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Girl Power in Groups: Investigating Gender Effects in Risky Decision Making

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Abstract

Most important decisions in society are made by groups of individuals, not individuals in isolation. In this thesis we conduct a lab experiment using the investment decision introduced by Gneezy & Potters (1997) with the aim of studying how individual risk preferences translate to a group setting. More specifically, we are interested in the role of gender in this process. First, we find that females take less risk than males in their investment decision, as is shown in previous studies. Second, we find no evidence for a change in risk attitudes when individuals are asked to make the same investment decision for a small group including themselves. Third, when groups are asked to make this investment decision together we find that those with a larger share of females take less risk, and that this difference is captured by individual risk preferences. Fourth, we observe a tendency for groups to take more risk than individuals. Finally, we find a peer effect in preferences after interacting with a group. These findings together contribute to a better understanding of gender effects in groups who face risky decisions.

Keywords: Risk, Peer Effects, Group Decision Making, Gender

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1 Introduction

Most important decisions in society are not made by individuals in isolation, but by groups of individuals (e.g. committees, boards and legislatures). Within the economics field there is a dearth of consideration given to the group as a decision making unit. Preceding thought focuses almost exclusively on individual behaviour. Studying individuals is a logical starting point to better understand how decisions are made, however the axioms arrived at from the individual may not carry over to the group level. In a group environment we have different, often opposing, opinions that must be reconciled. How this happens is not immediately clear. In addition to preferences about the issue at hand, group decisions might for example be affected by both social and competitive preferences of the group members.

Preferences taken into the group environment may also vary systematically by gender. Powerful groups in society, especially in the private sphere, are often dominated by men – only 24 per cent of board members in Swedish stock listed companies are women (SCB, 2012). Several behavioural differences have been established between men and women in the literature. In particular experimental studies have found gender differences in individual behaviour explained by differences in risk preferences, social preferences and competitive preferences (Croson & Gneezy, 2009). To understand how these carry over to a group setting is crucial for understanding whether gender has an effect on group decision making.

Interesting group decisions in society often involve a level of risk. In this thesis we study such risky decisions. More specifically, we aim to investigate how risk preferences at the individual level translate to a group setting and to understand the role of gender in this process. There is a large body of research on gender differences in individual risk preferences to draw upon. We formulate the following research questions that detail the specific issues that we wish to address in this thesis:

i. Do females take less risk than males in individual financial investments (as demonstrated in previous studies)?
ii. Do individuals change the amount of risk they take when they make financial investment decisions on behalf of a group including themselves? Is there a gender difference in this regard?
iii. Do groups with a larger share of females take less risk in financial investments? If so, is this explained by gender differences in individual risk preferences?
iv. Do groups take more or less risk than individuals? Is this dependent on the share of females in the group?
v. Is there a peer effect in risk preferences after interacting with a group? If so, does the size of this peer effect vary by gender?

To answer these research questions we conduct a lab experiment using the *investment decision* introduced by Gneezy & Potters (1997). Subjects make decisions individually, on behalf of a group including themselves and jointly within a small group where group members discuss and make the investment decision collectively.

As demonstrated in previous studies we find that females take less risk than males in their investment decision. We also find that neither females nor males on average change the

amount of risk they take when they invest on behalf of a group including themselves relative to investing solely for themselves. When groups make the risky investment their decision is influenced by the number of females in the group; groups with a larger share of females take less risk. Furthermore there seems to be no explanation to this behaviour other than gender differences in individual risk preferences. Moreover we find that there is a tendency for groups to take more risk than individuals. This result seems to be independent of the share of females in the group. Finally we identify a peer effect in preferences – individuals' risk preferences are significantly affected by those that they interact with in a group.

This thesis begins with a review of the relevant literature from which we derive our research hypotheses. Following this, the experimental design and procedure is described. After presenting and analysing the results from the experiment we round off with a discussion of our findings and how they sit with the current literature.

2 Literature Review

Having specified our line of inquiry, we start by considering the research questions in the context of previous literature. At the time of writing – to the authors' best knowledge – an authoritative account of gender effects in group decision making does not exist in the field of economics (the topic has been studied more extensively in psychology). The attraction of entering a relatively fresh research area comes with the downside of a sparse narrative. In this light, the literature review focuses on bringing together the strands that support our thesis to present a cohesive view of where the current state of knowledge is placed. It is most natural to consider the literature based around the topics that the research questions suggest:- gender differences in risk preferences, social risk preferences, group behaviour and peer effects. After considering these separate pillars, and importantly the linkages between them, we hope the reader will have a comprehensive understanding of where our study sits.

