Gender Differences in Risk Aversion

An Experimental Study from Peru

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Preface

I would like to express my profound gratitude to my supervisor, Ragnhild Haugli Bråten, for contributing to laying the foundation of my thesis, for her impeccable guidance, her constructive feedback and her valuable and important discussions. Her support, guidance and encouragement trough out the entire process is highly appreciated. I am also deeply thankful towards the Land and Gender in Peru research team. Especially Henrik Wiig and Daniela Fuentes, for their priceless advices, invaluable comments and experience. I am further thankful for the Land and Gender in Peru research project for allowing me access to their data material collected during the autumn of 2010.

Further and more informal thanks are directed towards my dear family, friends and fellow students for inspiring conversations and encouragement. I am especially grateful towards my parents for constant support and appreciated inputs. Last but not least I would like to thank my dear boyfriend Nizam Najjar for constructive advice and motivation.

All faults and errors are entirely mine.

Lene Sandvik

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1 Introduction

Risk aversion is a concept in economics of how people behave when they are exposed to uncertain outcomes. The concept of being risk averse is defined as the propensity to prefer an offer with an expected lower but more certain outcome, compared to an offer with a higher expected outcome with more risk. A more risk averse person is thus less inclined to make an investment with a fairly rewarding outcome if the outcome is uncertain, than a person who is less risk averse. For a poor peasant, this might imply little or no investment in modern production technologies that could lead the peasant out of poverty. Knowledge of risk behavior is thus of importance for public policy making in a pro-growth policy agenda.

Are poor farmers more risk averse than western students? And is the degree of risk aversion in part determined by gender? This thesis examines risk attitudes amongst low-income peasants in the rural highlands of Peru. I will investigate gender specific differences in risk behavior amongst peasants in two regions in the rural southern Peruvian highlands[1]. I will examine whether or not the Peruvian women in our sample are more risk averse than men, with my hypothesis being

Peasant women in the Peruvian highlands are more risk averse than men.

The empirical analysis is based on both quantitative and qualitative data. The main method used in this thesis is experimental. By using a risk game[2] with real monetary rewards, conducted in the two regions in the southern Peruvian highlands, I was able to deduce the participants' degree of risk aversion. The hypothesis will also be addressed by the data generated from both a questionnaire connected with the experiment and a survey of the larger research project Land and Gender in Peru. In addition, I collected qualitative data in the same period and the same area[3] as the experiments of the one region was conducted. The qualitative data collection consisted of observing the participants and their decision-making process

[1] Henceforth referred to as Peruvian peasants/women/men for simplicity
[2] Conducted by Ragnhild H. Bråten, Doctoral Student at the Frisch Centre, and myself
[3] In the period October to November 2010 in Cusco, Peru

during the experiments, conversation with the participants after the game and conversations and interviews with other locals.

In section 2 I give a textbook presentation of the theory of behavior under uncertainty relevant for my thesis. Most of the existing experimental literature on risk aversion and gender find women to be more risk averse than men. This is presented in section 3. However, I also present some papers suggesting no apparent link between gender and risk aversion. There also seems to be a distinction between the findings in the western world and the underdeveloped word. Most of the experimental research on risk aversion in the western world is conducted with a university student sample. As opposed to much of the literature from developing countries, the majority finds a significant gender-specific difference in risk aversion. There also appear to be a relationship between poverty and risk behavior. In section 3.3 I give a short presentation of the theoretical implications of risk aversion and poverty in the theory of poverty traps, postulating that poor peasants are highly risk averse because they are more vulnerable to negative shocks. And since they are more risk averse, they are more reluctant to undertake risky investments, which might push them out of poverty. In section 4, I present the method used to elicit risk aversion, the experimental design. I also discuss briefly some of the shortcomings with the method and the experimental design. The results and the discussion are shown in section 5. The sampling characteristics display the characteristics of the participants, who in short can be summarized as low-educated, low-income peasants with a highly gender segregated labor sphere. Nonetheless, in general they report to be satisfied with both their economic situation and health. The participants risk behavior is consistent with the expected behavior of poor peasants; the majority is either highly risk averse or risk loving. According to my regression analysis in section 5.3, women are significantly more risk averse than men. However, after controlling for principal work activity, there is no statistical evidence of gender-specific differences in risk behavior. Still, the only work activity with a significant effect on risk aversion, is housework. Only a minority of women has housework as their main activity, suggesting that there is still a gender difference with women being more risk averse than men. Furthermore my findings also suggest that men are significantly more extremely risk loving than women, and that this difference might be the driving force of gender differences in risk behavior. All descriptive and econometric analysis has been executed by the use of the statistical software Stata11.

2 Theory of Risk Aversion

How do economic agents behave when facing a risky choice? What constitute risk averse behavior? I will in this section give a brief overview of standard economic theory of decision making under risk, concentrated around the theory important for my experimental method. The theoretical presentation of risk aversion is based on chapter 8 “Uncertainty and Risk” in Frank Cowell`s book (2005) “Microeconomics, Principles and Analysis” and chapter 11 “Uncertainty” in Hal R. Varian`s book “Microeconomic Analysis” (1992).

2.1.1 Von Neumann-Morgenstern Utility

Consider a representative economic agent faced with a risk game consisting of two choices; a safe amount, denoted by $\gamma \geq 0$, and a binary lottery with a state contingent payoff $x_\varphi \geq 0$ depending on the state, denoted φ, realized. There are no negative payoffs; hence the agent is not faced with a budget constraint. All possible states are presented with Ω, and π_φ denotes the probability of the state, normalized so as to sum to 1, $\sum_{\varphi \in \Omega} \pi_\varphi = 1$.

Assume a game in which the agent can choose between a safe payoff and a lottery. The choice selected by the agent depicts his/her risk behavior. And the agents risk behavior in the game depends on his/her preferences for risk, his/her utility function.

I will assume constant relative risk aversion (CRRA), so that a proportional change in each of the alternative payoffs does not alter the agents’ relative utility. Utility of a lottery, a monetary good in the risk game, when assuming CRRA, is represented with the von Neumann-Morgenstern utility function (U)

$$(2.1) \qquad U(x_\varphi) = \frac{x_\varphi^{(1-\rho)}}{1-\rho}$$

Where ρ denotes the individual’s degree of risk aversion.

The appropriate measure for relative risk aversion is, following Varian (1992, p`189), the Arrow-Pratt measure:

$$(2.2) \qquad \rho = -\frac{U''(x)x}{U'(x)}$$

Using the Arrow-Pratt measure, and the utility function (2.1), I can investigate the nature of the relative risk aversion depicted by the utility function. The first derivative of (2.1) is:

$$(2.3) \qquad \mathrm{U}'(\,x_{\varphi}) = x_{\varphi}^{-\rho}$$

and the second derivative

$$(2.4) \qquad \mathrm{U}''(\,x_{\varphi}) = -\rho x_{\varphi}^{-1-\rho}$$

Inserting for (2.3) and (2.4) in (2.2)

$$(2.5) \qquad \rho = -\frac{\left(-\rho x_{\varphi}^{-1-\rho}\right)x_{\varphi}}{x_{\varphi}^{-\rho}} = \rho$$

Equation (2.5) proves that the relative risk aversion denoted in (2.1) is constant at a rate ρ. A higher value of ρ implies higher degree of risk aversion, and a negative value of ρ denotes a risk loving attitude.

The economic agent also has the choice of a safe payoff, γ. As this is a secure monetary reward, the probability connected with the safe payoff is equal to one. Still, the agents' utility does depend on his/her degree of risk aversion. The more risk averse the agent is, the higher is her utility of a safe amount as opposed to the lottery. Utility of the safe amount, $U(\gamma)$, can thus be expressed as

$$(2.6) \qquad U(\gamma) = \frac{\gamma^{(1-\rho)}}{1-\rho}$$

From (2.6) we see that the U(γ) is only affected by the monetary reward of the secure amount, γ, and the participants degree of risk aversion, ρ.

2.1.2 Expected Utility and Risk Aversion

Having defined the utility function of the state contingent good, assuming the standard necessary axioms, the expected utility for the state contingent good can be expressed. The agents' utility depends on both the agents' degree of risk aversion and the alternative payoffs. Ergo the maximization problem the agent faces is not a standard utility optimization where the agent "only" has to maximize his/her utility of the good. The agent needs to take the probabilities into account, when optimizing his/her utility of x_φ, hence the agent must maximize his/her expected utility of x_φ. I will express the expected utility (EU) function for the risky choice as (EU_φ) represented by:

$$(2.7) \qquad EU_\varphi = \textstyle\sum_{\varphi \in \Omega} \pi_\varphi U(x_\varphi)$$

Assume a situation with only two possible states of the world. Denote the outcome of the one state, x_α, with the following probability π_α, and the outcome of the other state, x_β, with the following probability (1- π_α). In the two-state risk game, EU_φ can thus be expressed as

$$(2.8) \qquad EU_\varphi = \pi_\alpha U(x_\alpha) + (1 - \pi_\alpha) U\left(x_\beta\right)$$

Inserting for $U(x_\varphi)$ from (2.1) in (2.8)

$$(2.9) \qquad EU_\varphi = \pi_\alpha \frac{x_\alpha^{(1-\rho)}}{1-\rho} + (1 - \pi_\alpha) \frac{x_\beta^{(1-\rho)}}{1-\rho}$$

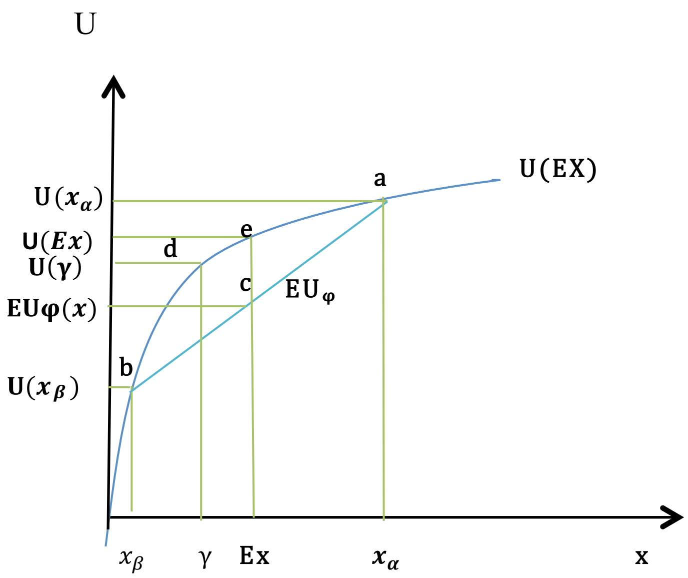
As stated in section 2.1.1, the probability connected with the safe amount equals 1, thus the expected utility of the safe amount can be expressed as

$$(2.10) \qquad \mathrm{E}U_{\gamma} = U(\gamma) = \frac{\gamma^{(1-\rho)}}{1-\rho}$$

Expected utility theory postulates that the agents' choice does not depend on the highest expected value, but the highest expected utility of the value. I have illustrated the relation with expected utility, utility, and risk aversion in Figure 1, below. The possible outcomes are presented on the horizontal line, x. The utilities of the respective outcomes are drawn on the vertical line, U. Point a in figure 1 displays the monetary outcome, x_{α}, on the horizontal line. The corresponding utility, depending on the agents degree of risk aversion, can be read from the vertical line, U(x_{α}). Point b depicts the utility represented with outcome, x_{β}, U(x_{β}). In figure 1 I have drawn a linear line between point a and point b, representing the expected utility of the two states, EU_{φ}. As both outcomes, x_{α} and x_{β}, have a have a probability of 50 %, the expected outcome (Ex) of the lottery is in point c. The corresponding expected utility of Ex is presented on the vertical axis (EU_{φ}(x)).

