.6 $	3/10	3.85 $	7/10	0.1 $
4	4/10	2 $	6/10	1.6 $	4/10	3.85 $	6/10	0.1 $
5	5/10	2 $	5/10	1.6 $	5/10	3.85 $	5/10	0.1 $
6	6/10	2 $	4/10	1.6 $	6/10	3.85 $	4/10	0.1 $
7	7/10	2 $	3/10	1.6 $	7/10	3.85 $	3/10	0.1 $
8	8/10	2 $	2/10	1.6 $	8/10	3.85 $	2/10	0.1 $
9	9/10	2 $	1/10	1.6 $	9/10	3.85 $	1/10	0.1 $
10	10/10	2 $	0/10	1.6 $	10/10	3.85 $	0/10	0.1 $

More than five hundreds published papers cite H&L, but in the majority of them the H&L is performed only as a control for experiments dealing with other topics.

3.2 Investment method

Investment method is another elicitation task that is easier to understand and also widely used to measure risk preferences. It was introduced by Gneezy & Potters (1997) who used it to prove myopic loss aversion of investments in risky assets. Then it was refined by Charness & Gneezy (2011) and helped them to compare gender differences in attitudes to risk.

The subject (decision maker) receives $X and is said to decide how much of it ($Y) he would like to invest in a risky asset and how much of it to keep. The invested money yields a dividend of $(k*Y), where k>1, with probability p and is lost with probability (1-p). The subject keeps the money that was not invested $(X-Y). The final payoff is either $(X-Y+kY) with probability p or $(X-Y) with probability (1-p). The products of p and k have to be greater than one, so that the expected value of invested money was higher than the expected value of money kept. The chosen height of Y is the only decision that the subjects have to make in the experiment. The invested amount $Y is then used as the measure of risk preferences.

It is obvious that for these assigned parameters, risk neutral and of course risk seeking individuals should invest their whole endowment $X, because marginal return of the risky option is greater than one. Hence, a disadvantage of this method is that it cannot distinguish between risk seeking and risk neutral preferences. On the other hand, there are

several advantages of this method. It has relatively simple rules with just one trial required, and the experimenters need only basic tools for a realization. Due to this fact, it can be implemented even in developing countries, where we cannot use the modern technology. As an example, we can use Charness & Viceisza (2012) who use this task on people in rural Senegal and produce results that are closely coincident with patterns found in previous studies, just with a little bit higher level of risk aversion. In contrast to H&L task that produce a significant low level of understanding.

3.3 Ordered lottery selection method

The ordered lottery selection method was first proposed by Binswanger (1981) to identify risk attitudes using experimental procedures with real payoffs. A more popular version of this method was introduced by Eckel & Grossman (2002), and since it is often called Eckel and Grossman elicitation task.

The subject is asked to choose within a set of lotteries that differ in linearly increasing expected return and simultaneously in greater standard deviation. The number of lotteries can be varied, for example in the original Eckel & Grossman´s (2002) paper, we can find five lotteries, in our case, there are six lotteries, see Table 2. The probability of each outcome is kept at 50% in all cases. Then the chosen lottery is played and the subject is paid depending on the result. The lotteries are constructed so that risk averse people choose lotteries with the lowest standard deviation. On the other hand, risk neutral and risk seeking individuals should choose lotteries with high expected return as well as high standard deviation. From this follows that it has only a low level of variation of risk seeking behavior.

Table 2: The Eckel and Grossman task

	Low payoff		High payoff		Expected return	Standard deviation
Lottery 1	1/2	28 $	1/2	28 $	28 $	0 $
Lottery 2	1/2	24 $	1/2	36 $	30 $	6 $
Lottery 3	1/2	20 $	1/2	44 $	32 $	12 $
Lottery 4	1/2	16 $	1/2	52 $	34 $	18 $
Lottery 5	1/2	12 $	1/2	60 $	36 $	24 $
Lottery 6	1/2	2 $	1/2	70 $	36 $	34 $

Similarly to the Investment method, it is also relatively easy to understand the assignment of this task.

3.4 Becker–DeGroot–Marschak method

This method is not as frequently used as previous ones. It may be due to more complicated instructions to understand for participants. The original design of this method was developed by Becker et al. (1964) and is used to measure individual´s willingness to pay for a certain item. Then it was a few times modified for a possibility to test risk aversion.

The subject is given a series of lotteries and is supposed to choose a minimum selling price of each of them. The experimenters then draw a random number (buying price) from a range of the lowest and the highest outcome of the lottery. If the selling price is lower than or equal to the buying price that was drawn, the lottery will be sold, and the subject receives the buying price as a payoff. Otherwise the risky lottery will be played.

The paper presented by Berry et al. (2011) gives an empirical test of whether Becker-DeGroot-Marschak method provides an accurate measure of an individual's willingness to pay through the sales of point-of-use water filters in Ghana. It is the first evaluation of Becker-DeGroot-Marschak method involving a non-trivial good, and additionally the first in a developing country context. They find out that it provides an exact measure of willingness to pay and is incentive compatible under weak assumptions and also provides a test for screening and causal effects of prices.[1]

Keller et al. (1993) come up with the finding that although it is clear that this method does not necessarily reveal subjects' true certainty equivalents of lotteries if decision makers do not maximize expected utility, the mechanism may still be used to get some information about their preferences.

As was mentioned, it is not clear that subjects always understand the logic of this task. It is important to realize that the drawing of a buying price is not dependent on the chosen selling price. The model becomes more appropriate as the subject becomes more familiar with the experiment.

[1] Incentive compatibility is a characteristic of mechanisms that occur when the incentives that motivate the actions of individual participants are consistent and follow the rules established by the group. Its constraint ensures that participants are motivated to behave in the way that is consistent with the optimal solution to achieve group goals.

3.5 Balloon analogue risk method

The balloon analogue risk task (henceforth, BART) was developed by Lejuez et al. (2002) to measure risk seeking behaviour. This method is more technically demanding as it requires computers, and also multiple trials are needed.

Subjects are presented with simulated balloons on a computer screen and are told to pump the balloon by pressing a response key (Figure 1). After each pump, the balloon becomes bigger, and the subject earns money that is deposited into a temporary bank. The possibility of exploding varies across experiments and is never revealed to participants. As the balloon grows, the chances that it would explode after another pump grow as well. On the other hand, it brings greater potential reward. At any moment, the subject can choose to stop pumping the balloon and take the amount of money accumulated so far in the task. If the balloon explodes, all the earnings for the particular trial are lost, and the subject gets zero. The individual´s risk preferences are represented by adjusted average number of pumps of unexploded balloons. This task determines that risk seeking individuals are more likely to explode the balloon leading to earning less reward.
We can also see it as a process of drawing without replacement from an urn of unknown size which contains n balls, (n-1) balls are safe and one represents an explosion.

Figure 1: BART

It has some limitations, such as the fact that the bursting of the balloon truncates the data which means that we cannot identify properly subjects whose preferences would stop after the explosion, and it also features ambiguity, so probabilities are not clearly visualized. However, as data from experiment of Lejuez et al. (2002) suggest, the BART is a useful and potentially promising instrument for examining a level of risk aversion.

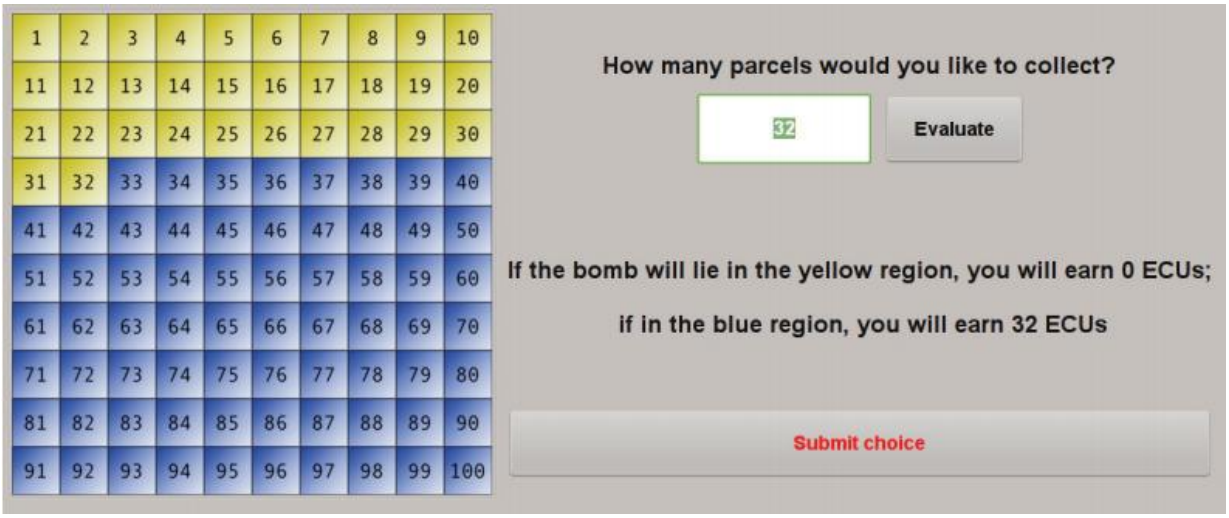
3.6 Bomb risk elicitation method

The bomb risk elicitation task (henceforth, BRET) is similar to the previous one and was introduced by Crosetto & Filippin (2013). The task is short in time and relies on a visual representation in continuous time. It provides an intuitive and transparent illustration of probabilities and outcomes that makes it easy to understand even to subjects with low numeracy skills. There are two versions of BRET, static and dynamic one.