2.1 Gender Differences in Risk Preferences

The notion that males and females react differently when making decisions under risk was first considered in the psychological literature. A study by Powell & Ansic (1997) transcends the psychological and economic literature. They take previously developed ideas about gender differences and ponder whether such differences exist in financial decision making. Using a simple monetary lottery conducted in a laboratory experiment they arrived at the conclusion that females are less risk seeking than males (Powell & Ansic, 1997). An interesting aspect of this study was their use of real financial data relating to the insurance market and currency market which grounded the risky decision in a realistic setting.

Croson & Gneezy (2009) conduct a broad review of gender differences in preferences (including risk preferences). They list 10 papers that use different methods to study risk preferences in lab experiments, all finding that male subjects take more risk than female subjects, with a couple of exceptions for papers that find no gender difference in high risk situations Croson & Gneezy (2009). Other evidence suggests that the gender difference is robust across age and experience; Cardenes et al. (2012) show that a difference exists in Colombian and Swedish children and Olsen & Cox (2001) show that female professional

investors weight risk attributes – such as the possibility of loss and ambiguity – more heavily than their male colleagues.

As mentioned above there are several ways to study risk preferences. One popular method is to conduct laboratory experiments using the investment decision introduced by Gneezy & Potters (1997). In these experiments subjects are given an endowment and asked how much of this endowment (if any) they want to invest in a risky asset and how much they would like to keep with certainty (Gneezy & Potters, 1997). A study by Charness & Gneezy (2012) reviews all experimental studies that use this investment decision to examine gender differences in risk preferences. The five studies that they review in detail report that males on average invest 12.5 to 32.0 percentage points (p.p.) more of the endowment compared to females. In addition they summarise results from ten other studies, of which nine report that males take more risk than females in this investment game (Charness & Gneezy, 2012). As the studies reviewed all differ in context, stake size, probability of a successful investment and other aspects, Charness & Gneezy (2012) conclude that there is strong evidence for robust gender differences in this type of risky investment decision.

The gender difference found in lab experiments seems to translate to real life data. In a review of the literature Eckel & Grossman (2008) state that evidence from field studies point to women being more risk-averse than men. As an example Jianakoplos & Bernasek (1998) use the *Survey of Consumer Finances* in the United States to show that single women take less risk in financial investment decisions than men. More recently a paper by Halko et al. (2012) demonstrates that females are more risk-averse in their stock holdings.

One of the major criticisms against the statement that there is a gender effect in individual decision making under risk is that the observed gender difference may depend on how the decision is framed.[1] Several papers examined the gender difference with respect to contextual environments, for example framing lotteries as an investment decision suggesting the gain domain or an insurance decision evoking the loss domain (Schubert et al., 1999; Moore & Eckel, 2003). While experimental designs are not entirely consistent with one another, various studies provide conflicting evidence. Subjects in Schubert et al.'s (1999) analysis demonstrate no significant difference in risk attitudes across genders. Moore & Eckel (2003) on the other hand produce some curious results. Under the investment frame women are significantly more risk-averse than men, however when the lotteries are framed as insurance decisions women become more risk-seeking than men (Moore & Eckel, 2003).

Furthermore, we would suggest that cultural context plays an important role in shaping and evoking the emotional reaction to risk that is proposed as the underlying cause of the gender difference in risk preferences (Croson & Gneezy, 2009). For example Cardenes et al. (2012) report cross-cultural differences where Swedish children demonstrate a smaller gender gap than Colombian children. Another example is Gong & Yang (2012), who report that the gender gap in risk preferences is smaller in matrilineal societies relative to patriarchal societies.

There is enough evidence to state that before the literature can offer a predictive assessment on the intricacies of the gender effect more research is needed on the influence of context and

[1] Kahneman & Tversky (1979) were the first to demonstrate how preferences could be manipulated by the language used to describe the decision situation.

culture. In general however there is relatively strong evidence in favour of a gender difference in risk preferences.

2.2 Social Risk Preferences

In social risk preferences we are trying to capture how an individual reasons when they take a risky decision on behalf of others. Behaviour under this situation could theoretically be different compared to behaviour when an individual takes a risky decision for themselves. There are new considerations and pressures that subjects feel they need to incorporate into their decision making process, for example altruism (i.e. an intrinsic desire to be fair to others). Harrison et al. (2013: p26) offer an exposition of how altruism may effect an individual's risky decision:

> *"If altruism is an aspect of what motivates individual choice, then it is possible that social risk preferences differ from individual risk preferences for individuals who perceive themselves as different from others…To exemplify, a highly risk-averse individual may be willing to give up some of his own utility by taking on more risk in a social setting than in an individual setting in order to avoid imposing [less] risk on others than they prefer"*