The agents utility function of the expected outcomes U(EX) is drawn as a concave curve, implying risk aversion. Hence the agent is willing to accept a lower outcome if it is more secure, in this case fully secure. This behavior is demonstrated in figure 1, by comparing point c, d and e. Point e represents the utility of Ex, where U(Ex)>EU_{φ}(x), hence the agent values the utility of the expected value (point e) more than the expected utility (point c). Point d in figure 1 represents the utility of the safe amount γ. The secure outcome, γ, is less than the expected outcome of the lottery, Ex. However the utility of the secure payoff is higher than the expected utility of the lottery, U(γ)> EU_{φ}(x). Thus the utility function indicated in this figure depicts a risk averse individual, who prefers the secure amount as opposed to the lottery even when the expected outcome of the risky prospect is higher.

Figure 1. Utility Function of a Risk Averse Person



Note: γ represents the secure outcome. x_α and x_β the possible outcomes of the lottery, each represented with a 50% probability of occurring. The curvature of the utility function thus implies that the agent prefers the secure outcome to the lottery, even though the expected value of the lottery is higher tan the secure alternative.

According to expected utility theory, the curvature of the utility function determines the risk preferences. A higher risk aversion is equivalent with a more concave utility function. A risk loving agent has a convex utility function, implying a negative value of ρ. The risk loving agent values the expected utility more than the utility of the expected value. A risk neutral agent, on the other hand, has linear utility function.

3 Literature

3.1 The Importance of Experimental Research

The experimental method is not a newly valued tool in scientific inquiry, but has ever since the Renaissance been of importance (Levitt and List, 2009). The understanding of the importance of empirical testing of economic theory is nor a recent development within economics. The famous economist Ragnar Frisch is one of the early advocators' for empiric exploration. He was concerned with the lack of empiric testing, and sought an *"experimental and numerical verification" of economic models in "(...) a desire to turn pure economics . . . into a science."* (Bjerkholt 2010, pp`22).

There exists now a variety of experimental methods, such as lab experiments, artefactual field experiments, framed field experiments, natural field experiments and natural experiments (Levitt and List, 2009). In behavioral economics, the most common experimental method is laboratory experiments. Laboratory experiments are characterized by that the participants volunteer to participate and make decisions in a controlled environment (in a lab). The artefactual method resembles the laboratory, with the only difference being that the participants are so-called "non standard subjects" often from the environment of interest (Levitt and List, 2009). A framed field experiment differs from the artefactual in that it embodies contextual elements from the environment in question. This method is often used to test the implications of a policy implementation. Natural field experiments differ fundamentally from all the experimental methods described above, as the participants in the experiments do not know that they are participating. Finally, a natural experiment differs from all the above-mentioned experiments by the uncontrolled randomization of the sample. In other words, the researcher has not controlled the assignments of treatment.

Standard economic theory tends to generalize economic preferences to be constant across borders. That if one specific experiment in one country, amongst one homogenous group, find women to be significantly more risk averse than men, then this must hold for all economic actors regardless of differences in geographical and demographical characteristics. The ruling idea seems also to be that women are more risk averse than men: *"Under different environments and tasks, the majority of studies about gender differences in risk- taking report the same conclusion: women are more risk averse than men"* (Ergun, García-Muñoz, Rivas (2011, p`3). These gender specific differences in behavior are mainly explained by arguments based on either evolutionary theory or socialization theory. Croson and Gneezy (2009) explore ten different literature contributions investigating gender-specific differences in risk taking within experimental economics. The majority of the literature explored in Croson and Gneezy (2009) use a western student sample. The results from their study underpin Ergun et al. (2011) findings; women are more risk averse than men. Croson and Gneezy (2009) propose some probable explanations for the gender-specific difference, such as differences in emotions, overconfidence amongst men and differences in interpretation of the risky prospect. Nonetheless, they do suggest that these findings might be culturally biased.

However, there exists experimental literature contradicting this generalization, suggesting that attitudes towards risk are highly contextual. Henrich et al. (2005) conducted cross-cultural economic lab experiments in twelve countries, on four continents, where all the societies included in their sample differed in social, economic and cultural characteristics. Even though the experiments conducted were Public Good, Ultimatum and Dictator Game, they also investigated attitudes towards risk. They find that some societies act in accordance with expected utility maximization for risk neutral agents, whilst other groups experiences such a high degree of risk aversion that they "would be unable to function in variable environments" (Henrich et al., 2005, p´11).

There is a growing amount of literature within behavioral economics investigating risk attitudes. Although the majority of the experiments investigating risk attitudes are conducted as lab[4] experiments with western university students, increasing amount of experiments are now being conducted in developing countries. The degree of risk aversion and the effect of socio economic characteristics differ between experimental results, suggesting the importance of empirical research on attitudes towards risk. "*The nature of risk aversion (to what extent it exists, and how it depends on the size of the stake) is ultimately an empirical issue"* (Holt and Laury, 2002, p`1644).

[4] I do not distinguish between lab experiment and artefactual field experiment in this thesis due to its similarities.

3.2 What Affects Risk Attitudes?

As early as 1980, Binswanger (1980) expressed doubt on the truthfulness in the general idea that women are more risk averse than men. He used both interviews and lab experiments to elicit risk behavior in rural India amongst low-income farmers, and his findings show little support to the gender differences in risk behavior.

Schubert, Brown, Gysler and Brachinger (1999) ran a lab experiment amongst undergraduate students from different academic fields in Switzerland. The experiment consists of four different framings, where the risk choice was presented differently in each framing (as an investment, an insurance, a gain-gambling, or as a loss-gambling choice). They find evidence that gender-specific risk behavior is frame-conditioned. Hence not only are gender differences explained by including socio economic variables, it is also dependent on the game framing. Binswanger (1980) also supports this finding, and claims further that certain games might resemble certain daily situations, which will affect how the participant acts. Daily situations differ most often across societies, thus a natural conclusion is that game behavior is society dependent. Schuberts et al.`s (1999) findings with a western university student sample suggest that it is differences in wealth, not gender, which explains most of the differences in risk attitudes.

Using a US survey sample, Jianakoplos and Bernasek (1998) find that, compared to men, women´s aversion towards risk decreases less as wealth increases. Hence there is a significant difference in gender on the impact of wealth on risk behavior. More surprisingly they find that women exhibit a decreasing risk aversion with respect to age. As women age, they become less risk averse, whilst men tend to become more risk averse with age. They also find that education has a significant negative effect on risk aversion, and that the effect of education is bigger for women than men.

Tanaka, Camerer and Nguyen (2010) carried out a cross-sectional lab experiment in rural Vietnam on participants that had already participated in a household survey, thus being able to link risk behavior to demographic and economic variables. They find no significant effect of gender on risk aversion. Age and education, however, has a significant positive effect on risk aversion, meaning the more educated and the older the participant is, the more risk averse.

Holt and Laurys (2002) famous lab experiment, where they created what has later been referred to as a Multiple Price List (MPL) to elicit US university students risk behavior, has been replicated by several behavioral economists. The MPL format gives the participants ten choices of two different prospects, one relatively risky and one relatively safe, where the probabilities differ for each choice. The MPL format use real monetary rewards and the participant must choose between the two prospects presented to them. Holt and Laury (2002) report from their study significant effect of gender when the payoffs are low, supporting the general idea of women being more risk averse. Surprisingly they find that there is no significant effect of gender under the high payoff conditions. Holt and Laury (2002) control for other socio economic variables such as age, education level, faculty and income, but find that only income has a significant (mildly) negative effect on risk behavior.

Harrison, Lau and Rutström (2002) copied Holt and Laury's (2002) MPL design and executed a lab experiment using surveys with real monetary rewards in Denmark on subjects between 19 and 25. They find no significant evidence that gender affect risk behavior, contradicting the general idea that women are more risk averse than men. Neither in the low payoff scheme is gender found to have a significant impact when controlling for other socio economic variables. However they do find evidence of the importance of socio demographic characteristics on risk aversion. Age is found to have a significant negative effect on risk aversion. Furthermore, education is found to have a significant positive effect on risk aversion, using skilled labor as a proxy for education. Harrison et al. (2002) also find that students are more risk averse than non-students.

Galarza (2009) also reproduced Holt and Laury's (2002) procedure in a laboratory experiment amongst small-scale cotton farmers on the Peruvian south cost. In his findings he reports a moderate degree of risk aversion amongst the Peruvian cotton farmers. Although reporting a vaguely more risk averse behavior amongst women than men, he finds no significant effect of gender on risk behavior. The only effect of significance on risk behavior was the participants' education level. Peruvian cotton farmers with higher education are found to be less risk averse, contradicting both the findings of Tanaka et al. (2010) in Vietnam and Harrison et al. (2002) in Denmark.

Dohmen, Falk, Huffman and Sunde (2010) conducted a laboratory experiment with randomly drawn adults in Germany to elicit attitudes towards risk. The participants' in the risk experiment were faced with a slightly different choice table than Holt and Laury's (2002) MPL. In Dohmen et al.`s (2010) format, the choice table consists of twenty choices, each choice a binary choice between a lottery or a safe amount. The risk experiment was run with the intent to investigate whether or not cognitive ability affects risk aversion. Their research finds significant evidence that the higher the cognitive ability the lower the risk aversion. In their empiric regression model they also control for gender, finding no significant effects.

Akay, Martinsson, Medhin and Trautmann (2009) conducted a similar experiment to the one run by Dohmen et al. (2010), in Ethiopia amongst subsistence farmers. Akay et al.`s (2009) risk game with Ethiopian farmers finds that more than half the population behaves highly risk averse. By comparing their results with similar experiments run with western students, they conclude that it is the extreme cases of risk aversion amongst the Ethiopian peasants that are the main driving-force for the more risk averse behavior compared to the risk attitudes of the western students. They conclude that; "*In any case, the data support the view that strong risk aversion predominates among the farmers"* (Akay et al., 2009, p`10). They control for socio-economic characteristics, but they find no significant effect of wealth and income on Ethiopian peasants risk attitudes. However, they do find health to have a significant effect on risk aversion. The poorer the health the more risk averse the participant acts. They find no significant evidence of gender differences in risk attitudes.

Deriving out of the literature within experimental economics presented above, there appears to be a difference in the findings from experiments conducted in western countries to those conducted in underdeveloped countries. The latter finds gender-specific differences in risk aversion to a lesser degree. The fairly homogenous sample in the western experiments and the possible publication bias[5] indicates the value of further investigation on gender and risk aversion.

3.3 Risk Aversion as Poverty Trap

Risk is an important factor in (almost) every economic decision in life. The importance of risk is of even more significance amongst farmers, as their production outcomes are highly volatile due to the unpredictable climate. Poor peasants are thus not only vulnerable to individual shocks such as injuries, but also to external shocks, like the weather. It is also well known within development economics that in many cases poorer peasants in developing countries lack formal credit- and insurance institutions. As so elegantly stated by Kanbur and Squire (2001, p`205): *"The poor suffer from risk because they lack the means to protect themselves adequately against it - this is what makes them vulnerable."*

According to the theory of poverty traps with multiple equilibriums within development economics, decision-making under risk explains much of the poverty traps we encounter in the underdeveloped world. Within the theory of the poverty trap with multiple equilibriums, outside shocks may have permanent outcomes either towards a higher level equilibrium and thus economic growth, making new investments more attractive, or to a lower level equilibrium, pushing the economic actors into a worse-off state. As farmers within the less developed world are more vulnerable to economic shocks, the possibility of being pushed down to a worse-off state will, according to Barret, Barnet and Skeeds (2008), limit their incentives for investments in technologies. Because the consequences of a failing investment are more severe for poor people, the poor should be less willing to take risk than the rich. As stated by Kanbur and Squire (2001, p`205); "If a contingency occurs, the poor have few assets to dispose of in addressing the problem, or the depletion of those assets must plunge them further into long-term poverty". Feder (1980) further claims that risk aversion can explain the differences between countries in the adoption to more modern technologies of production. Jianakoplos and Bernasek (1998) also suggest a link between agents that exhibit higher risk

[5] There might be a publication bias, implying that results revealing gender differences are more likely published than "non-results".

aversion and lower wealth accumulation. Hence a vicious circle appears; because you are poor, you are more risk averse, which again is a hinder for wealth accumulation.