3.6.1 Static version

There is a 10 x 10 square and each cell represents a box (see Figure 2). Subjects are told that ninety nine boxes are empty, while the remaining one contains a bomb that will explode at the end of the task. They have to decide how many boxes they want to collect by choosing a number from 0 to 100. Then they receive money for every box collected. The position of the bomb is determined after the subject makes its choice by drawing a number from 1 to 100 from an urn. If the drawn number is lower or equal to the number that subjects chose, it means that they collected the bomb and earn nothing. Otherwise, if they leave the chosen field without a bomb, they receive particular amount for every box collected.

Figure 2: Static BRET

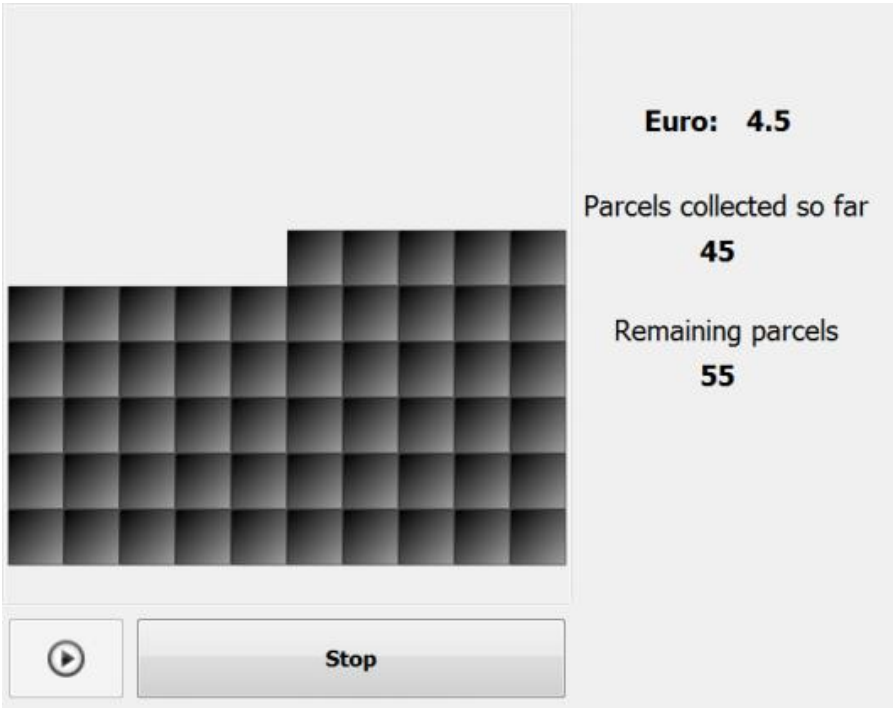


3.6.2 Dynamic version

It is very similar to the static version, but we can find some differences. This dynamic visual version has to be presented on a computer screen with the same format of square and boxes. There are two buttons below the square, Start and Stop. The task starts in the moment when the subject presses Start button and then one box is automatically removed from the screen every following second. The subject can see the actual number of boxes collected at any point in time (see Figure 3). Each time a box is removed, the subject earns additional amount of money on his provisional account. The process of removing boxes can be, at any time, stopped by hitting the Stop button. Subjects are also not informed if the box is empty or contains the bomb. The position of the bomb is determined in the same way as in static version.

In both cases subjects have no possibility to determine the position of the bomb during the game and face the same opportunity set. A risk neutral subject should choose 50 boxes and risk averse and risk seeking subjects less and more than 50, respectively.
The dynamic visual version of BRET is sometimes preferred to the classic one, because the set of lotteries is presented in a sequential way, and so subjects can focus only on two lotteries every single moment. Furthermore, the visual representation provides more understandable predicative value of probabilities involved.

Figure 3: Dynamic BRET after 45 seconds



The main difference between BART and dynamic BRET is that BRET transparently displays probabilities, because the subject can see how many boxes have been collected and how many are left. This fact helps to measure risk preferences more precisely, because we eliminate the truncation of the data, and the probabilities are easier to infer from the visual representation.

3.7 Questionnaires

Questionnaires are the easiest way how to elicit risk preferences. They are based on individual's self-reported propensity for risk. Questionnaire measures are cheaper to use and also easier to respond to without additional instructions for participants than the previous methods. In contrast, they are inherently difficult to translate into numerical parameters, and factors such as hypothetical bias, inattention, and strategic motives can cause distortion of reported risk attitudes of participants.

The measurement of risk preferences is usually based on a general risk question, for example, as in German Socio-Economic Panel.[2] Dohmen et al. (2011) explore these data and add incentivized lottery eliciting risk preferences to their experiment which correlates with the survey measure. This provides the validation of the question about risk taking in general that generates, based on result of Dohmen et al. (2011), the best all-round predictor of risky behavior. It also suggests that simple and qualitative surveys can generate a behaviorally valid measure of risk attitudes using instruments that are easy to use and relatively cheap to administer.

The original domain-specific risk taking scale was developed by Weber et al. (2002). They come up with the result that the measured risk preferences are highly dependent on the domains in which they are elicited, so there is no consistent risk aversion across all content domains.[3]

Finally, the results of Lönnqvist et al. (2014) suggest that the questionnaire is the most adequate measure of individual risk attitudes for the analysis of behaviour in economic experiments. The data have good construct validity, because they are correlated with an external predictor of risk taking behaviour. Moreover, they have reasonable predictive power relating to the transfer behaviour in the trust game. Their measurement also shows a very high re-test stability when they repeat the experiment after one year again.

[2] See more in chapter Theory of dimensions
[3] See more in chapter Theory of dimensions

3.8 Comparison of methods

As we can see, our thesis that different characteristics of methods are additional source of heterogeneity was confirmed.

We can divide above mentioned methods into several categories. First dividing aspect is the technical difficulty of the task to be realized. Some of them require computers or other modern technology to work. Therefore, it is not possible to use them in rural parts of developing countries. This is place where only easy methods using just papers and pens are appropriate. As an example, Charness & Viceisza (2012) use a simple investment game and a questionnaire based task on a rural population in Senegal. Next aspect is based on how well the participants can understand the assignment of the task. Methods such as H&L are proved to be more difficult to understand for some individuals that can cause ambiguity results and not finding significant gender differences. On the other hand, technically complicated ones, BART and BRET, seem to be relatively easy to understand. All the mentioned methods, except questionnaires, are incentive compatible and thereby should better predict real life behaviour. Another aspect is the size of the range of risk attitudes. Investment and ordered lottery selection methods cannot measure preference in the risk seeking domain, in other words, they cannot distinguish between risk neutral and risk seeking individuals. In contrast, the H&L and BRET allow estimating a fairly complete range of preferences.

Another interesting fact is whether the individual is consistent across different methods in risk attitudes behaviour. Results of Deck et al. (2013) suggest considerable within subject variation in behavior across tasks. It means that individuals exhibit differently behaviour across elicitation methods, and it can cast doubt on the commonly assumed single risk attitude per person approach of standard economic models. Based on their results, we find little support for the hypothesis that between-task within-subject variation can be explained by domain specific risk attitudes.

4 Are men more risk seeking than women? Heterogeneity of results

The main aspect that we are interested in is if the method finds, on average, gender differences or not. It is obvious that the special characteristic features of the method eliciting risk preferences play an important role in finding results between women and men in risk preferences. Crosetto & Filippin (2014), who reconsidered gender differences in risk attitudes, find that the likelihood of observing gender differences differs systematically across elicitation methods and propose which characteristics of the tasks drive these results. Specifically, this includes the number of choices, the list of lotteries that are generated by changes in probabilities rather than outcomes, the truncation of the domain of risk preferences covered by the task, and the availability of a safe option among the set of alternatives because, on average, males make a lower number of safe choices, while variance is similar. They conclude that if all these factors are present, then it obviously influences the likelihood of observing gender differences in attitudes to risk.

Most of the papers dealing with this problem come with the result that men are more risk seeking than women (e.g. Charness & Gneezy 2011, Croson & Gneezy 2009, Borghans et al. 2009). However, not all of them confirm the generally known fact that women are more risk averse (e.g. Crosetto & Filippin 2014, Nelson 2013). One reason may be that it is easier for researchers to publish papers that report gender differences in attitude to risk corresponding with the consensus than papers that report no difference, or those reporting results that are swimming upstream. This fact suggests that such behaviour can cause a publication bias, because researchers would be influenced by the presence of consensus.
However, Crosetto et al. (2014) find in their study no significant evidence of an outcome reporting bias in papers focused on gender differences in attitudes to risk. The presence of a strong consensus does not affect the likelihood of reporting other results than those being in harmony with a consensus. They find only two variables affecting the likelihood of reporting gender differences. These two are the relevance of risk attitudes for the research question of the study and the fraction of women in the group of authors. Nevertheless, it does not imply a reporting bias.

One of the biggest problems in research on gender differences in risk preferences is the variation of methods used in experiments that we discussed in the last chapter. This fact makes it hard for us to compare the results of different methods measuring risk aversion. It can be a reason for often disputes between researchers, since not all of them use the same method. Therefore, we should make sure that we compare the same methods.

There are many experiments measuring risk aversion but just few of them are directly concerned with gender differences that make it difficult to compare results. Most of

them were also conducted by different research workers in different locations, with different forms, durations, background of participants, payments, etc. It can also be an explanation for inconsistent results.

4.1 Positive evidence for gender differences

Most of the empirical studies show that there is a significant evidence for differences between women and men in attitudes to risk.

Charness & Gneezy (2011) strongly support the consensus of women being more risk averse than men. They collected the data from 15 sets of experiments dealing with a simple investment game, which come from different researches and have different instructions. Nevertheless, their results can be considered as significant, because the data are based on the same trivial investment game that was introduced by Gneezy & Potters (1997). The originality of their work is in assembling already existing empirical papers using thousands of observations that were collected by different researchers, but working with similar investment game. The final finding of this study says that women make smaller investments in the risky asset than do men, and so appear to be financially more risk averse.

This clear and consistent result confirms us the consensus, but of course we must have on mind that it takes into account just one method of measuring risk aversion. Similarly, many studies using ordered lottery selection method find consistent results that women are less risk seeking than men (e.g. Eckel & Grossman 2002).

Croson & Gneezy (2009) are also concerned with this problem. They review the experimental economics literature examining gender differences in risk preferences. The summarizing finding is that men are more risk seeking than women. They also notice one interesting fact contained in Finucane et al. (2000) that they find a gender difference among white people, but not among any other ethnic group. They call this finding "the white male effect." This finding is very interesting, because it suggests us that there may be cultural aspects influencing gender differences in risk preferences. They also mention that women tend to be more risk averse than men in both lab settings and investment decisions in the field.

In addition, Croson & Gneezy (2009) come up with the possible explanations for gender differences in risk taking. The first of them is based on different emotional reactions to uncertain situations between women and men, and this can lead to differences in risk attitude. More on risk perceived as feeling is described in Loewenstein et al. (2001). The theory built on psychology says that women experience emotions more intensively than men and also that emotions affect the way how people perceive and evaluate probabilities.

The second explanation for gender differences in risk preferences corresponds with the confidence. Men are considered to be more confident in their success in uncertain situations than women that pushed them to be more risk seeking. The last factor explaining our problem is the difference in interpretation of situations including risk. Croson & Gneezy (2009) suggest that men have a tendency to perceive risky situations as a challenge that they want to participate in. On the other hand, women tend to view risky situations as a threat and do not want to be part of it. Such behaviour leads to higher risk tolerance.

Borghans et al. (2009) focus on both risk and ambiguity aversion. They conduct the experiment with high-school students and use an unusual method of their experiment with compulsory participation. Borghans et al. (2009) also confirm the consensus about women being more risk averse than men. With higher ambiguity women and men show similar results. Furthermore, they find out that psychological traits are strongly associated with risk, but the same does not hold for ambiguity.

4.2 Neutral and negative evidence for gender differences

Above you can see several studies that find the evidence and confirm the consensus, and now we will focus on those works that do not agree with it that much.

Crosetto & Filippin (2014) reconsider the widely known fact that women are more prudent to risk than men. They focus on the most commonly used risk elicitation task described in Holt & Laury (2002). Despite the fact that this task is one of the most popular elicitation methods in economics, it has never been the subject of a complex gender analysis. Novelty of their work is in gathering microdata of large sample of H&L task that help them to boost the statistical power of their analysis. The result of their experiment says that significant gender differences are the exception rather than the rule depending on H&L task. Finally, they summarize that gender differences in risk taking are closely connected to the features of methods used in the experiments. Several other researchers in the past decade confirm that significant gender differences in H&L are only rarely found. According to Crosetto & Filippin (2014), who gather a large set of data of H&L replications, only 3 out of 21 papers report significant gender differences, 3 provide mixed evidence, while 15 do not find any significant differences between women and men in attitudes to risk. The original Holt & Laury´s (2002) article finds a gender gap only in the low stake but not in the high stake treatment. They also find that subjects exhibit substantially greater risk aversion at higher stakes.

Crosetto & Filippin (2013) find, based on a robust result of both static and dynamic bomb risk elicitation task, that there can be observed no significant gender differences in attitudes to risk. They argue that it is due to the lack of the loss aversion in their task.

Nelson (2013) replicates and comments on Charness & Gneezy (2011). She raises the problem with two kinds of gender differences. Most of the researchers do not adequately distinguish between gender differences at the individual level and at the aggregate level. After re-examination of the data, Nelson (2013) affirms that modest differences between women and men exist at aggregate level, in contrary to the claim of Charness & Gneezy (2011), who present it at the individual level.

5 Theory of dimensions

In this chapter we focus on different dimensions of risk that can be distinguished. In real world we meet risk in more contexts and life situations, and everybody perceives risky situations in every age of his life differently.

Weber et al. (2002) present a psychometric scale that assesses risk taking in five content domains: financial decisions (separately for investing versus gambling), health/safety, recreational, ethical, and social decisions. As expected, respondents' degree of risk taking was highly domain-specific, i.e. not consistently risk averse or consistently risk seeking across all content domains. This scale, usually called Domain-Specific Risk Taking (DOSPERT) Scale, has been used and validated by many researchers and cited in many papers examining risk attitudes in different dimensions from the psychological approach. Weber et al. (2002) also present several examples from the everyday life of the personal decisions that differ in content and associated goals: health/safety decisions (e.g., seatbelt usage, smoking), recreational decisions (e.g., sky diving versus bowling), social decisions (e.g., confronting coworkers or family members), and ethics decisions (e.g., cheating on exams, terminating a comatose family member's life support).

Their results suggest that male and female respondents differed significantly in their risk taking of all risk categories except social risks, with female respondents being less likely to engage in risky behaviors. Results of their analysis also strongly support the hypothesis that risk taking is domain-specific.

Blais & Weber (2006) propose a 30-item revised version of the original DOSPERT Scale. It evaluates behavioral intentions, that is, the likelihood with which respondents might engage in risky behaviors originating from five domains of life. Blais & Weber (2006) state a few sample items including: “Having an affair with a married man/woman” (ethical), “Investing 10% of your annual income in a new business venture” (financial), “Engaging in unprotected sex” (health/safety), “Disagreeing with an authority figure on a major issue” (social), and “Taking a weekend sky-diving class” (recreational). Higher scores indicate greater risk taking in the domain of the subscale. They find that the level of apparent risk taking varies for a given participant across the five risk domains.

Although they use the same assessment method, individuals have not shown themselves to be consistently risk seeking or risk averse across different domains and situations, both in laboratory studies and managerial contexts. Their analysis of variance shows between-domains differences in mean risk taking, and also the multilevel modeling shows that within-participants (i.e., individual-level) variation in risk taking across the five

content domains of the DOSPERT scale was about seven times as large as between-participants variation.

Dohmen et al. (2011) find uncertainty and risk attitudes to be clearly related across most contexts and domains. Their analysis uses different sources of data. One of them is the German Socio-Economic Panel (SOEP) that is widely used by many researches. The German SOEP is a longitudinal survey measuring the risk attitudes of approximately 11,000 private households (more than 22,000 individuals) that is a representative sample of the adult population living in Germany. Respondents are asked for a wide range of personal and household questions and for their attitudes on assorted topics, including political and social issues such as household composition, employment, occupations, earnings, health, and satisfaction indicators. The exact wording of a general question (translated from German) based on Dohmen et al. (2011) is as follows: "How do you see yourself: are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, where the value 0 means: 'not at all willing to take risks' and the value 10 means: 'very willing to take risks'."

Their survey includes five additional questions that use the same scale as the general risk question, but ask about risk taking in specific context which are car driving, financial matters, sports and leisure, health, and career. They also find that the results on determinants are robust to using these alternative risk measures; for example, women are less willing to take risks in every context. Then they find out that the proportion of individuals who are relatively unwilling to take risks, that is, choose low values on the scale, is higher for women and increases strongly with age. Due to the fact that there are no explicit stakes or probabilities in the questions, there is the potential that factors other than risk preference could lead to variation in responses across individuals.

Dohmen et al. (2011) also analyze a deeper question of whether there is a stable trait determining risk taking across different domains of life. They choose behaviors that span the different contexts identified by the five domain-specific questions: portfolio choices (financial context), participation in sports (sports and leisure), self-employment (career), and smoking (health), and they measure them as binary variables. They find that all measures are significantly related to several behaviors, providing further evidence on their behavioral validity. Based on their results, the best all-round explanatory variable, not surprisingly, is the general risk question, which predicts all behaviors. On the other hand, the single best risk measure in any given context, although less successful across contexts, is the measure incorporating the corresponding specific context. For example, the best predictor of smoking is the question about willingness to take risks in health matters, rather than the general risk question or questions incorporating different contexts. These findings indicate that asking for a global assessment of willingness to take risks reflects a useful all-round measure of risk attitudes. Questions focused on specific contexts are not as good as

all-round predictors, but provide strong measures within their particular domain of risky behavior.