The theory predicts that a high degree of risk aversion prevents economic actors from undertaking investments that may increase the value of production, and hence their possibilities of moving out of poverty. When a high percentage of the population are risk averse, adoption of new production technology that can improve their production may not occur, and the population/country remains within the underdeveloped state. Moscardi and Janvry (1977) introduce a "safety-first rule", which they argue is followed by subsistence farmers when basic needs are at risk. They find evidence that poor peasants are more risk averse. Kanbur and Squire (2001) states that the problem with risk is that the poorer peasants are facing has two dimensions; they continue their low risk activities with the corresponding low returns, and they are extremely vulnerable to small negative shocks.

That wealth and risk aversion are correlated is consistent with the Expected Utility Theorem and Decreasing Absolute Risk Aversion, which postulates that poorer people are less willing to take risk. Binswanger (1980), however, finds no significant link between risk aversion and wealth. Neither does Tananka et al. (2010). They used an instrumental variable for income, and find that neither household income nor village income has an effect on risk aversion. As mentioned in section 3.2; Akay et al. (2009) find no effect of wealth, whilst Holt and Laury (2002) find income to have a significant effect. Knowledge could also be vital for a better understanding of possible rewards from investments. In agriculture, lack of knowledge and information of available production technologies is salient. A peasant woman confirmed the importance of knowledge; *"We produce corn, potatoes and onions. We don't produce quinoa anymore. Last year the harvest got sick, and I don't know how to avoid the plagues".* Investigating risk aversion amongst low-income farmers is of importance due to its vital implication regarding the peasants' inclination towards undertaking risky but possibly rewarding investments. As reducing exposure to risk is introduced as a mean against long-run poverty (Kanbur and Squire, 2001), investigating risk behavior is important for possible future policy implementation.

4 Method

4.1 Estimation Procedure to Measure Risk Behavior

In order to measure risk aversion amongst poor peasants in rural Peru, I will use the data of a one-stage risk experiment. The risk experiment was run in rural Peru, in fifteen communities in two regions in the southern highlands, Cusco and Apurimac. The risk experiment is one of four experiments run by the research project Land and Gender in Peru, executed by NIBR and the Frisch Centre.

Before the experiment, the participants answered a short questionnaire stating how satisfied they were with different aspects of their lives, such as marriage, economic situation, health etc. The sample consists of the same households that participated in a survey run by NIBR. I thus have access to a large variety of data, such as age, income, education, decision power, etc. on my subject pool. Some of the data collected from this questionnaire and the survey will be used as control variables.

The households were selected at random, based on the criteria that they were a couple (married or cohabitants), that they both lived most of the year in the community, that both spouses could participate and that they had agricultural land. In total, the experiment was conducted with 289 couples, thus 578 individuals. The selection process might create a selection bias as the sampling method can be related to the dependent variable (see section 5.2), risk aversion. Marriage or cohabitation is regarded as more stable and their living conditions as more secure, people who choose to marry or cohabit might therefor be of a more risk averse character. Harrison et al. (2002) did, for example, find that singles have a higher degree of risk aversion than married. Unfortunately I am not able to control for this possible bias.

We used eight enumerators who speak both Spanish and the local Quechua language, as the majority of the participants have Quechua as their mother tongue. The experiment was thus conducted in either Spanish or Quechua depending on the participants' comprehension of each of the languages.

From the pilots we ran in two other districts, we discovered that several of the participants in the pilot were not paying attention to the instructions when read out aloud in front of all the participants, and that several of the participants did not show up. We therefore ran the experiments with each individual in their own home, to make sure that the participant was paying attention to the instructions and that they showed up. In order to keep the anonymity and to make sure that their decisions were not influenced by the presence of others (for instance their spouse), we emphasized that no other person but the participant and the enumerator could be present in the room during the experiment.

As the majority of the participants had low reading skills, and many of them were illiterate, the risk game had to be simple and understandable. To avoid any misunderstandings, the enumerators explained the game both orally[6] and virtually until the participants confirmed that they understood the rules.

The participants in the risk game were never presented with the possibility of negative payoffs. First of all due to the clearly unethical implications. Secondly, by introducing the possibilities of a negative payoff the game might be measuring the participants' budget constraints, and not their attitudes towards risk (Binswanger 1980). As Binswanger (1980, p´396) states *"One cannot, in measuring pure attitudes to risk, propose games to individuals for which the worst possible loss exceeds their current cash holding"*.

[6] See the instructions of the risk game in Appendix B.

4.2 Experimental Procedure/Design

In order to measure rural Peruvian peasants' attitudes towards risk, we followed the experimental procedure of Akay et al. (2009) conducted in Ethiopia, were they in addition measured attitudes towards ambiguity, a setup we also followed.

The experiment is a one-stage game, with twenty choices between a secure amount and a lottery[7]. Appendix A lists all possible choices the participants faced. The probabilities and the monetary rewards of the lotteries are kept constant across the decisions rows, where there was a 50% probability of winning 10 Soles[8] and a 50% probability of winning 0 Soles. The safe amount increases by 0,5 Soles for each row, starting with 0,5 Soles until the safe amount equaled the high payoff of the lottery. We found each participant´s level of risk aversion by marking their first safe choice. A lower safe choice represents a higher level of risk aversion (see table 1, section 4.3). According to expected utility theorem, rational behavior implies choosing the lottery for small safe amounts, and then to switch to safe option at some point.

In the beginning of the experiment the participants were shown a brown bag consisting of ten poker-chips; five red and five blue. They were then asked to choose a color, and explained that if they chose the risky option, they would earn ten Soles only if the chip they were to draw have the same color as the chosen color, if not they would earn zero. If the participant for instance chose the poker-chip with the color red, and the chip he/she draws from the brown bag is blue, he/she walks away from the game without any reward.

They were then presented with the choice of fifty centimos for sure or the possibility of earning ten Soles if they were to draw the poker chip with their chosen color. The safe pot increased step by step with fifty centimos at a time, until the participant chose the safe amount. The participant was then asked if she/he wanted the safe amount for the rest of the options, up on till the amount in the safe pot equaled the possible payoff of the risky option

[7] As shown in Apendix B, the experiment consisted of both a risky prospect and an ambiguous prospect – with a total of 40 choices. However, only the outcomes of the risky prospect are of concern here.

[8] 10 Soles is approximately equal to 3,6 US $ and equals approximately half a day unskilled labor wage.

(ten Soles). If yes, the secure option was marked for the rest of the options. If no, the experimenter continued increasing the secure amount fifty centimos at a time.

In total the participants were presented with twenty choices in the risk game. They were explained that only one of the choices was to be paid[9]. Which of the choices that was to be realized would be decided at random by the drawings of a stack of cards, each card representing one of the choices. According to Dohmen et al. (2010) *"This procedure gives subjects an incentive to choose according to their true preferences in each row, and thus is incentive compatible".*

4.3 Certainty Equivalent and Risk Aversion

Each participant's degree of risk aversion is measured by looking at his or her first switch from the risky choice to the safe, γ_f. The participants' certainty equivalent is the value of the secure amount, γ_f, where the subject is indifferent between choosing the risky option or the safe amount. But if the participant switches at 4 Soles it is impossible to know the exact switching point, it can be anywhere between 3,5 Soles to 4 Soles. The participants' certainty equivalent is therefore calculated as the mean between the last safe option and the first safe choice. In the risk game the participant has a total of 20 choices. As before let γ_f be your first safe choice, γ_f can take any value within the interval [0.5 , 10]. The participants' certainty equivalent (CE) is then

$$(2.11) \qquad CE = \gamma_f - 0{,}25$$

The agents' attitudes towards risk can now be deduced from the agents' choices in the risk game. The degree of risk aversion, ρ, is derived from the subjects' certainty equivalent. At this value the subjects expected utility of the two choices must be equal, $EU_\gamma = EU_\varphi$, from (2.9) and (2.10) replacing γ_f with CE from equation (2.11), we then get:

[9] One of the forty choices made in both prospects, see footnote 8

$$(2.12) \qquad \frac{CE^{(1-\rho)}}{1-\rho} = \pi_\alpha \frac{x_\alpha^{(1-\rho)}}{1-\rho} + (1-\ \pi_\alpha) \frac{x_\beta^{(1-\rho)}}{1-\rho}$$

From equations (2.12), and the now known probabilities π_α, (1-π_α), the certainty equivalent, CE, and the value of the two states of the world x_α, x_β , one can solve for ρ. Inserting for the known values of $x_\alpha = 0$, $x_\beta = 10$, and π_α= (1-π_α), = $^1/_2$,

$$(2.13) \qquad \rho = \frac{LN(^1/_2)}{LN(\text{CE}) - LN(10)}$$

The participants degree of risk aversion can now be derived from equation (2.13) by inserting his/hers choice of γ_f.

In table 1 all possible options are listed, with their corresponding monetary value, γ_f and CE. In table 1 I have also listed the CRRA coefficient associated with, ρ, and equivalent risk aversion label following the same labeling as Akay et al. (2009). The following coefficient of risk aversion, ρ, can be meassured for each choice by comparing the CE for each choice to the expected value of the risky choice. Level of risk aversion, ρ, for each choice is derived from equation (2.13).

Table 1. CRRA coefficients

First Safe Choice	γ_f	CE	ρ	Risk Aversion
[1 , 2]	[0.5 , 1]	[0.25 , 0.75]	[0.81 , 0.73]	Highly Risk Averse
[3 , 6]	[1.5 , 3]	[1.25 , 2.75]	[0.67 , 0.46]	Risk Averse
[7 , 9]	[3.5 , 4.5]	[3.25 , 4.25]	[0.38 , 0.19]	Mildly Risk Averse
[10 , ∞)	[5 , ∞)	[4.75 , ∞)	[0.07 , -∞)	Risk Neutral/Loving

Note: The table depicts the level of risk aversion connected with the participants' first safe choice. Numbers are rounded.

From the expected utility theory the lottery has an expected payoff equal to $\left(\frac{1}{2}\right)0 + \left(\frac{1}{2}\right)10 = 5$ Soles. A high density of first safe choice around γ_f = 5 Soles, implying risk neutrality, is thus expected.

The assumption of constant relative risk aversion is not necessarily a problem free assumption. Several scholars within experimental research have approached this, and there is now a growing body of empiric research with evidence against the CRRA assumption.

Harrison et al. (2002) experiment in Denmark, found significant evidence that risk attitudes changes from risk averse to risk loving, when the monetary reward of the risky choice increases. Binswanger (1980) also concludes in his findings that risk behavior depends on the payoff. The tendency that risks behavior changes when payoffs are scaled up or down is clearly inconsistent with the constant relative risk aversion assumption.

However, Croson and Gneezy (2009) suggest in their paper that the value of the prize is not of importance when investigating the effect of gender on risk aversion. They refer to experimental studies with higher stakes that also find gender difference in risk taking, supporting the theory of constant relative risk aversion. Furthermore, within the small payoff interval in the risk game [0.5 , 10] Soles, I would argue that risk aversion is constant. For this reason and simplicity I will continue with the CRRA assumption.

5 Results and Discussion

5.1 Non-Standard Behavior

According to expected utility theory, consistent behavior in our game, where only the safe amount increases, implies only one switching point. In other words, once the participant has chosen the safe amount, it is considered inconsistent and irrational to switch back to the lottery. If the participant chose the safe amount, at say 3 Soles, it would be irrational to then later in the game choose the lottery, as the safe amount is now a higher, whilst the expected outcome of the lottery is unchanged. This special form of behavior is in the literature often referred to as multiple switching behavior, MSB (see Galazara, 2009).