They further find that gender differences are most pronounced for risk attitudes in the car driving and financial matters and least pronounced in the career domain. Finally, their results suggest that risk attitudes are strongly but not perfectly correlated across contexts. This suggests the presence of a common underlying risk trait, but also points to some value-added from asking context-specific questions.

Vieider et al. (2014) are concerned with common components of risk and uncertainty attitudes across contexts and domains in 30 countries around the world. They find that students of the humanities and of the social sciences other than economics tend to have a lower risk acceptance, although this effect is only significant for some of the measures. They observe one of the strongest effects for the per capita income measure. Subjects from countries with lower GDP per capita are more willing to accept uncertainty for the incentivized measure, in terms of gains and losses, risk and true uncertainty. The same effect is also found for the general survey question, occupational risks, and financial risks. For sports it goes in the opposite direction, with people from richer countries declaring themselves to be more willing to take risks. Finally, they find that women are more risk averse in incentivized measures for gains but not for losses. In terms of the survey measure, they find a gender effect for most contexts.

Hanoch et al. (2006) use an innovative subject pool for their experiment instead of typically used convenient one such as university students. They specifically target relevant subsamples to provide further validation of the domain-specific nature of risk taking. Their research shows that individuals who exhibit high levels of risk taking behavior in one content area (e.g., bungee jumpers taking recreational risks) can exhibit moderate levels in other risky domains (e.g., financial risks). Their results suggest that within each domain, the target subsample of risk takers (e.g., gamblers for the gambling domain) would show greater propensity for engaging in risky behaviors compared with the other subsamples, but that each subsample would not necessarily exhibit strong risk seeking tendencies outside its domain.

Finally, results of Byrnes et al. (1999) clearly support the idea that male participants are more likely to take risks than female participants at a general level. Nevertheless, a more qualified interpretation of their results is that gender differences varied according to context and age level. They find that certain topics such as intellectual risk taking and physical skills produce larger gender differences than others (e.g. smoking). They also find that some contents produce similar gender differences at different ages, whereas others produce developmental increases or decreases in the size of the gender gap.

6 Methodology

In this section we answer on the question about gender differences in attitudes to risk based on results of our analysis. Crosetto & Filippin (2014) state that gender differences in risk attitudes depends on the specific features of methods used to elicit risk preferences. It can mean, for example, that using questionnaires does not have to show gender differences. We shed light on this and show that even simple survey question can report significant gender gap. Furthermore, we will distinguish and analyze more domains of risk and consider other aspects influencing willingness to take risk such as personality characteristics, including personality profile, trait anxiety and height, where gender differences may be found. We examine how personality traits can explain risk preferences and whether it is a personality that makes the gender differences or not.

6.1 Experimental design

We use the data gained from the experiment conducted with university students by Cahlíková et al. (2015). Participants were asked on a series of questions. All the sets of questions were asked in the Czech language and include the following information: their gender, age, how many siblings they have, whether they smoke, height (in cm), highest education, and how many years they attend university. Then we wanted to know their attitudes to risk and asked them how they are willing to take risk in different domains: in general, while driving, in financial affairs, in sport or during recreation, in their career, and their health. And they were said to tick a box on the 11-point scale, where the value 0 means: "I do not risk at all" and the value 10 means: "I risk very much". The construction of these questions was used the same as in Dohmen et al. (2011). As we know, survey questions are not incentive compatible, however Dohmen et al. (2011) provide us a valuable instrument for research using survey data by validation of the general risk question. They find that responses to the general risk question are a reliable predictor of actual risky behavior, even controlling for a large number of observables. They ran a large survey including risk measures but also a complementary field experiment that tests the behavioral validity of the survey measures. This procedure offers the advantages of both statistical power and confidence in the reliability of the survey questions.

Finally, participants were asked to answer on a set of questions of their personality scales, namely the NEO-FFI and the STAI-T. The exact form of these questions cannot be published, because it is under copyright. We have available the final version of these personality scales summed together.

The NEO-FFI is a shortened version of the Revised NEO Personality Inventory (NEO-PI-R) that was first introduced in Costa & McCrae (1992) as a revision of the original version to facilitate a comprehensive and detailed assessment of normal adult personality. It is a psychological measure of the five major domains of personality as well as the six facets that define each domain. It provides a systematic assessment of emotional, interpersonal, experiential, attitudinal, and motivational styles which means a detailed personality description that can be a valuable resource for a variety of researchers. The NEO-FFI consists of 60 questions which are designed to measure the five personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism (usually called the Big Five personality traits). In the table below we can see closer characteristics of these personality traits. They are related to the behaviour in risky situations as Borghans et al. (2009) find, based on their analysis, that personality traits are strongly associated with risk and also explain a portion of the gender differences in attitudes to risk.

It is important to note that each of the five personality factors represents a range between two extremes. For example, extraversion represents a continuum between extreme extraversion and extreme introversion. In the real world, most people lie somewhere in between the two polar ends of each dimension.

Description of the Big Five personality traits

Openness	▪ active seeking and appreciation of experiences for their own sake ▪ being curious, original, imaginative, intellectual, creative, and open to new ideas
Conscientiousness	▪ degree of organization, persistence, control and motivation in goal directed behaviour ▪ being reliable, organized, systematic, punctual, prompt, and achievement-oriented
Extraversion	▪ quantity and intensity of energy directed outwards into the social world ▪ being outgoing, talkative, assertive, excitable, and enjoying social situations
Agreeableness	▪ tendency to be compassionate and cooperative rather than suspicious and antagonistic towards others ▪ being affable, tolerant, trusting, kind, cooperative, and compassionate
Neuroticism	▪ relates to individual's emotional stability and degree of negative emotions ▪ being anxious, irritable, temperamental, and moody

The STAI is a commonly used measure of anxiety that was introduced by Spielberger et al. (1983). Anxiety can be defined as a feeling of unease, worry, tension, and stress. It can be used in clinical settings to diagnose anxiety and to distinguish it from depressive syndromes. It also is often used in research as an indicator of caregiver distress. In our analysis, we use the trait component of the STAI, and it can be defined as feelings of stress, worry, discomfort, etc. Higher scores are indicating higher levels of anxiety.

For our analysis we have 128 participants available, see Table 3. We have the same proportion of women and men making both 64. Average age of our participants is approximately 21.4. The height of our participants is in a broad range starting with 158 cm to 196 cm making the average height just a little bit more than 175 cm. We use height in our analysis, because it is assumed to have robust effect on risk preferences in the literature. We also have 17 smokers in our group.

Our aim is to check whether the Female dummy variable is statistically significant in the regressions that we run and also to check the stability of coefficients after adding some control variables if we have robust effect enough.

Table 3: Summary of participants´ characteristics

Variable	Obs	Mean	Std. Dev.	Min	Max
Fraction female	128	.5	.50		
Age	128	21.41	1.61	18	30
Height	128	175.19	9.05	158	196

6.2 Results

6.2.1 Willingness to take risk in general

We start with the willingness of participants to take risk in a general domain. In Figure 4 we can see histograms of the distribution of general risk attitudes among our participants divided by gender. Most of the individuals choose the middle values and, not surprisingly, nobody chooses the edge ones. Men most frequently choose the value 7 and their mean is almost 6 while women have both mean and median of the same value, i.e. 5.

Figure 4: Histograms of responses to the question about willingness to take risks in general divided by gender

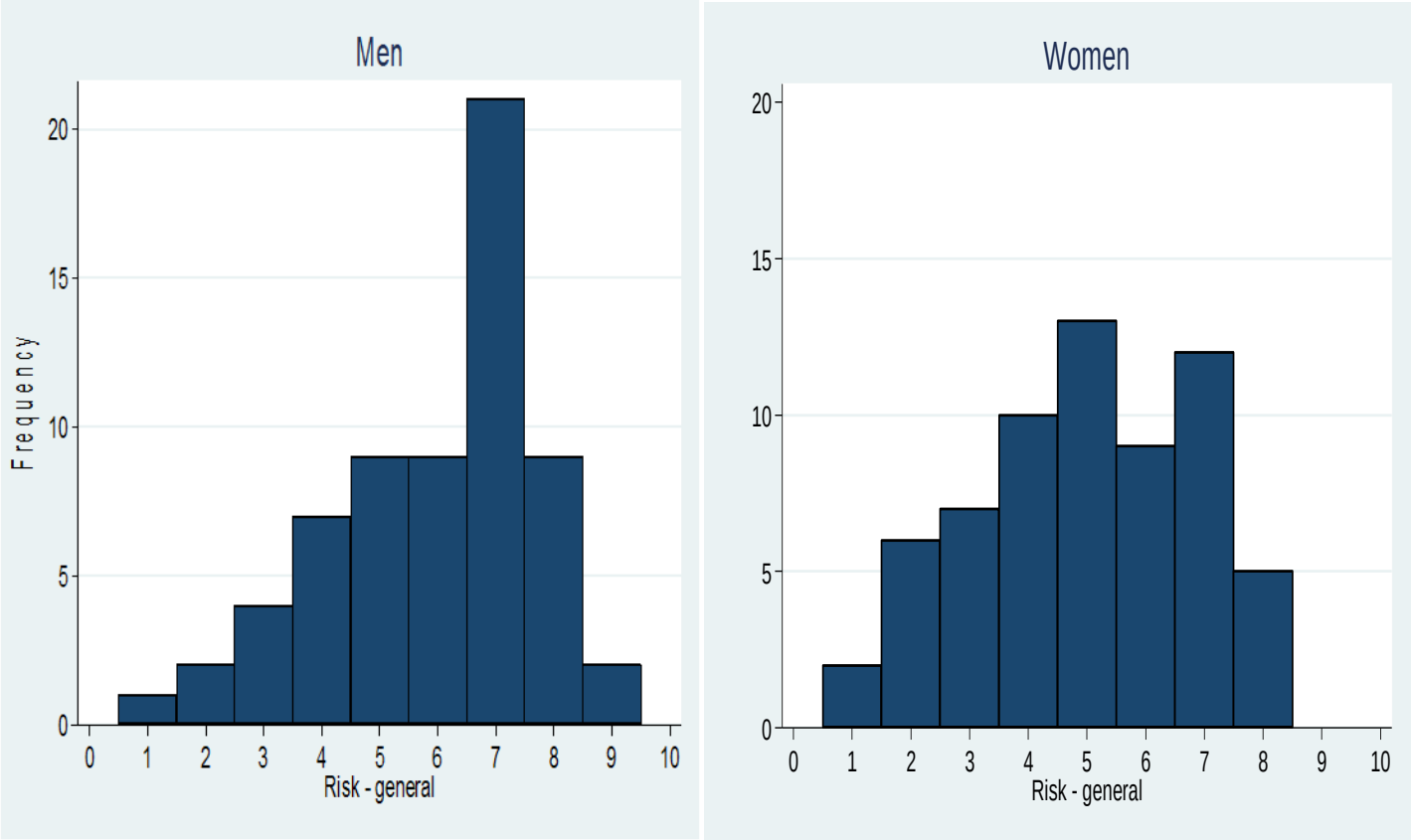


Table 4 shows the impact of chosen personal characteristics, that is gender and height. We estimate regressions where the dependent variable is an individual's response to the general risk question. We have also checked all preconditions necessary to give a causal interpretation of regression results.

Using just the gender of our participants in the regression on general risk, we can see that the consensus that women are more risk averse than men was in our sample confirmed, see Column (1). Women show almost one point less, on average, than men in the general risk question, and the results are statistically significant at the 1% level. Similar result comes from application of height in the regression, Column (2). We find out that taller participants appear to be more willing to take risks. We do not take into consideration age of our participants for our regressions because of a narrow age range. We use only university students who are, not surprisingly, of the similar age, which means that it would not show a significant effect.

Table 4: Primary determinants of risk attitudes in general

	Risk in general	
	(1)	(2)
Female	-0.984***	
	(0.327)	
Height		0.0404**
		(0.0184)
N	128	128
R^2	0.067	0.037
F	9.069	4.801

We use OLS regression technique and the regression includes a constant.

Standard errors are stated in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Now we determine the joint role of these basic characteristics and add some more. Table 7 summarizes our regressions. In the first column we can see gender and height as explanatory variables. Gender effect is still statistically significant while height is no more. It can be explained by the fact that women are smaller than men by nature that makes it correlated with the gender. Smoking is the new variable that we add in our regression. It tells us that smokers are not significantly more or less risk taking in general than non-smokers. The next variables used in our regression are the Big Five personality traits and the Trait Anxiety. Basic statistics we can see in Table 5 and further distribution by gender in Appendix A. At first, we determine the gender effect on results of these inventories. Not surprisingly, women and men show relatively big differences in these tests. Women score more than man by over 0.4 standard deviations in STAI-T on average, see Table 6. From the NEO-FFI the most noticeable differences can be observed in neuroticism, where women score more than men approximately by 0.67 standard deviations and in agreeableness with 0.5 standard deviations difference. The remaining personality characteristics from NEO-FFI do not show statistically significant difference between women and men. We should also check the level of correlation among NEO-FFI. Table 8 shows that NEO-FFI are not very correlated. The highest pairwise correlation is between

extraversion and neuroticism, but not even 0.5. Now we consider willingness to take risk in general as a dependent variable and NEO-FFI and STAI-T as explanatory variables. Extraversion is statistically significant at 1% level, only other significant variable is openness at 10% level. One point change in extraversion corresponds with 0.083 increase of willingness to take risk in general on the scale from 0 to 10. Our results are consistent with those presented by Nicholson et al. (2005) with the highest risk propensity in extraversion and openness. Trait anxiety can also not be considered as a good predictor for risk taking in general, which corresponds with results presented by Aimone & Ball (2012) and Zhang et al. (2015). In all regressions the effect of gender is robust and statistically significant at no less than 5% level. It implies that the effect is not caused by the variables that we added.

Table 5: Summary statistics of NEO-FFI and STAI-T

Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
Openness	128	29.8	6.2	17	43
Conscientiousness	128	31.4	6.9	3	46
Extraversion	128	32.1	6.2	13	43
Agreeableness	128	29.6	5.9	13	46
Neuroticism	128	20.5	8.0	5	41
Trait anxiety	128	39.8	8.9	22	59

Table 6: Differences in standardized NEO-FFI and STAI-T by gender

	Gender differences					
	Openness	Conscientious-ness	Extraversion	Agreeableness	Neuroticism	Trait anxiety
Female	0.228 (0.176)	0.184 (0.177)	0.0455 (0.177)	0.507*** (0.172)	0.666*** (0.167)	0.428** (0.173)
N	128	128	128	128	128	128
R^2	0.013	0.008	0.001	0.065	0.112	0.046
F	1.675	1.079	0.0659	8.735	15.87	6.093

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Determinants of risk attitudes in general

	Risk in general			
	(1)	(2)	(3)	(4)
Female	-1.023**	-0.979***	-0.896**	-0.927***
	(0.506)	(0.328)	(0.362)	(0.335)
Height	-0.00279			
	(0.0280)			
Smoker		0.317		
		(0.483)		
Openness			0.0480*	
			(0.0275)	
Conscientiousness			-0.0269	
			(0.0250)	
Extraversion			0.0830***	
			(0.0308)	
Agreeableness			-0.0242	
			(0.0278)	
Neuroticism			-0.0135	
			(0.0273)	
Trait anxiety				-0.0151
				(0.0190)
N	128	128	128	128
R^2	0.067	0.070	0.190	0.072
F	4.504	4.730	4.727	4.839

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Correlations among NEO-FFI

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Openness	1.00				
Conscientiousness	0.07	1.00			
Extraversion	0.18	0.10	1.00		
Agreeableness	0.15	-0.03	0.06	1.00	
Neuroticism	0.16	-0.33	-0.47	0.03	1.00

6.2.2 Willingness to take risk in different domains

In this section we deal with the five questions that ask about willingness to take risks in different domains. Our aim is to check the robustness of the gender effect in other domains than the general one. Based on summary statistics of risking in these domains divided by gender, see Table 9, we can notice that our male and female participants are at most willing to take risk in sports domain where the mean values are 6.6 and 5.3, respectively. On the other hand, men are least willing to take risk in health domain with the mean approximately 3.3 while women in the driving domain with the mean a little less than 2. In Appendix B we can see histograms of the distribution of risk attitudes in all domains divided by gender. From the table in Appendix C we can see that the risk attitudes are not perfectly correlated across domains, but the pairwise correlations are quite large.

Table 10 explores the gender difference in risk attitudes in each of the five specific domains. To simplify comparison, the first column reports results for willingness to take risk in general as shown previously. Women are significantly less willing to take risks than men in all domains except the health domain. Gender differences are most pronounced for risk attitudes in driving domain where women gain about 1.5 points less than men on average. This confirms the general stereotype that women are more careful while driving. Considering smokers as control explanatory variable leads to interesting results. In Table 11, we can see how smokers from our sample are willing to take risk in different domains. The only statistically significant effect of smoking at 1% level is observed, as expected, in the health domain, which tells us that smokers reach over 3 points more than others. Other domains are not statistically significant except driving domain at 10% level.

Table 9: Summary statistics of willingness to take risk in different domains

Variable	Gender	Observations	Mean	Std. Dev.	Min	Max
General	Men	64	5.95	1.80	1	9
	Women	64	4.97	1.89	1	8
Driving	Men	64	3.47	2.22	0	9
	Women	64	1.95	1.80	0	7
Financial	Men	64	4.89	2.24	0	9
	Women	64	3.55	1.97	0	8
Sports	Men	64	6.61	1.88	1	10
	Women	64	5.33	2.42	0	10
Career	Men	64	5.63	1.77	2	9
	Women	64	4.36	1.15	1	8
Health	Men	64	3.33	2.27	0	8
	Women	64	2.94	2.64	0	10

Table 10: Gender differences in risk attitudes in different domains

	Willingness to take risk in:					
	General	Driving	Financial	Sports	Career	Health
Female	-0.984***	-1.516***	-1.344***	-1.281***	-1.266***	-0.391
	(0.327)	(0.357)	(0.373)	(0.383)	(0.335)	(0.435)
N	128	128	128	128	128	128
R^2	0.067	0.125	0.094	0.082	0.102	0.006
F	9.069	17.99	13.00	11.19	14.30	0.808

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Smoking as a determinant of risk attitudes in different domains

	Willingness to take risk in:					
	General	Driving	Financial	Sports	Career	Health
Female	-0.979***	-1.500***	-1.339***	-1.270***	-1.270***	-0.342
	(0.328)	(0.353)	(0.374)	(0.382)	(0.336)	(0.394)
Smoker	0.317	1.029*	0.313	0.739	-0.305	3.091***
	(0.483)	(0.521)	(0.551)	(0.563)	(0.494)	(0.581)
N	128	128	128	128	128	128
R^2	0.070	0.151	0.096	0.094	0.105	0.190
F	4.730	11.15	6.626	6.491	7.304	14.66

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

$^{*}p < 0.10, ^{**}p < 0.05, ^{***}p < 0.01$

The last variables that we consider in our regression on willingness to take risk in different domains are NEO-FFI and STAI-T. The relationship between these variables and risk attitudes is less consistent across domains. For example, conscientiousness is a good predictor for the health domain statistically significant at even 1% level with a robust effect and also for the sports one at 5% level. Additionally, extraversion is significant in general, financial, and health domains. Only the career domain is not predicted by any of NEO-FFI. Female dummy variable is still robustly significant just as without adding NEO-FFI in the regressions. It means that the gender gap does not arise from differences in personality in any of the domains. Trait anxiety has a positive and statistically significant impact on risk taking only in the health domain. This tells us that anxious people tend to be a little more risk seeking in the health domain. More detail results can be seen in Table 12 and Table 13.