I have excluded all observations where the participants' show MSB, reducing the sample size from 578 to 560 individuals. Though this behavior is irrational according to expected utility theory, it might also be an expression of indifference towards risk until a certain value. As one of the women said during the risk game; *"until 5 I want to take some risk and some secure choices*", expressing indifference but not perfunctoriness. Nonetheless, it still makes it difficult to deduce their correct certainty equivalents, thus excluding these observations is necessary.

There are also participants' who chose the risky option throughout all the game. This behavior is irrational, as stated by the expected utility theory. These observations will be categorized as first safe option equal to 21, and a certainty equivalent equal to 10,25. The corresponding monetary payoff from the safe amount, γ, is equal to 10 Soles. At this row, you cannot win more than the safe amount; hence there are no monetary rewards for the lottery when the safe amount is 10 Soles. According to expected utility theory, even the most risk loving person should choose the safe option at this point.

This extreme version of risk loving behavior is also clearly gender-specific. As shown in table 2, 85 % of the participants who choose the risky choice when there are no monetary rewards connected with this choice, the “no switchers”, are men. Hence, the irrational risk loving behavior is clearly male biased.

Table 2. "No Switchers" and Gender

First Safe Choice	Total*		Gender			
			Men		Women	
	4 %	20	85%	17	15%	3

Note: Frequence and percentage of the "no switchers" by gender
*Percentage of "no switchers" of all participants. Numbers are rounded.

Other researchers also find this irrational behavior, and the common solution is to exclude these observations in the analysis. However, the behavior of the “no switchers” is still, in my opinion, a result of extreme risk loving preferences, and not because of low understanding of the game. The game was, as mentioned in chapter 4, designed to make sure that everyone were able to understand as much as possible, where each enumerator explained the procedure until they believed that the participant had understood. The enumerators were of the opinion that the “no switchers” had understood the game just as well as the other participants. A former merchant, now a highland peasant in Cusco, explained his “no switching” behavior by a preference for risk; *“I want the risky option because I don’t like to earn money the easy way. I always go for the risky option, never the safe, here and in real life. My motto is; if it goes bad, try again.”* Hence, this behavior should not be characterized as more abnormal than the participation in other forms of gambles just for the thrill in itself. As this behavior appears to be just as well thought out as the behavior of the other participants, it will not be excluded.

5.2 Sampling Characteristics

The sample population consists of couples that are either married or cohabiting from the rural areas in the southern highlands of Peru, with the majority having Quechua as their mother tongue. After excluding the individuals with MSB, as explained in section 5.1, the sample consists of 560 individuals. The participants vary in age, all within the age range 20 till 88 years old, with the mean age being 46 years old.

The major economic activities in the highlands are agriculture and animal breeding. Around 90% of the sample report either agriculture or breeding of animals as their main economic activity (see table 3). As can be read from table 3, 6% of the sample lists "paid labor" (agricultural/animal breeding laborer, transportation, trade, mining, handicrafts and other services in general) as their main economic activity. Only 3 % of the sample, all being women, lists housework as their principal activity.

The labor market is also highly gender segregated, in which women are mainly responsible for the breeding of animals whilst men are responsible for the plots. Approximately 92% of the men list agriculture as their main activity, whilst only 33 % of the women regard this activity as principal (see table 3). Having said that, as much 58% of the women report agriculture as their secondary activity[10]. The gender segregation is even more obvious when we look at the breeding of animals. Only 1 participant of the male sample considers animal breeding as his main activity, whilst the majority of the women (54%) list this activity as their main activity. As a 28 years old woman from the Peruvian highlands stated, it is often the man who acts as the responsible economic actor within the household; *"It is the woman who is the caretaker of animals, whilst the husband is responsible for the crops. They both make the decisions regarding animals together. However, it is the husband alone who makes all the decision regarding their plots, which crops to produce, the use of fertilizers and pesticides, and whether or not to sell the production."*

[10] It should be noted that the rational behind that women to a lesser extent report agriculture as their main economic activity, might be because the contributions by women in agriculture is not regarded as equally valuable to the contribution of men, even though the time spent on agricultural work might be similar.

Table 3. Economic Activity

Main Economic Activity	Male		Female		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Agriculture	257	92 %	93	33 %	350	63 %
Animal breeding	1	0 %	150	54 %	151	27 %
Housework	0	0 %	19	7%	19	3 %
Paid Labor	21	8 %	12	4 %	33	6 %
Other	0	0 %	5	2 %	5	1 %
Total	279	100 %	279	100 %	558	100%

Note: Main economic activity reported by gender.
2 missing observations on principal activity.
Numbers are rounded.

The majority of the sample have not finished secondary school, and as much as 57% of the sample have not even completed primary school; equivalent to 6 years of schooling (see table 4). There is also an obvious difference in the distribution in education with respect to gender, demonstrated in table 5. Furthermore, there is a fairly big difference in gender that reports higher level of education (secondary or higher). More than half as many men as women report higher levels of education, respectively 17% of male sample as opposed to 6 % of the women. Gender is also significantly (at a 1% level) correlated with education; there is a negative relationship between women and education.

Table 4. Level of Education

Level of Education	Gender				Total	
	Male		Female			
< Primary	133	48 %	184	65 %	317	57 %
< Secondary	98	35 %	80	28 %	178	32 %
Higher	48	17 %	17	6 %	65	12 %
Total	279	100 %	281	100 %	560	100 %

Note: Reported education level. < Primary signify that the participant has not finished primary school (6 years of schooling), < secondary signify that the participant has not finished secondary school. And higher indicates all education above, including finished secondary. Numbers are rounded.

There is also a strikingly huge difference between the two genders, looking at the variables capturing the participants' literacy and mathematical ability. Only 14% of the men are not able to read, in contrast to 40 % of the women (see table 5). Looking at the samples mathematical skills[11] the same pattern appears. Far less women than men are able to perform a simple multiplication correctly. Whilst about 27 % of the population is illiterate, almost half the population, 49%, is not able to solve the mathematical problem. The highlands of Peru have however experienced a great improvement in the investments in education the last decade. The percentage of illiterate is clearly decreasing with age, as demonstrated by table 6, the number of illiterate decrease from 46% to 9% when we move from the oldest age group to the lowest (from above the age 50 to the age group under 30). This tendency is not as clear when looking at math skills. Yet, the difference between the oldest and the youngest age group is fairly big, where as much as just under 66% of the age group 50 and above are not able to solve a simple mathematical problem, as opposed to 37% of the age group under 30, illustrated by the same table. A local schoolteacher confirms this; *"When I started working as a schoolteacher 13 years ago, it was different. Almost none of the children in the village went to school, especially not the girls. The general idea was that girls were to get married at the age of 16, so why invest in their education? Now almost all the children attend school. There are even people living here with higher education, there are two engineers and some nurses"*. According to the schoolteacher, the reason for this change is the road connecting the village to the outside world; *"The villagers could now see how others are living, which made them want to improve their own situation. They also had better possibilities of getting paid jobs outside of the village. And when the fathers saw that other children were getting education, they also wanted their children to attend school"*.

Table 5. Literacy, Mathematical Ability and Gender

Variable	Gender				Total	
	Male		Female			
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Read	239	86 %	168	60 %	407	73 %
Mathskills	177	63 %	108	38 %	285	51 %

Note: Table depicting literacy and math skills (able to solve a simple math problem), the respective frequencies and percentage by gender. Numbers are rounded.

[11] Math skill is measured by the participants' ability to calculate 5*6.

Table 6. Literacy, Mathematical Ability and Age

Variable	Read			Mathskills		
Age group	Freq.	Percent	Total	Freq.	Percent	Total
>30	52	91%	57	36	63%	57
30-39	137	83%	166	93	56%	166
40-49	116	78%	148	91	61%	148
<50	102	54%	189	65	34%	189
Total	407	73%	560	285	51%	560

Note: Table demonstrating literacy and mathematical ability within the different age groups.
Numbers are rounded.

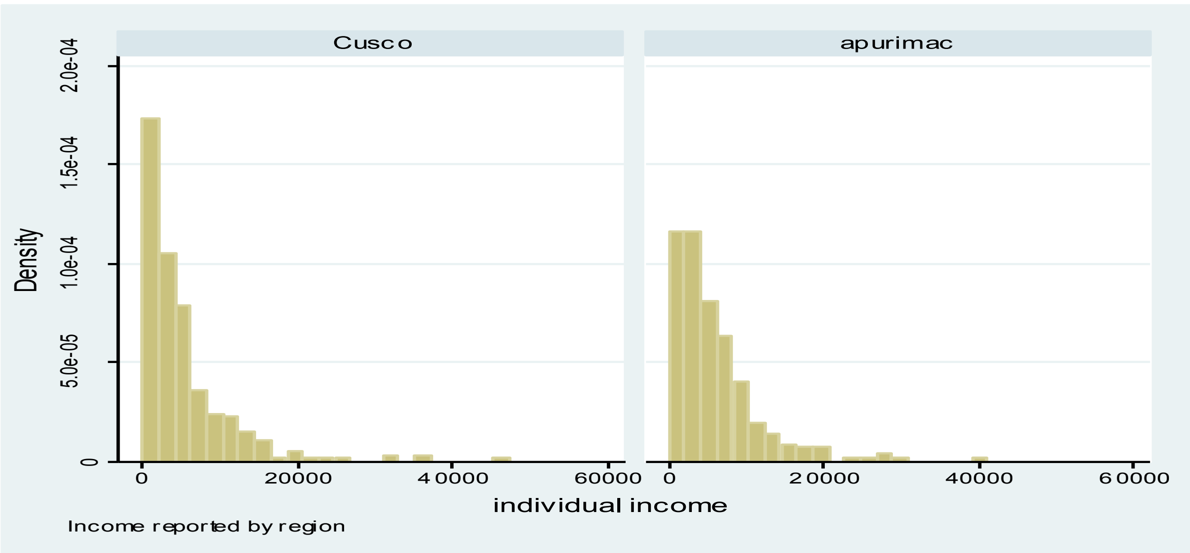
The measurement of income that I will use stems from the income data based on households' own estimation of how much income each individual generates through each economic activity. The couple estimated share of total household income generated by each economic activity, and then each member`s relative contribution to each activity. Hence, the income measure used is measuring the monetary value of the individuals' total contribution to the income production within the household. Only a minority of the households in the subject pool have a salary based income, it is thus likely that their concept of exact income is fairly low, making my income variable a highly subjective and not very precise estimate. Though it is an imprecise estimate, it does however give a fairly good picture of the living standard amongst the Peruvian peasant sample. As figure 2 depicts, the peak is at an annual income less than 1000 Soles (equal to approximately 355 US $), furthermore 75 % of the population in both regions reports an annual income of less than 8000 Soles (2846 US $), suggesting that the majority is quite poor. However there is a difference in income distribution between the two regions, with the participants' in Cusco reporting a higher density of farmers reporting an extremely low annual income; less than 1000 Soles (see figure 2). In Cusco as much as 18 % of the population has an annual reported income less than 1000 Soles, as opposed to only 5 % in Apurimac.

There are also differences in income within a region. The income spread is wider in Cusco, where the income reported lies within the bound [0 , 55800] Soles, distinguished from the range bound reported in Apurimac; [0 , 39690] Soles. Incomes in Cusco, for instance, vary up to 55800 Soles annually, whilst the median income is as little as 3400 Soles annually, and 75

% of the sample report less than or equal to 6804 Soles a year. Cusco also has one extreme outlier; one of the participants' reports an annual income of 151200[12] Soles. The same tendency of variations within the region also applies for Apurimac, though not as great as Cusco.