After we added variety of control variables in different domains of risk, gender aspect remain statistically significant with a robust effect on risk attitudes. Health domain is the only exception through all regressions where we fail to find differences between women and men.

Table 12: NEO-FFI as determinants of risk attitudes in different domains

	Willingness to take risk in:					
	General	Driving	Financial	Sports	Career	Health
Female	-0.896**	-1.210***	-1.168***	-0.899**	-1.160***	-0.252
	(0.362)	(0.411)	(0.422)	(0.441)	(0.387)	(0.460)
Openness	0.0480*	0.0182	0.0463	0.0163	0.0401	0.0195
	(0.0275)	(0.0312)	(0.0320)	(0.0334)	(0.0293)	(0.0348)
Conscientiousness	-0.0269	-0.0245	-0.0248	-0.0708**	-0.0205	-0.141***
	(0.0250)	(0.0284)	(0.0291)	(0.0304)	(0.0267)	(0.0317)
Extraversion	0.0830***	0.0453	0.0719**	0.0289	0.0458	0.0820**
	(0.0308)	(0.0350)	(0.0359)	(0.0375)	(0.0329)	(0.0391)
Agreeableness	-0.0242	-0.0615*	-0.0305	-0.0347	-0.0160	-0.0493
	(0.0278)	(0.0315)	(0.0324)	(0.0338)	(0.0297)	(0.0353)
Neuroticism	-0.0135	-0.0238	-0.0257	-0.0407	-0.0187	0.0261
	(0.0273)	(0.0309)	(0.0317)	(0.0331)	(0.0291)	(0.0346)
N	128	128	128	128	128	128
R^2	0.190	0.181	0.179	0.141	0.153	0.215
F	4.727	4.454	4.390	3.315	3.656	5.525

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: STAI-T as a determinant of risk attitudes in different domains

	Willingness to take risk in:					
	General	Driving	Financial	Sports	Career	Health
Female	-0.927***	-1.645***	-1.269***	-1.293***	-1.224***	-0.783*
	(0.335)	(0.363)	(0.382)	(0.394)	(0.344)	(0.416)
Trait anxiety	-0.0151	0.0340	-0.0197	0.00312	-0.0111	0.103***
	(0.0190)	(0.0206)	(0.0216)	(0.0223)	(0.0194)	(0.0235)
N	128	128	128	128	128	128
R^2	0.072	0.144	0.100	0.082	0.104	0.139
F	4.839	10.49	6.909	5.563	7.272	10.10

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.3 Discussion of results

We find a statistically significant impact of gender using a simple survey measure that asks people to give a global assessment of their willingness to take risks in general. This strongly confirms the consensus that women are more risk averse than men. We also find significant gender differences in all domains except the health domain. This result is robust even after using additional variables in our regressions. Furthermore, we replicate other findings concerning the determinants influencing risk attitudes such as height and NEO-FFI.

Results of our analysis are mostly consistent with those stated by Dohmen et al. (2011). They find that women are significantly less willing to take risks than men in all domains even in health domain where we fail to find gender difference. It can be because of the different distribution of smokers in our sample or simply that women are less afraid of diseases. Compared to us they also find robust effect of age, because they use much wider age range. For example, we find similarly that smokers are willing to take risk in health domain most from all participants.

7 Conclusion

The aim of this thesis is to find if there really are gender differences in attitudes to risk, as it was questioned by Crosetto & Filippin (2014) whose results suggest that gender differences in risk attitudes are rather exception than a rule. Our findings show the opposite: gender differences in risk preferences are significant and ubiquitous. On the other hand, we are in accordance with findings of Crosetto & Filippin (2014) that the likelihood of observing gender differences depends on the features of the task used to elicit risk preferences based on current studies. The main reason may be that some methods are difficult to understand for participants that cause heterogeneity in results presented by researchers.

We shed new light on heterogeneity of the results. Using and extending the design of Dohmen et al. (2011), we found that gender differences in attitudes to risk can be detected by a simple survey measure, even after controlling for the characteristics that are known to play role in attitudes to risk and can differ between men and women. We started with the general risk question and using just the gender in our regression we strongly confirmed the consensus that women are more risk averse than men. We also confirmed the findings of previous studies that the height is a good predictor of risky behaviour. Nevertheless, we found that these variables are evidently correlated as women are, on average, smaller than men by nature. We also used personality traits as control variables such as NEO-FFI and STAI-T in which women and men show relatively big differences. We found only extraversion and openness to have statistically significant effect on general risk question. Female dummy variable is statistically significant and robust both before and after adding the Big Five personality traits. It implies that the gender gap does not arise because of differences in personality in any of these dimensions.

Next we focused on in which dimensions of risk gender differences can be shown. Women are significantly less willing to take risks than men in all domains except the health domain. Gender differences are most pronounced for risk attitudes in the driving domain. We further found that the only statistically significant effect of smoking is observed in the health domain that confirms results presented in Dohmen et al. (2011). The relationship between the Big Five personality traits variables and risk attitudes is less consistent across domains. Innovatively, we used trait anxiety in the regression with gender and found that it has a positive and statistically significant impact at 1% level on risk taking only in the health domain. This tells us that anxious people tend to be a little more risk seeking in the health domain. After we added variety of control variables in different domains of risk, gender aspect remained statistically significant with a robust effect on risk attitudes.

Nevertheless, health domain was the exception through all regressions, where we failed to find differences between women and men. If we compare our results with Dohmen et al. (2011), we can see that they correspond in most cases. Despite nice results of our study we have a few limitations. We worked only with the student sample from the Czech Republic which may be plagued by the white-male syndrome, and our data were obtained by a survey measure even though it was validated.

To sum up, based on the results of our analysis and current literature we are able to confirm the consensus that women are more risk averse than men. We believe that this thesis provides a leap forward in the understanding of gender differences in risk attitudes by bringing new evidence to the debate.

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List of appendices

Appendix A: Summary statistics of standardized NEO-FFI and STAI-T for men and women (tables)

Appendix B: Histograms of responses to the question about willingness to take risks in different domains (graphs)

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Appendix D: Height as a determinant of risk attitudes in different domains (table)