Local sources also suggest that there is a geographical difference in income. The Villages are located at a high altitude between 3000 – 3500 meters above sea level. Plots located at a higher altitude tend to be smaller. As a 32 years old man from one of the districts located at a higher altitude explained; *"Most of what we produce here is for our own consumption; corn, potatoes, quinoa etc. Our plots are too small to compete with the larger producers, so crop production is not very rewarding. We also have animals, a pig, a cow, and some guinea pigs. But for most peasants here, these are for our own consumption. What would be rewarding would be to breed animals for sale. But as we are not accustomed to breed animals on a large scale, none of us do."* Even though there are variations in income, the majority of the population in question is extremely poor farmers, with around 80 % valuing their income generating activities as less than 9000 Soles a year (approximately equal to 3201 US $).

Figure 2. Reported annual income in the two districts, Cusco and Apurimac



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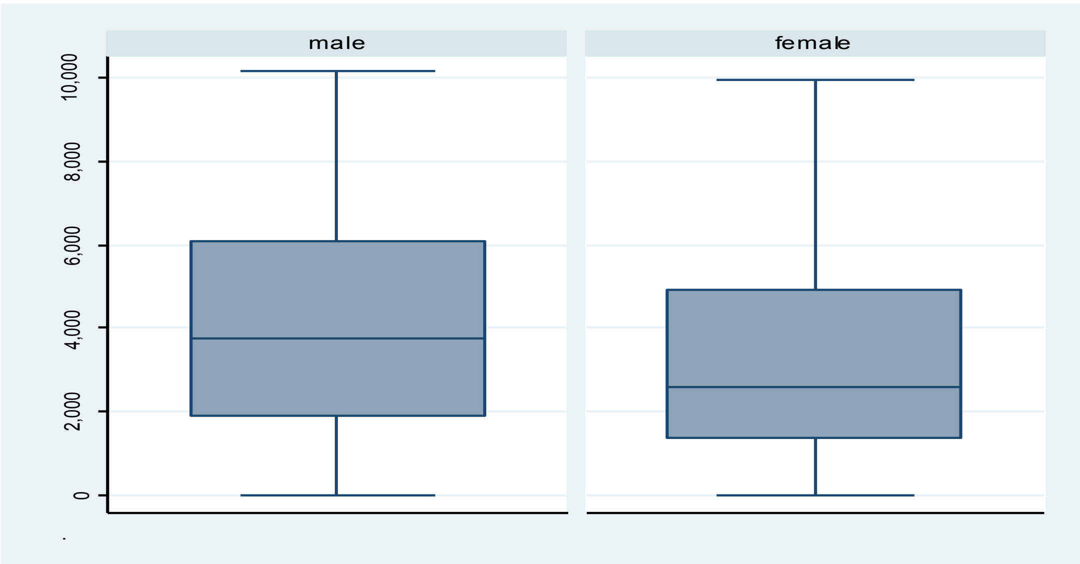
[12] This outlier is excluded from this discussion on income and from figure 2. However, it is not excluded from the regression analysis in section 5.5, see footnote 17

Note: Cusco: median = 3400 S/. annually , 25th Percentile = 1586 S/., 75th percentile 6804 S/. Range [0 , 55800]. Apurimac: median= 4303 S/. , 25th =2086 S/., 75th=7600 S/., Range [0 , 39690]

Women have less income than men, significant at a 1 % level, as demonstrated in figure 3. The median annual income reported by men equals 4800 Soles, as contrasted with the median income reported by women; 3030 Soles annually. The income spread is also smaller for women than men, respectively [0 , 31063] [0 , 47380] Soles, suggesting smaller differences within the female population.

Figure 3. Income Distribution by Gender



Note: Male: median = 4800 Soles annually, 25th Percentile = 2400 S/., 75th percentile 9117 S/. Range bound [0 , 47380] Outlier 151 200. Women: median= 3030 S/. , 25th =1486%, 75th=5875, Range bound [0 , 31063], outlier 55800

The absolute income measure gives an indication of the samples' purchasing power. Your behavior is, however, affected not only by your income but also by your income relative to those around you and your aspirations. The variable economic satisfaction is based on the question "How satisfied are you with your economic situation on a scale from 1-10?", and the participants answer is labeled as "not satisfied" if the answer is in the interval [1-3], "satisfied" if the answer falls within the interval [4-6] and "very satisfied" for all answers within the interval [7-10]. Surprisingly, considering the population in question, the majority is satisfied with their economic situation (see table 7). Even more surprising is the result that remarkably more of the farmers report to be "very satisfied" (38%) than "not satisfied" (10%) with their economic situation, as demonstrated in table 7.

Table 7. Economic Satisfaction

Satisfied With Economic Situation	Freq.	Total Percent	Cum.
Not Satisfied	55	10 %	9,82
Satisfied	291	52 %	61.79
Very Satisfied	214	38 %	100.00
Total	560	100 %	

Note: Reported satisfaction with own personal economic situation. Numbers are rounded.

As shown in table 8, there is no apparent link between economic satisfaction and reported income. Farmers with a low annual income[13] are not less satisfied with their economic situation. Only 12 % of those with an annual income less than 1000 Soles are not satisfied, whilst 26 % of the same group reports to be very satisfied with their private economy.

Table 8. Economic Satisfaction and Income

Level of Income*	Economic Satisfaction		
	Not	Satisfied	Very Satisfied
0-1000	12%	62%	26%
1001-2000	11%	52%	36%
2001-3000	12%	45%	42%
3001-4000	11%	48%	41%
4001-5000	9%	62%	30%
5001-6000	10%	46%	44%
6001-7000	10%	41%	48%
7001-8000	6%	52%	42%
8001-9000	11%	37%	53%
9001-56000	6%	55%	39%
151200	0%	100%	0%

Note: Economic satisfaction of the participants sorted by income group
*Reported yearly income in Soles. Numbers are rounded.

[13] Income is still measured by the monetary value of the individuals' production within the household.

Our sample is as well in general feeling healthy. As displayed in table 9, the majority of the observations report a fair or good health, and there are more observations reporting a good or excellent health than a poor or very poor health (respectively 38% and 29%). More interesting is the gender difference in health. Looking at the gender specific numbers in table 9, we find that the percentage of women reporting a poor health is higher than for men, and that a higher percentage of men report to have a good health.

Table 9. Health and Gender

	Male		Female		Total		
Health	Freq.		Freq.	Percent	Freq.	Percent	Cum.
Very Poor	4	1 %	13	5 %	17	3 %	3 %
Poor	63	23 %	84	30 %	147	26 %	29 %
Fair	90	32 %	95	34 %	185	33 %	62 %
Good	114	41 %	83	30 %	197	35 %	98 %
Excellent	8	3 %	6	2 %	14	3 %	100 %
Total	279	100 %	281	100 %	560	100 %	

Note: Reported personal health.
Numbers are rounded.

5.3 Experimental Results

I have also compared the risk attitudes of our sample with the attitudes towards risk from other samples in other countries. In table 9 below I have added the risk attitudes from our sample to Akay et al.`s (2009) table 1. In their table 1, they report the risk attitudes found amongst Ethiopian peasants by Akay et al. (2009), amongst Dutch students by Trautmann et al. (2009) and amongst U.S students by Holt and Laury (2002). The risk games executed in Ethiopia and the Netherlands are equivalent to our experimental design. Holt and Laury (2002) conduct a slightly different experiment (see section 3.2), but the results are comparable to our results.

Above half the population in our sample, 52% to be exact, exhibit a high degree of risk aversion with a $\rho > 0{,}68$. This result fits well with the theory discussed earlier; poorer populations' exhibit to a larger degree extreme risk aversion (without discussing the causality). The result resembles the findings from Ethiopia by Akay et al. (2009). The amount of observations with a risk averse attitude, 0,41 < $\rho \leq$ 0,68, is also quite similar to our sample. When it comes to a degree of risk aversion of $\rho \leq$ 0,41 (mildly risk averse to risk loving), peasants from the Peruvian highlands have a larger share of the population being risk neutral or risk loving, than the Ethiopian sample. The Ethiopian sample have a higher density of observations in the mildly risk averse group, compared to our sample.

Looking at the western student sample, the differences between the US student sample and the Dutch are more apparent than the similarities. Only 1 % of the Dutch sample demonstrates a highly risk averse behavior, compared to 39% of the US sample. Both Peruvian and Ethiopian participants do however show a notably higher percentage of the population being highly risk averse than the US student sample.

Table 9. Distribution of CRRA coefficients in four different experimental studies

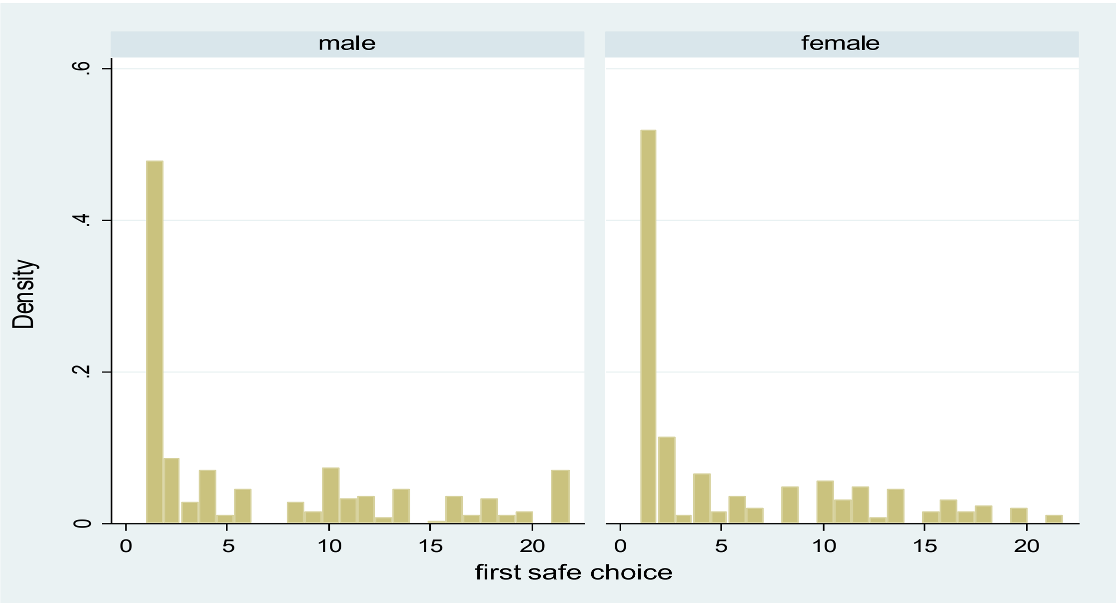
Risk Game Samples	Risk Neutral/ Loving	Mildly Risk Averse	Risk Averse	Highly Risk Averse
	$\rho \leq 0{,}15$	$0{,}15 < \rho \leq 0{,}41$	$0{,}41 < \rho \leq 0{,}68$	$\rho > 0{,}68$
Peruvian farmers (n=560)	30 %	5 %	13 %	52 %
Ethiopian farmers (n=92)*	22 %	11 %	10 %	58 %
Dutch students (n=79)*	19 %	35 %	44 %	1 %
U.S. students (n=93)*	19 %	19 %	23 %	39 %

Note: Comparing risk attitudes found amongst the participants in our sample to the risk attitudes found by Akay et al. (2009), Trautmann et al. (2009) and Holt and Laury (2002).
* Reported in Akay et al. (2009) table 1. Numbers are rounded.

Furthermore, both the Ethiopian and the Peruvian sample show few observations within the more conservative range; mildly risk averse and risk averse. The majority of the sample is within the more extreme categories; highly risk averse and risk neutral to risk loving. Amongst the peasants in the Peruvian sample only 18% of the participants behave in a risk averse to a mildly risk averse manner. The western student samples, on the other hand, have a higher density in the more conservative range. This difference in risk aversion indicates that there is a truth in the theory's prediction that there is a correlation between poverty and risk aversion. Whether it is poverty that affects risk attitudes or risk attitudes that affects poverty is still not answered. One possible reason for the high degree of extreme risk aversion amongst Peruvian peasants could be a low understanding of the probabilities, and a low comprehension of the choices, due to lower mathematical skills.