Appendices

Appendix A

A - Table 1: Summary statistics of standardized NEO-FFI and STAI-T for men

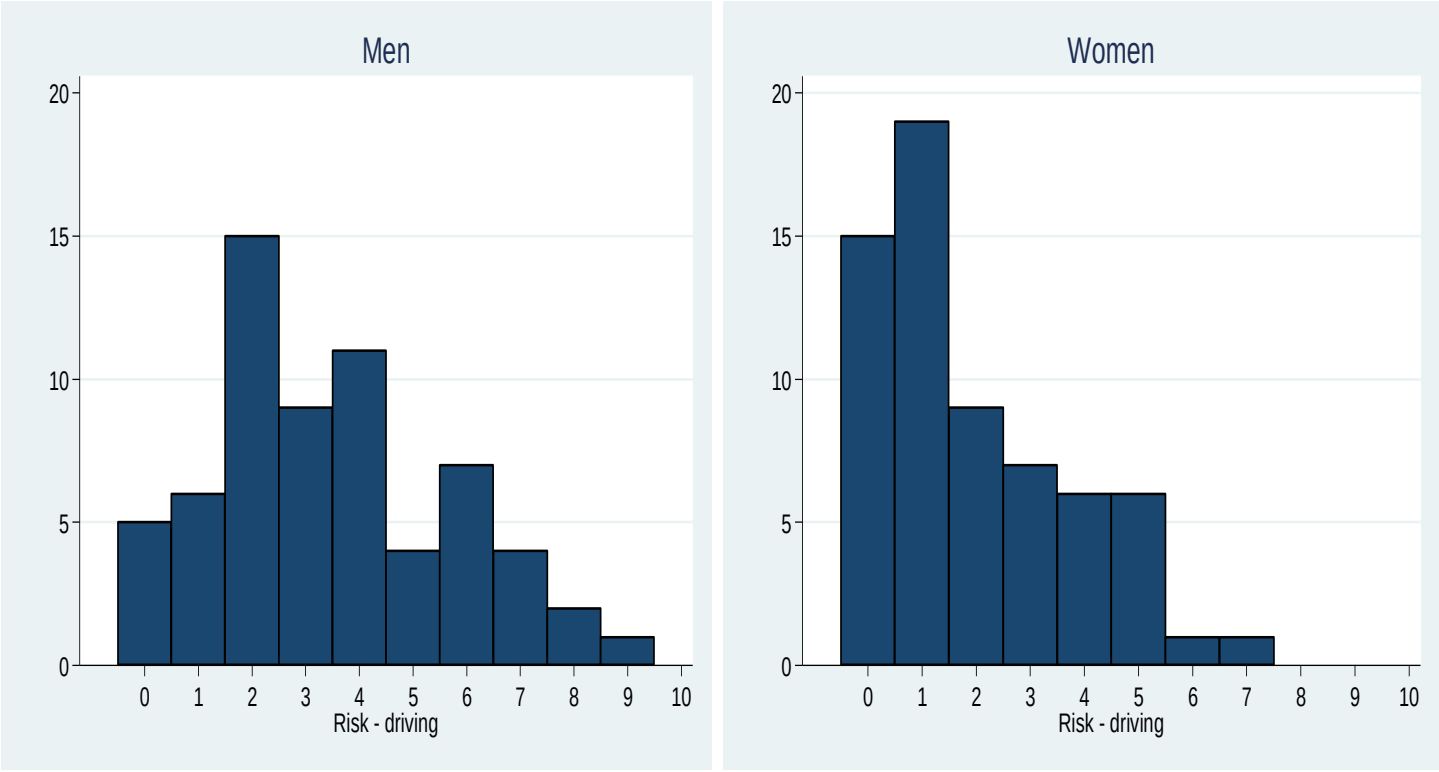
Variable	Observations	Mean	Std. Dev.	Min	Max
Openness	64	0	1	-1.9	2.1
Conscientiousness	64	0	1	-2.9	1.8
Extraversion	64	0	1	-2.4	1.6
Agreeableness	64	0	1	-2.8	2.8
Neuroticism	64	0	1	-1.9	1.7
Trait anxiety	64	0	1	-1.8	2.2

A - Table 2: Summary statistics of standardized NEO-FFI and STAI-T for women

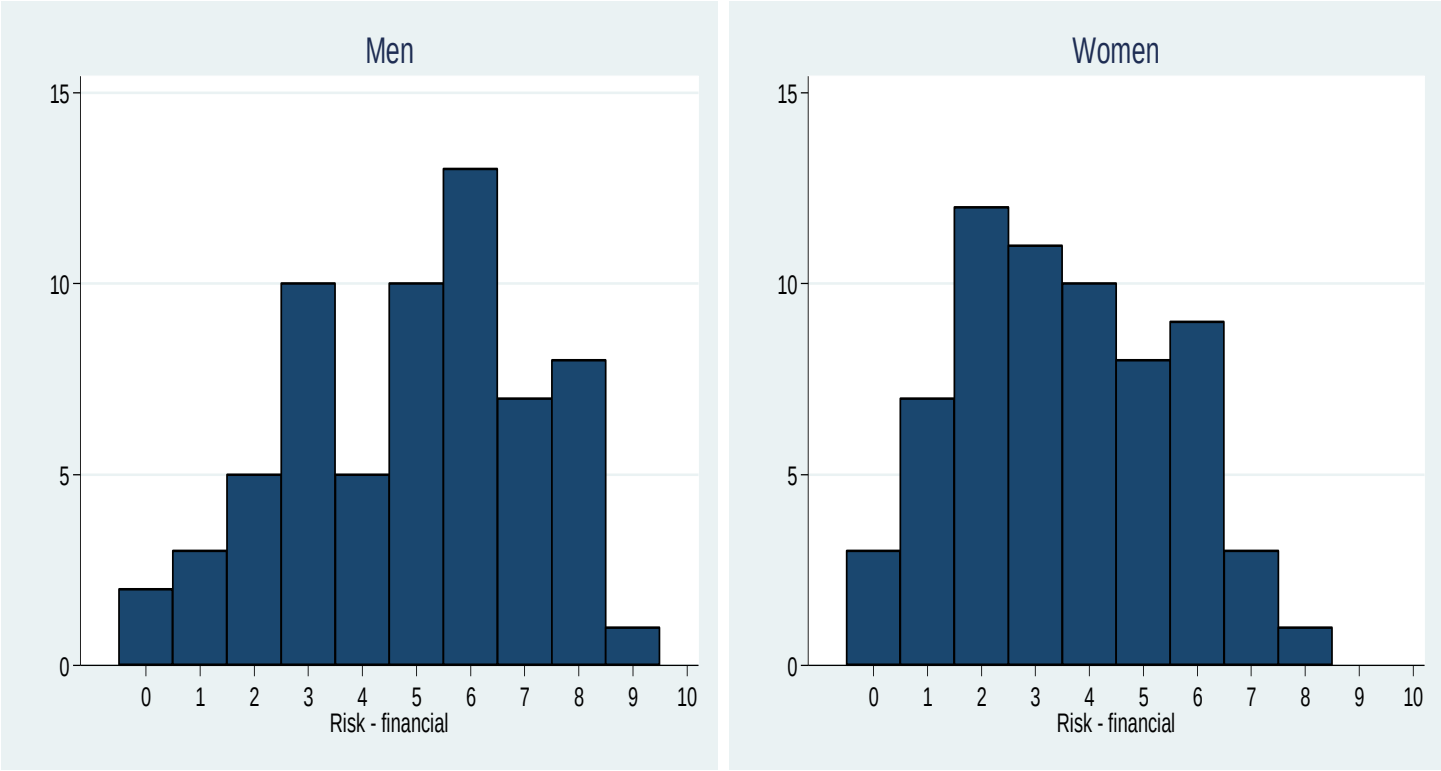
Variable	Observations	Mean	Std. Dev.	Min	Max
Openness	64	0	1	-2.1	2.1
Conscientiousness	64	0	1	-4.1	2.1
Extraversion	64	0	1	-3.1	1.8
Agreeableness	64	0	1	-2.0	1.9
Neuroticism	64	0	1	-1.8	2.6
Trait anxiety	64	0	1	-2.0	1.9

Appendix B

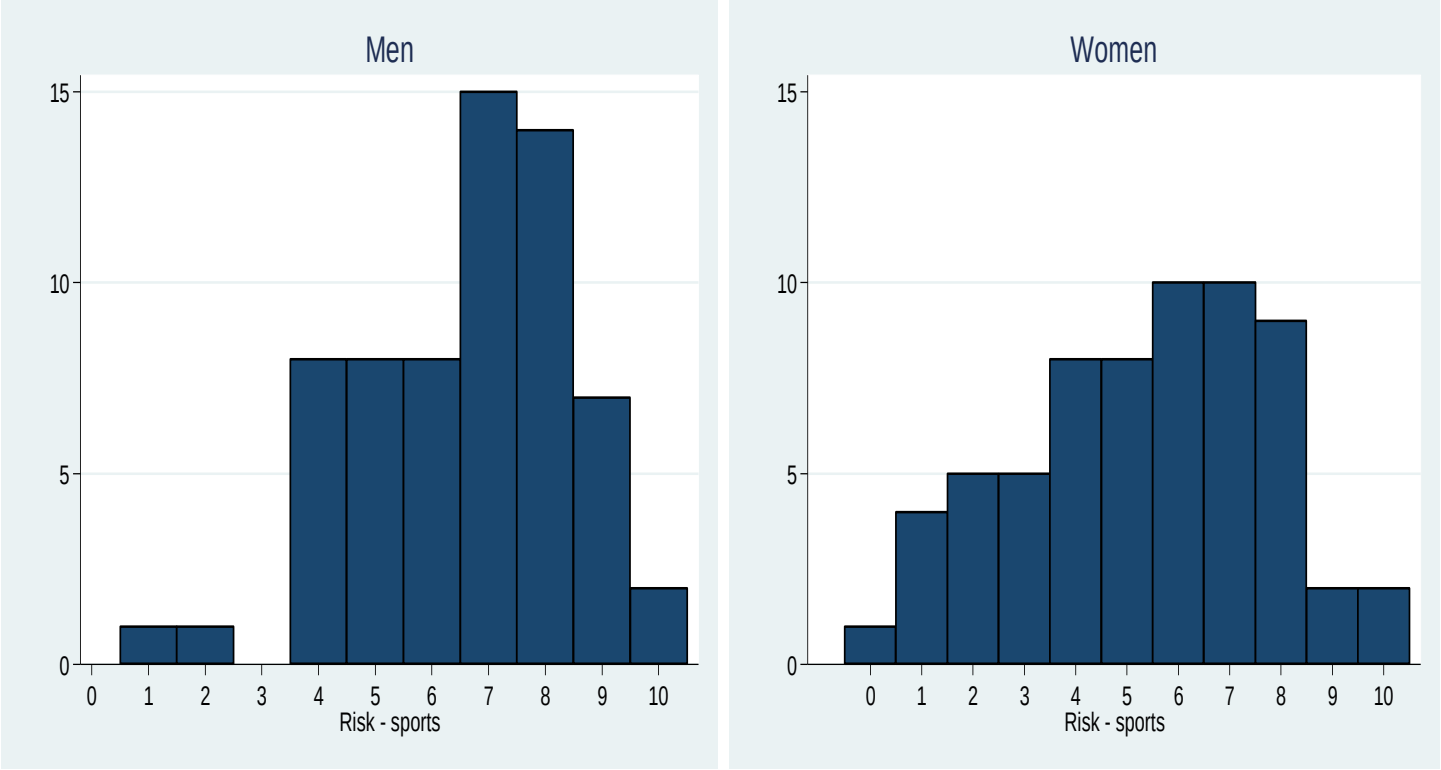
A - Figure 1: Histograms of responses to the question about willingness to take risks in driving