Figure 4 shows histograms of first safe choice for all participants by gender. In section 4.3 I expected to find a high density of first safe choice around option 10, with a safe amount, γ_f, equal to 5 Soles implying risk neutrality. However, though there is some clustering at this point, it is clearly not the peak. As displayed in figure 4, the peak for both women and men is for first safe choice = 1, with the corresponding safe amount, γ_f, = 0,5 Soles. The peak is higher for women than men, implying that more women than men choose the safe amount at option 1. The distribution is skewed to the left, indicating that the participants' first safe chose is at low values of the safe option. There is also a fairly high density of men that never chooses the safe amount (in figure 4, this behavior is demonstrated by a first safe choice = 21).

Figure 4. Risk Aversion by Gender



Note: First safe choice in risk game by gender

5.4 Econometric Model and Specification

The econometric model I will analyze is:

$$(M.A) \quad Risk\ Aversion_i = \propto + \beta_1 Female_i + \sum_{j=1}^{8} \tau_j Controls_i + \varepsilon_i$$

This model captures the effect of gender on risk behavior amongst our sample in the southern Peruvian highlands. The footnote i denotes the specific participant, $\propto$ is the constant term, β_1 the coefficient capturing the effect of gender (being a woman) on risk aversion, τ_n the coefficient capturing the effect of my control variables and ε_i the error term capturing all the variations the controls or gender did not explain. Model (M.B) below is the same as (M.A) only I have here specified the controls in (M.B);

$$\begin{aligned}(M.B)\ Risk\ Aversion_i = \\ &\propto + \beta_1 Female_i + \tau_1 Apurimac_i + \tau_2 Age_i + \tau_3 Health_i + \tau_4 Math\ skills_i \\ &+ \tau_5 Satisfaction\ with\ Economic\ Situation_i + \tau_6 Individual\ Income_i \\ &+ \tau_7 Level\ of\ Education_i + \sum\nolimits_{k}^{4} \tau_{7+k}\ Main\ Activity_{ki} + \varepsilon_i\end{aligned}$$

In order to investigate the gender effect on risk aversion amongst Peruvian peasants I will use the Ordinary Least Squares method (OLS). All of the estimations are done by the use of STATA11. The sample consists, as mentioned earlier, of individuals in a couple; hence it is natural to assume that some of the responses of the one partner are correlated with his/her partners' response. To control for possible correlated data, to make sure my standard errors are correct, I will cluster on the household ID.

“Risk Aversion” is my dependent variable. “Risk Aversion” is the inverse of the participants’ first safe choice amongst the twenty options, its switching point to the safe amount. A low switching point implies a low certainty equivalent and risk aversion. And a high switching point implies a high certainty equivalent and a less risk averse behavior.

Gender is my explanatory variable, coded as a [0/1] dummy with female as the indicator. I will also add controls to examine whether there is a direct relationship (if my hypothesis holds) between gender and risk aversion, or if the apparent possible relationship is merely capturing other effects such as income or education.

I will include a region dummy to control for demographic variations in the sample as the experiments were run in two different regions. As other scholars have suggested from their experimental results, behavior is contextual and demographically dependent, thus by including a region dummy I can control for regional differences. The dummy is coded [0/1] with Apurimac as the indicator.

I will also control for other socio-economic variables that might affect risk aversion, and which my explanatory variable gender otherwise would capture. I will not investigate the causality relation between these variables and risk aversion.

Individual income is one of the control variables I will include. Previous studies have, as reported in chapter 3, found income and wealth to have an effect on risk aversion. The richer you are, the more you can bear to loose in a pursuit of more income. Hence I expect a negative effect of income on risk aversion. As also commented in section 3.3, it is plausible that risk aversion is a decreasing function of income.

I will also include the variable “Satisfaction with Economic Situation” which is, as explained in the previous section, a measure of satisfaction with their economic situation. As discussed earlier, there is no apparent link between income and economic satisfaction. One should thus suspect that satisfaction with economic situations is just as important when investigating behavior towards risk.

Education has also been found to be of importance when eliciting risk behavior, and is therefore included as a control variable. From the existing literature, see chapter 3, it is difficult to predict what effect education might have on risk aversion. There is also a vast difference in education level between the majority of the populations investigated in the above-mentioned experiments and the population studied here. The level of education is fairly low (see in section 5.2). As commented in section 3.3, lack of knowledge could lead the participant to act in a more risk averse manner. Higher level of education might also be necessary to have a sufficient concept and understanding of risk and probabilities. On the other hand, the participants were fully informed, which according to basic economic theory, is one of the lead assumptions that needs to be fulfilled for economic actors to be able to undertake rational decisions. I will include the variable "Level of Education" to control for the level of education.

I will not control for literacy, as literacy is (not surprisingly) collinear with education level. It can thus be dropped as the variable education contains almost the same information.

I will also include the variable for mathematical skill "Math skills", discussed in section 5.2. Mathematical ability can have an effect on the participants' ability to understand the game and a participant with math skill could thus be expected to make a better possible choice. As already shown section 5.2, there is a huge gender-specific difference in mathematical ability.

The participants' health and its age could also be of significance when investigating risk behavior. Health can, in the same ways as income and wealth, affect the participants' possibility set. To control for health, I have included the variable "Health", stemming from a question "How would you describe your health on a scale from 1 to 6, 1 being very poor and 6 being excellent". I will also control for age.

The work sphere is highly gender segregated, and it is plausible that the participants' main activity has an effect on risk behavior. Working in agriculture is, for instance, related with a lot of risk, whilst housework is not associated with uncertain outcomes to the same extent. Thus, it would be expected that a person with agriculture as main economic activity exhibit a lower level of risk aversion than a person who has housework as his/her principal activity. Although animal breeding is not identified with a lot of risk, high scale livestock production is considered as a smart investment with future payoffs. Hence participants working with animal breeding might be more accustomed to consider the possible payoffs of different choices. Participants working as paid laborer has a salary-based income that is a more secure livelihood, thus it should be associated with a more risk averse behavior. However, in the two regions in the rural highlands of Peru, paid labor is unconventional. Thus participants earning a wage might be those who "think outside the box" in order to rise their standard of living, a quality not connected with highly risk averse behavior. 4 dummy variables referring to the different activities are included in the model, with agriculture as the reference group. "Animals as Main Activity" is the dummy for animal breeding as main activity; "Paid Labor as Main Activity" is the dummy for paid labor, "Housework as Main Activity" for housework as main activity and "Other Main Activity" is the dummy for other, non-specified activity.

I find no reason to worry about my explanatory variables being highly correlated. None of the variables included in model (M.B) have a high correlation. The largest correlation coefficient, equal to 0,5067 significant at a 1% level, is (not so surprising) between level of education and math skill, where education is positively correlated with mathematical ability. Stock and Watson (2007) rule for problematic multicollinearity is a correlation coefficient larger than 0,8, which none of my correlation coefficient comes close to. The problem with independent variables with a collinear property is that this will lead to over estimation of the estimated results. Strictly correlated variables thus lead to misleading conclusions.

5.5 Results and Discussion

I will in this section investigate my hypothesis;

Peasant women in rural Peruvian highlands are more risk averse than men.

The first model (1) in table 10 regresses the dependent variable, Risk Aversion, on the independent [0/1] gender dummy (Female).

$$\text{(M1)} \quad Risk\ Aversion_i = \propto + \beta_1 Female_i + \varepsilon_i, \text{ where i=1, … 560}$$

Model (1) finds empiric evidence, significant at a 5% significance level[14] with a p-value equal 0,0225, that gender does affect risk behavior in our sample in the rural Peruvian highlands. If the participant is a woman, her predicted first safe choice is 1,150 less than her male counterpart. In other words, women switch from the risky choice to the safe choice before men in our sample in the rural Peruvian highlands. Hence women in our sample are significantly more risk averse than men, $\beta_1 \neq 0$. My finding supports the general idea that women are more risk averse than men. There is thus no significant evidence that a gender difference in risk aversion is a phenomenon particularly found amongst western students. The adjusted R-square is reported to be only 0,0083. The adjusted R-square is a measure of how much of the total variation in risk aversion that can be explained by the included variables after having adjusted for the amount of degrees of freedom. However, I am only investigating if there are gender-specific differences with respect to risk aversion, thus I will not focus on the adjusted R-square.

In model (2) I have included 7 of the 8 control variables, see second column in table 10;

[14]That a variable is significant at a 5% level means that there is less than 5% probability that we wrongly reject the null hypothesis that the true coefficient is equal to zero.

$$(M2)\ \ Risk\ Aversion_i = \propto + \beta_1 Female_i + \tau_1 Apurimac_i + \tau_2 Age_i + \tau_3 Health_i + \tau_4 Math\ skills_i + \tau_5 Satisfaction\ with\ Economic\ Situation_i + \tau_6 Individual\ Income_i + \tau_7 Level\ of\ Education_i + \varepsilon_i,\ \text{i=1, … 560.}$$

The gender dummy is still negative and significant at a 5 % significance level, hence gender-specific differences in risk aversion was not capturing the effect of these included controls on risk aversion. Thus my hypothesis still cannot be rejected at a 5 % significance level, peasant Peruvian women in our sample are significantly more risk averse than men.

The [0/1] region dummy Apurimac, has a significant effect on risk aversion at a 5% significance level, with a p-value=0,0249. A participant from Apurimac is predicted to be making the switch towards the safe amount 1,239 choices before a participant from Cusco; hence a participant from Apurimac is estimated to be more risk averse than a participant from Cusco. This finding supports the statement that risk behavior is culture conditioned.

Economic satisfaction also has a significant, negative effect at a 10% significance level on risk aversion. In other words, the more content the participant is with his/her economic situation-either with respect to his/her aspirations or compared to the economic situation of other- the less risk averse he or she is. How rich you feel and/or your aspirations are of significant importance when the participant makes a decision regarding risk.

Model (2) finds no significant effect of the other included control variables, health, age[15], math skill, income and education on risk attitudes. The insignificance of mathematical ability indicates that participants with a better understanding of mathematics do not choose significantly different from those with a lower concept.

[15] With reference to investments in agriculture, the advantage of experience (which comes with age) will most probably not give you an upper hand with respect to returns on a possible investment. The loss in muscle mass and generally lower health will most certainly be a disadvantage, and might be a disincentive to invest. However, this discussion is beyond the purpose of this thesis, and will thus not be pursued further

Although individual income has as expected a negative effect on risk aversion, neither this variable is found to have a significant effect[16], nor does income affect the significance of gender on risk behavior. The decreasing absolute risk aversion and the expected utility theorem (see section 3.3) postulates that the poorer the farmer the higher the risk aversion. As men in our sample report a higher annual income than women one should expect to find that women are less inclined to undertake risky choices because of an income difference. The insignificance of income might be a reflection of couple's tendency towards considering household income, and not necessarily individual income, when making economic decisions. As the participants are couples where both partners participate in the risk experiment, the remaining significance of gender is thus not as surprising. However, a person with more economic resources has less economic hinders to undertake a risk in the pursuit of a higher monetary reward, whilst the lack of significance of the income variable in model (2) suggests that there is no link between income and risk aversion. The lack of significant result of income on risk aversion can be due to measurement difficulties. As pointed out in section 5.2, income is measured by the participants' subjective monetary value of their production; this measurement might not be sufficient to estimate the effect of income on risk aversion. Given that the measurement of income is correct, the lack of significance, combined with the significant effect of economic satisfaction[17], might also indicate that aspirations or satisfaction with private economy is a better measure when investigating risk aversion. That it is how poor you feel and/or your aspirations which is of importance when deciding how much you are willing to loose in the quest for a higher payoff.

I would argue that the insignificance of education on risk aversion is design conditioned. This is also supported by the contradicting findings within in the literature of the effect of education on risk aversion, shown in chapter 3. The purpose of our risk game is to look at gender differences in risk aversion, not the effect of education on risk behavior. As shown in section 5.2, a high density of the participants' has almost no schooling and education level is correlated with gender. For this reason, the risk experiment was designed with the intention that all participants had enough knowledge and information to make a rational, well-informed decision. As with age and health, this finding does not imply that education has no effect on

[16] The income measure used does not exclude the outliers. However I ran a test regression excluding these extreme observations, and the effect of income remained insignificant.
[17] I have also controlled for individual income alone, finding the same insignificant effect. Income and economic satisfaction are, as shown in 5.2, not correlated.

aversion towards risky investments in agriculture. However, this discussion exceeds the intention of this thesis.

I control for principal activity in model (3), see table 10. As two of the participants have not reported their principal activity, the sample size is reduced from 560 to 558 participants.

$$(M3)\quad riskaversion_i = \propto + \beta_1 female_i + \tau_1 apurimac_i + \tau_2 age_i + \tau_3 health_i + \tau_4 mathskill_i + \tau_5 economicsatisfaction_i + \tau_6 income_i + \tau_7 education_i + \sum_k^4 \tau_{7+k}\, mainactivity_{ki} + \varepsilon_i,\ \text{i=1, … 558, k=1, … 4}$$

By including four dummy variables for the different categories of main activity, using agriculture as reference, there is no statistical evidence of gender-specific differences in risk aversion. The p-value is now reduced from p=0,0225 in model (1) to p=0,4304 in model (3). Ergo, the null-hypothesis that the gender coefficient is equal to zero, $\beta_1 = 0$, is not rejected. The gender dummy was explaining the effect of housework as main activity on risk aversion. As shown in model (3), table 10, the dummy variable “Housework as Main Activity” is positive and has a p-value = 0,0049. Model (3) accordingly predicts that participants who report housework as main economic activity are significantly, at a 1% significance level, more risk averse than those who report agriculture as principal activity. The coefficient of the Housework as Main Activity dummy, τ_{10}, is further rather big; $\tau_{10} = 3{,}136$. A person reporting housework as main activity is thus estimated to switch to the safe choice more than 3 choices before a participant reporting agriculture switches to the safe choice. There is no significant effect of the other main activities on risk aversion, hence participants reporting Animals, Paid Labor or Other as Main Activity are not statistically more or less risk averse than those working in agriculture.

Table 10. Regression Analysis for Risk Aversion amongst our Peruvian sample

Dependent Variable / Control Variables	All Sample			Limited Sample	
	Risk Aversion (OLS) (1)	Risk Aversion (OLS) (2)	Risk Aversion (OLS) (3)	Risk Aversion (OLS) (4)	Risk Aversion (OLS) (5)
Female	**1.150****	**1.239****	**0.575**	**0.383**	**0.193**
	(0.0225)	**(0.0249)**	**(0.4304)**	**(0.4049)**	**(0.7857)**
Apurimac		**1.053***	**0.762**		**1.648*****
		(0.0644)	**(0.2528)**		**(0.0055)**
Age		**-0.00464**	**-0.00625**		**-0.00215**
		(0.8339)	**(0.7781)**		**(0.9147)**
Health		**0.235**	**0.287**		**0.344**
		(0.4048)	**(0.3188)**		**(0.2020)**
Math skills		**0.560**	**0.558**		**0.748**
		(0.3625)	**(0.3699)**		**(0.1800)**
Satisfaction with Economic Situation		**-0.710***	**-0.722***		**-0.916****
		(0.0912)	**(0.0906)**		**(0.0208)**
Individual Income		**-0.00000720**	**-0.00000779**		**-0.0000112**
		(0.7863)	**(0.7683)**		**(0.6498)**
Level of Education		**-0.189**	**-0.179**		**0.119**
		(0.7011)	**(0.7205)**		**(0.7823)**
Animals as Main Activity			**0.824**		**0.455**
			(0.3394)		**(0.5728)**
Paid Labor as Main Activity			**-0.141**		**0.259**
			(0.9006)		**(0.7833)**
Housework as Main Activity			**3.136*****		**2.438****
			(0.0049)		**(0.0237)**
Other Main Activity			**-1.186**		**-2.026**
			(0.5996)		**(0.3465)**
Constant	**-6.584*****	**-6.885*****	**-6.810*****	**-5.649*****	**-6.720*****
	(0.0000)	**(0.0001)**	**(0.0002)**	**(0.0000)**	**(0.0001)**
Observations	**560**	**560**	**558**	**540**	**538**
R^2	**0.0083**	**0.0218**	**0.0294**	**0.0011**	**0.0481**

Gender-Specific Difference in Risk Aversion, ***p*-values in parentheses**
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As shown in section 5.2, only women report housework as their principal activity, suggesting that there is still a gender difference in risk aversion. The participants live in a traditional society with a highly gender segregated work sphere; it could thus be assumed that women with housework as main economic activity are more risk averse because they are less used to deal with risky choices in their main activity, rather than that they choose housework because they are more risk averse. However, only a minority of the women participating in the risk game report housework to be their principal activity (see section 5.2). Looking at the activity-specific risk preferences amongst the women, there are a higher percentage of women in housework that are highly risk averse, shown in table 11. As opposed to 43% of women working in agriculture, 79% of women in housework choose the first safe choice for $\gamma_f \leq 1$ Soles (shown in table 11). Also women working with animals[18] have a lower percentage choosing the safe choice for $\gamma_f \leq 1$ Soles than women with housework. As discussed above, housework is not connected with uncertain outcomes; women with high aversion towards risk might thus be drawn towards this occupation. Hence the causality might go both ways. Women in housework do not report a significant lower level of education, nor is housework significantly correlated[19] with individual income or household income. There is neither a significant correlation[20] between economic satisfaction and having housework as main activity. Even health, age and math skills are uncorrelated with housework as main activity. Hence there are no apparent differences between the women choosing housework to the women working in agriculture or with animals, except for a difference in risk aversion. This can be interpreted as that there is a difference in risk aversion between women and men in our sample, and these risk averse women have housework as main activity.

[18] I have also controlled for main activity with Animals as Main Activity as reference group, finding a significant and positive effect of Housework as Main Activity on risk aversion and no significant affect of Female on risk aversion.

[19] The p-value of the correlation coefficient between Individual Income and Housework as Main Activity within the women in the sample is equal to 0,8607 and p-value between household income and Housework as Main Activity is equal to 0,9869. There is neither a significant correlation when looking within the whole sample.

[20] The correlation coefficient has a p-value = 0,2980. There is neither a significant correlation when looking within the whole sample.

Table 11. First Safe Choice by Activity for Women

First Safe Choice	Main Activity				
	Agriculture	Animals	Housework	Paid Labor	Other
1	32 %	47 %	74 %	67 %	20 %
2	11 %	12 %	5 %	0 %	0 %
3	1 %	1 %	0 %	0 %	0 %
4	5 %	5 %	5 %	8 %	20 %
5	3 %	1 %	0 %	0 %	0 %
6	6 %	2 %	0 %	0 %	0 %
7	0 %	2 %	0 %	0 %	40 %
8	5 %	5 %	5 %	0 %	0 %
9	0 %	0 %	0 %	0 %	0 %
10	8 %	4 %	0 %	8 %	0 %
11	4 %	2 %	5 %	0 %	0 %
12	8 %	3 %	0 %	0 %	0 %
13	2 %	0 %	0 %	0 %	0 %
14	5 %	3 %	5 %	8 %	0 %
15	0 %	2 %	0 %	0 %	0 %
16	2 %	3 %	0 %	0 %	20 %
17	1 %	2 %	0 %	0 %	0 %
18	3 %	2 %	0 %	0 %	0 %
20	2 %	2 %	0 %	0 %	0 %
21	0 %	1 %	0 %	8 %	0 %
Total Obs	93	150	19	12	5

Note: The percentage of the women's switching row for each safe choice by main activity. Numbers are rounded.

The region dummy, Apurimac, no longer has a significant effect on risk aversion. Hence the region differences in risk aversion were in part explaining the regional differences in occupation, 79% of the participants reporting housework as main activity are from Apurimac. Economic satisfaction still has a negative significant[21] effect on risk aversion. The other control variables remain insignificant, indicating that activity has a fairly robust effect on risk aversion and the loss of significance of gender- specific differences in risk aversion.

In the linear regression model (1) –(3) presented in table 10, the participants' that never switch to the safe option are included. As demonstrated in section 5.1, the majority of these "no switchers" are men. I will now extend the analysis, adjusting my model by excluding these observations, reducing my sample from 560 observations to 540 observations.

[21] Significant at a 10% significance level

I will first analyze the effect of excluding the “no switchers” by regressing risk aversion on gender

$$\text{(M4)}\quad riskaversion_i = \propto + \beta_1 female_i + \varepsilon_i, \text{ where i=1, … 540}$$

As demonstrated by model (4) in table 10, the difference of result is quite remarkable. The p-value of the gender dummy Female is reduced from 0,0225 in model (1) to 0,4049, even without controlling for other variables. Thus by excluding extreme behavioral cases, there is no evidence of women being more risk averse than men. Ergo, the difference in risk behavior between women and men, found in model (1) and (2), seems to be driven by the extreme risk loving cases amongst men in the sample. By excluding these participants, there is no longer a statistical significant difference in risk aversion between women and men. This result is interesting from a poverty trap point of view, as the poverty trap postulates that risk aversion implies a lower adoption of more advanced and less familiar production methods. Hence women, as they are more risk averse, are predicted to make fewer risky but possibly rewarding investments. However, when the gender-difference in risk behavior is explained by more men being extremely risk loving, this conclusion is faulty. The “no switcher” behavior is more consistent with gambling behavior, which might result in investments that more often lead to a worse off state than leading the peasant out of poverty. The findings in model (1) and (2) might thus be read as “men in our sample exhibit more extreme risk loving behavior than women”.

I will now investigate the effect of the control variables after having excluded the “no switchers”. As demonstrated in column 5[22] in table 10, the sample is now further reduced to 538 participants

[22] It should be noted that the adjusted R-square has increased from 0,0294 in model (3) to 0,0481 in model (5), indicating that model (5) explains more of the variation.

$$(M5)\ \ riskaversion_i = \propto + \beta_1 female_i + \tau_1 apurimac_i + \tau_2 age_i + \tau_3 health_i + \tau_4 mathskill_i + \tau_5 economicsatisfaction_i + \tau_6 income_i + \tau_7 education_i + \tau_{7+k} mainactivity_{ki} + \varepsilon_i,\ \text{i=1, … 538, k=2, … 5}$$

The p-value of the coefficient β_1 is increased from p=0,4049 in model (4) to 0,7857 in model (5); hence the gender dummy remains insignificant. An interesting development is that the p-value of the region dummy decreases to 0,0055, making the region dummy significant in model (5) at a 1 % significance level. Being from Apurimac will now decrease the number of risky choices by 1,645, indicating that a participant from Apurimac is estimated to be more risk averse than a participant from Cusco. Looking at the "no-switcher", 80% of the "no-switchers" are from Apurimac; hence the gamblers were concealing the more risk averse behavior, indicating fewer observations within the more conservative range[23] than Cusco. This supports the statement that risk behavior is culturally dependent.

Economic satisfaction now has a more negative effect on risk aversion; the predicted effect also has a higher significance at a 5% level. By only investigating the behavior consistent with the expected utility theorem, a participant's aspiration or income satisfaction has a more significant negative affect on risk aversion. This indicates that gambling behavior is not depended on how rich you feel or what your aspirations are. The housework dummy still has a positive, though slightly lower, effect on risk aversion. The p-value is further reduced from 0,0049 to 0,0237. Thus women having housework as main activity is still more risk averse, though the effect is reduced by excluding the "no switchers". None of the other control variables have a significant effect on risk aversion.