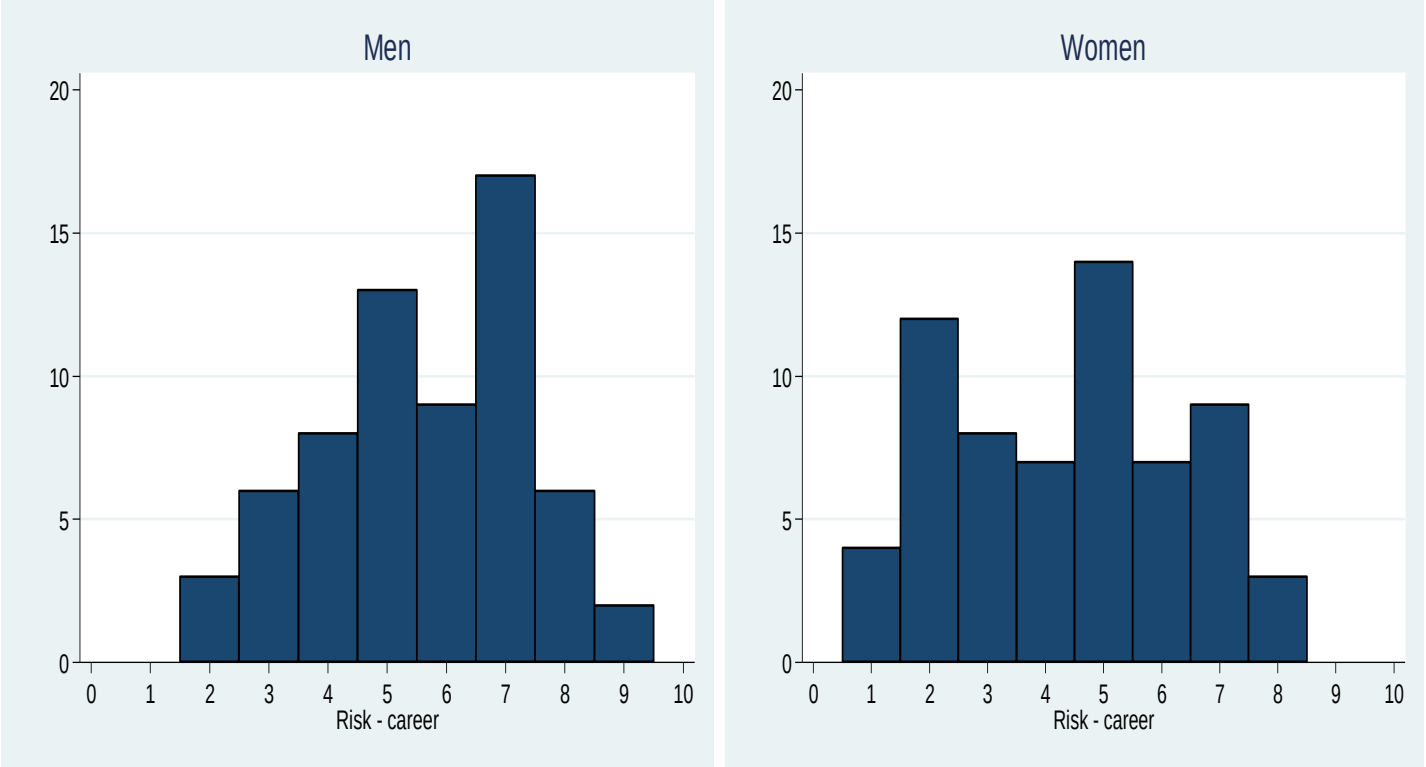
A - Figure 2: Histograms of responses to the question about willingness to take risks in financial



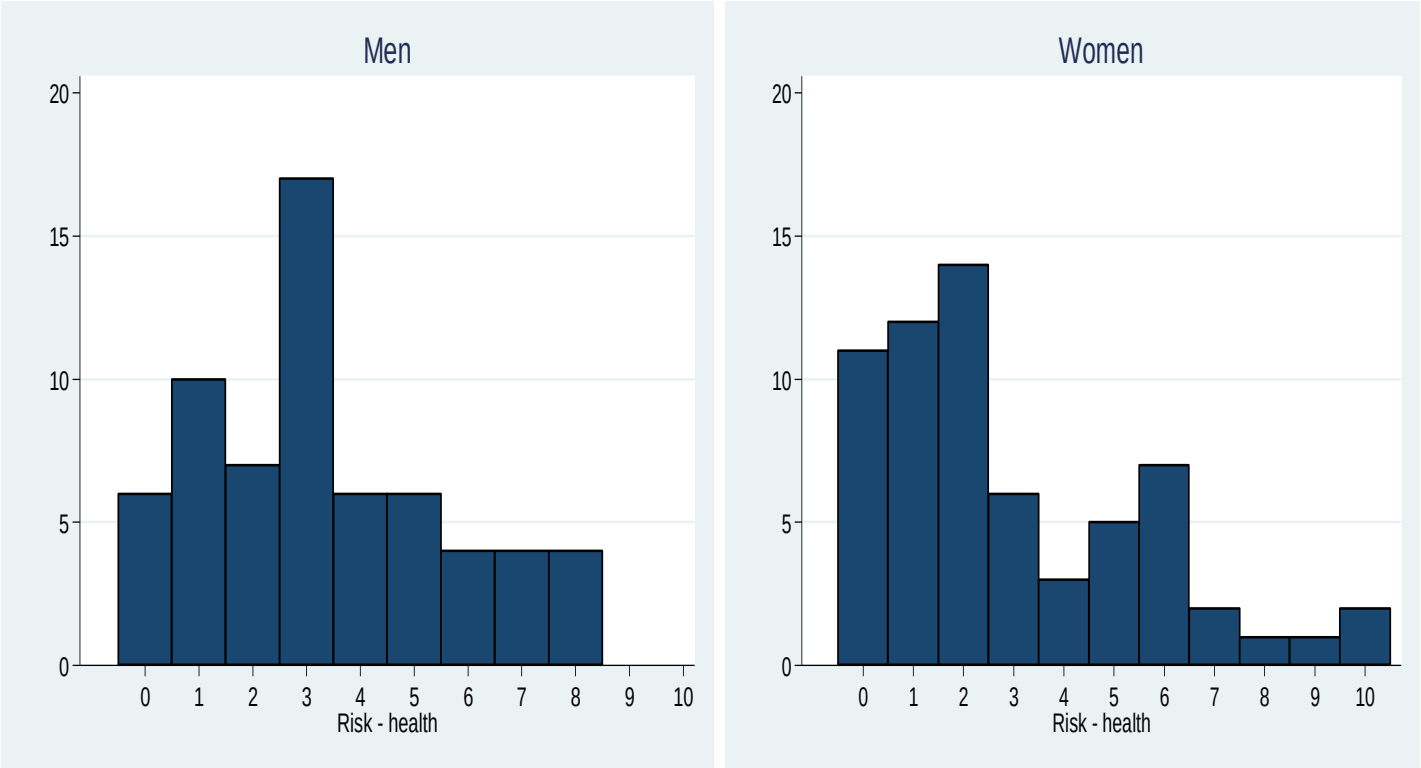
A - Figure 3: Histograms of responses to the question about willingness to take risks in sports



A - Figure 4: Histograms of responses to the question about willingness to take risks in career



A - Figure 5: Histograms of responses to the question about willingness to take risks in health



Appendix C

A - Table 3: Correlations among risk attitudes in different domains

	General	Driving	Financial	Sports	Career	Health
General	1.00					
Driving	0.36	1.00				
Financial	0.60	0.44	1.00			
Sports	0.55	0.28	0.38	1.00		
Career	0.68	0.42	0.60	0.52	1.00	
Health	0.23	0.36	0.16	0.38	0.18	1.00

Appendix D

A - Table 4: Height as a determinant of risk attitudes in different domains

	Willingness to take risk in:					
	General	Driving	Financial	Sports	Career	Health
Female	-1.023**	-1.194**	-1.635***	-1.340**	-1.377***	-0.747
	(0.506)	(0.552)	(0.576)	(0.592)	(0.518)	(0.671)
Height	-0.00279	0.0234	-0.0213	-0.00427	-0.00809	-0.0259
	(0.0280)	(0.0306)	(0.0319)	(0.0329)	(0.0287)	(0.0372)
N	128	128	128	128	128	128
R^2	0.067	0.129	0.097	0.082	0.102	0.010
F	4.504	9.259	6.692	5.561	7.136	0.645

We use OLS regression technique and the regression includes a constant. Standard errors are stated in parentheses.

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$