The findings in model (1) to (5) thus indicate that there is a gender-specific difference in risk aversion within our sample, finding women to be more risk averse than men. However, the sudden insignificance of female when controlling for activity, proposes that the effect of sex might be catching up the effect of variables correlated with sex, such as occupation. On the other hand, the only activity with a significant (positive) effect on risk aversion is housework, and only women and a minority of the women, report housework as their primary activity.

[23] Conservative range meaning risk averse to mildly risk averse, see section 4.3.

This indicates that women are in fact more risk averse, and that more risk averse women tend to choose housework as main activity. Hence the direction of causality is problematic. Furthermore, the loss of gender-specific risk aversion in model (4) and (5) suggests that the difference in risk behavior seems to be a difference in extremely risk loving behavior, where the men in our sample exhibit a higher degree of risk aversion indicating gambling preferences. This finding supports one of Croson and Gneezy (2009) conclusions; that it is overconfidence amongst men which explains the difference in risk behavior between women and men.

Conclusion

I have in this thesis looked into risk behavior amongst highland peasants in two regions in Peru, with the aim to investigate gender- specific differences in risk. I have used the data collected from a one-stage risk experiment to elicit risk behavior. I have further utilized data from a household survey[24] and a questionnaire[25] to control for some variables that often are correlated with both sex and risk aversion.

I find that, without controlling for other variables, women in our sample are significantly more risk averse than men. However, the significance disappears when I control for principal economic activity, implying that gender does not affect attitudes towards risk. Furthermore, housework as principal activity is found to have a significant positive affect on risk aversion. As only women report housework as main activity, the evidence could imply that the difference in risk aversion between men and women is not biological, but a result of a gender segregated work sphere. However, the fact that only a minority of the women, report housework as main activity, leads to my belief that there nevertheless are sex-specific differences in risk aversion. Furthermore, this finding also indicates that risk attitudes might affect occupational choice. The result of the exclusion of the extremely risk loving observations implies further that the risk game was capturing the significant gender difference in extreme risk loving behavior, where the men in our sample are more risk loving than women.

A high density of the participants in our sample is highly risk averse. There is also a fairly high density of extreme risk loving participants. The majority of the participants with an extreme risk loving behavior are men. My results thus indicate that there are differences between risk aversion amongst western university students and low-income farmers in the highlands of Peru, suggesting that there are correlations between highly risk averse behavior and poverty. However, I find no significant effect of income on risk aversion. Nonetheless, I suspect that this is a result of poor measurement. Satisfaction with own economic situation, on

[24] Conducted by the research project Land and Gender in Peru, NIBR
[25] Conducted by Ragnhild H. Bråten, the Frisch Centre

the other hand, is found to have a significant negative effect on risk aversion. This implies either that economic satisfaction is a better measure or that it is satisfaction with private economy that affects risk behavior. My results also support the finding that cultural characteristics influence risk attitudes.

My thesis suggests that risk aversion is a result of several factors such as socio-economic variables, culturally dependent variables and possibly gender. The implication of risk behavior on the propensity to engage in risky investments, and the linkage between investments and positive payoffs, point to the importance of further knowledge of risk behavior in public policy analysis and implementations of pro-growth policies such as land titling amongst low-income farmers.

References

Books

Stock, J. H. and M. W. Watson (2007): “Introduction to Econometrics”, 2nd edition. Boston: Pearson Education, Inc.

Varian, Hal R. (1992): “Microeconomic Analysis”, third edition. New York: Norton & Company.

Cowell, Frank (2005): “Microeconomics, Principles and Analysis”. Oxford: Oxford University Press.

Papers

Akay, Alpaslan, Peter Martinsson, Haileselassie Medhin and Stefan T. Trautmann (2009): “Attitudes toward Uncertainty among the Poor: Evidence from Rural Ethiopia”. Working paper, IZA Discussion Paper No. 4225

Barnett, Barry J., Christopher B. Barrett and Jerru R. Skees (2008): “Poverty Traps and Index-Based Risk Transfer Products”. World Development Vol. 36, No. 10, pp. 1766–1785

Binswanger, Hans P. (1980): “Attitudes toward Risk: Experimental Measurement in Rural India”. American Journal of Agricultural Economics, Vol. 62, No. 3, pp. 395-407

Bjerkholt, Olav and Ariane Dupont (2010): “Ragnar Frisch’s Conception of Econometrics”. History of Political Economy 42:1, Duke University Press

Croson, Rachel and Ury Gneezy (2009): “Gender differences in preferences”. Journal of Economic Literature, 47(2), pp1-27.

Dohmen, Thomas, Armin Falk, David Huffman, and Uwe Sunde (2010): “Are Risk Aversion and Impatience Related to Cognitive Ability?”. American Economic Review, 100(3): pp. 1238–60.

Ergun, Selim Jürgen, Teresa García-Muñoz, M. Fernanda Rivas (2011): “Gender Differences in Economic Experiments”, working paper, http://www.psicothema.com/

Feder, Gershon (1980): “Farm size, Risk Aversion and the Adoption of New Technology under Uncertainty”. Oxford Economic Papers, New Series, Vol. 32, No. 2, pp. 263-283

Galarza, Francisco (2009): “Choices under Risk in Rural Peru”. Staff Paper No. 542, University of Wisconsin-Madison, Department of Agricultural & Applied Economics

Harrison, Glenn W., Morten I. Lau and E. Elisabet Rutström (2002): “Estimating Risk Attitudes in Denmark: A Field Experiment”. Artefactual Field Experiments No. 0050, The Field Experiments Website

Henrich et al. (2005): ““Economic man” in cross-cultural perspective: Behavioral experiments in 15 small-scale societies”. Behavioral and Brain sciences, Vol. 28

Holt, Charles A. and Susan K. Laury (2002): “Risk Aversion and Incentive Effects”. The American Economic Review, Vol. 92, No. 5, pp. 1644-1655

Jianakoplos, Nancy Ammon and Alexandra Bernasek (1998): “Are women more risk averse?” Economic Inquiry, Vol. XXXVI, pp. 620-630

Kanbur, Ravi and Lyn Squire, (2001): “The evolution of thinking about poverty: exploring the interactions”. G. Meier and J. Stiglitz (eds.), *Frontiers of Development Economics: The Future in Perspective*. Oxford, Oxford University Press.

Levitt, Steven D., ohn A. List (2009): “Field experiments in economics: The past, the present, and the future”. European Economic Review 53, pp. 1–18

Moscardi, Edgardo and Alain de Janvry (1977): “Attitudes toward Risk among Peasants: An Econometric Approach”. American Journal of Agricultural Economics, Vol. 59, No. 4, pp. 710-716

Schubert, Renate, Martin Brown, Matthias Gysler and Hans Wolfgang Brachinger (1999): “Financial Decision-Making: Are Women Really More Risk-Averse?” The American Economic Review, Vol. 89, No. 2, pp. 381-385

Tanaka, Tomomi, Colin F. Camerer and Quang Nguyen (2010): “Risk and Time Preferences: Linking Experimental and Household Survey”. American Economic Review, 100:1, 557–571

Trautmann, Stefan T., Ferdinand M. Vieider and Peter P. Wakker (2009): «Preference reversals for ambiguity aversion». Working Paper, Erasmus University Rotterdam.

Appendix

A. An Example of a Choice List to Elicit Behavior Towards Risk

In this example of a choice list, the participant has chosen to switch to the safe amount at choice 5, when the safe amount was 2,5 Soles. The equivalent CE is thus 2,25, and the degree of risk aversion ρ =0,54 implying a risk averse participant.

Choice List

[1]	Draw a chip from the bag	X		Receive 0,5 Sol for sure
[2]	Draw a chip from the bag	X		Receive 1 Sol for sure
[3]	Draw a chip from the bag	X		Receive 1,5 Sol for sure
[4]	Draw a chip from the bag	X		Receive 2 Sol for sure
[5]	Draw a chip from the bag		X	Receive 2,5 Sol for sure
[6]	Draw a chip from the bag		X	Receive 3 Sol for sure
[7]	Draw a chip from the bag		X	Receive 3,5 Sol for sure
[8]	Draw a chip from the bag		X	Receive 4 Sol for sure
[9]	Draw a chip from the bag		X	Receive 4,5 Sol for sure
[10]	Draw a chip from the bag		X	Receive 5 Sol for sure
[11]	Draw a chip from the bag		X	Receive 5,5 Sol for sure
[12]	Draw a chip from the bag		X	Receive 6 Sol for sure
[13]	Draw a chip from the bag		X	Receive 6,5 Sol for sure
[14]	Draw a chip from the bag		X	Receive 7 Sol for sure
[15]	Draw a chip from the bag		X	Receive 7,5 Sol for sure
[16]	Draw a chip from the bag		X	Receive 8 Sol for sure
[17]	Draw a chip from the bag		X	Receive 8,5 Sol for sure
[18]	Draw a chip from the bag		X	Receive 9 Sol for sure
[19]	Draw a chip from the bag		X	Receive 9,5 Sol for sure
[20]	Draw a chip from the bag		X	Receive 10 Sol for sure

B. Instructions for Risk Game

This exercise consists of two parts; we call them A[26] and B. In each part you must chose in 20 different choice situations. We are only able to pay you real money for one of these choice situations and this will be determined by these cards afterwards. You will draw one card from this pile of cards. If you draw a red card, you will be paid for one of the A situations, if you draw a black card you will be paid for one of the B situations. The number on the card determines which situation you will be paid for *(show the cards).*

Prepare two sheets of papers at which you place money. One of the papers is for the safe option, the other is for the risky option. The risky option paper is divided in two by a straight line, to represent the good and the bad outcome.

We start with explaining the A situations. In this part of the game, you can choose between drawing a chip from the brown bag (*show the bag*) and have a chance to win 10 soles, or just receive a certain amount of money. If you choose to draw from the brown bag, how will it be decided whether you get 10 soles or zero? In this bag there are 10 chips, 5 red chips and 5 blue chips (*show*). Before drawing a chip, you must pick one of the colours to be your "winning colour". To indicate your choice, you place the chip with the chosen colour on the desk. Let us say you picked red. (*Put a red chip on the desk.*) Then you draw a chip from the brown bag without looking. If you draw a red chip, you will get 10 soles. If the chip is blue, you will not get anything. (*Draw a chip and announce the color as well as the payoff*).

In the first situation, you must choose between getting 0,5 sol for sure, or to draw from the brown bag. If you choose the draw from the brown bag you might earn 10 soles, but you might also earn nothing. (*Illustrate with showing 10 soles on one side of the risky paper, and 0,5 sol on the safe paper)* In the next situation, you must choose between getting 1 sol for sure, or drawing from the brown bag and possibly earn 10 soles *(Illustrate with 1 sol on the safe option paper).* In the next situation, the safe option is 1,5 soles *(Illustrate)*. The option to draw from the brown bag is always the same; you might get 10 soles, and you might get nothing. The safe option is different in every choice situation; it changes with 0,5 sol for every situation.

Do you understand the difference between the safe option and the option to draw from the brown bag?

[26] Part A is the risky prospect. Part B is for the ambiguous prospect. As this prospect is not relevant for my thesis, I will not include the instruction for part B.

Let’s look at the first choice situation. Now, the safe choice gives you 0,5 sol in any case. Remember, if you draw from the brown bag you might earn 10 soles and you might earn nothing (*Illustrate with money on paper again.)* Would you like to take the certain 0,5 sol or draw from the brown bag?

Now, the safe option gives you 1 sol. Drawing from the brown bag still gives you the chance to earn 10 soles. (*Illustrate with 1 sol on the safe paper)*. Do you choose the safe option or to draw from the brown bag?

Continue with decreasing the value of the safe option, 0,5 sol at a time. Once the participant chooses the safe option, ask “Does that mean that you want the safe option in all the choices with a higher safe option as well?” If affirmative answer, fill out the rest of the rows accordingly. If not, continue increasing value with 0,5 sol at a time.

Participant can always change their mind about previous choices within the same exercise.