In addition to altruism, social preferences include other aspects such as fairness considerations, warm-glow altruism and reciprocity. Independent of the motivation, social preferences capture how individuals might make different decisions when the decision affects others. However some types of social preferences are hard to measure. For example identifying altruism in the manner suggested by Harrison et al. (2013) above is complicated by regression to the mean, as subjects who first make an extreme decision (in this case highly risk-averse or risk-loving) tend to move closer to the mean in their second decision due to stochastic variability in decisions (Garcia-Gallego et al., 2011). In other words, social preferences that motivate subjects to change their behaviour in the direction of average behaviour are hard to detect,

Social preferences have been shown to matter in strategic ultimatum games, such as in Hoffman et al. (1994), and in non-strategic dictator games, where subjects give more aid to anonymous recipients they consider to be deserving (Eckel & Grossman, 1996). As for the role of gender, Miller & Ubeda (2012) show that females are more sensitive than males to social contexts involving the use of fairness principles in distributional games.

For our purposes it is most pertinent to examine whether social preferences play any role when making risky decisions on behalf of others. Daruvla (2007) uses a certainty equivalence experiment to show that when subjects decide on behalf of others they combine their own risk preferences with their predictions about the risk preferences of those they are deciding for i.e. they adds a social component to the reference point of their individual preferences. While Daruvla (2007) makes a suggestion as to how individuals formulate their decision when deciding on behalf of others, she does not include any results as to whether they take more or less risk when deciding on behalf of others compared to deciding for themselves.

Sutter (2009) makes use of the investment decision introduced by Gneezy & Potters (1997) in order to compare the amount invested (and thereby risk taken) individually and the amount invested under payment commonality. Payment commonality means that "an individual's

decision has consequences for the payoffs of other group members, even though the other members cannot influence the individual's decision" (Sutter, 2009: p2247). In this setting an individual makes the investment decision on behalf of themselves and two other subjects. Sutter (2009) concludes that payment commonality in itself has a significant positive effect on the amount invested. However this effect seems to be present only when revealing the preferences of other group members, an aspect that Sutter (2009) does not discuss. As such our conclusion from Sutter's (2009) experiment is that individuals do not change the amount of risk they take when investing on behalf of others unless they are aware of their preferences. When subjects have information about others' preferences they increase the amount of risk they take.

Chakravarty et al. (2011) use a lottery choice structure to study individuals who make decisions with uncertain outcomes where the other party bears the consequences. They find that when an individual makes a decision for an anonymous stranger there is a tendency to exhibit less risk-aversion relative not only to their own individual preferences but also to their beliefs about the preferences of others (Chakravarty et al., 2011). The result that subjects appear to take more risk even when they are aware of the others' risk preferences is compelling – if subjects are motivated by altruistic preferences then they should heed information about others' preferences. In this experiment subjects were making a decision with no consequence for themselves.

Harrison et al. (2013) address these concerns by having subjects in their experiment make decisions on behalf of themselves and two other anonymous individuals. Subjects are asked to express how much risk they would like to bear themselves (individual setting) and to express an individual preference for the risk that everyone in the group shall bear (the social setting). They find no evidence that subjects change their risk attitudes in a social setting relative to the individual setting (Harrison et al., 2013). As an explanation to this they conclude that any existing altruistic motivations for social risk preference appear to be dominated by financial consideration (Harrison et al., 2013). One may further speculate that the anonymity of the other individuals may lead to weak social risk preferences.

There is only a small amount of evidence concerning gender differences in social risk preferences. In a study into gender and leadership in groups using Gneezy & Potters' (1997) investment decision, Ertac & Gurdal (2012) notice that women are more apprehensive than men about making a risky decision that affects others in addition to themselves. They also remark that risk-loving males tend to be more willing to take the decision for a group of six (and thereby impose their preferences on others) than risk-averse men. For females there is no significant difference in risk preferences for those willing and non-willing to take the decision on behalf of a group. Furthermore, they find that individuals take less risk on behalf of a group compared to when they make the decision for themselves (Ertac & Gurdal, 2012).

Ertac & Gurdal's (2012) research concludes that women behave differently to men when making decisions on behalf of others. How they do so and to what extent requires more investigation. A point of caution for exploring any potential gender effect in this regard comes from Miller & Ubeda (2012). They remark that women seem to be more sensitive to decision making context in situations that trigger social preferences. We could perhaps extrapolate from this statement that when we believe social preferences to be at play, the method used to elicit risk preferences could provide a contextual influence on how women behave. A robust calibration of a gender effect ideally requires a comparison between studies that use different methods of eliciting risk preferences.

With regards to whether individuals behave differently when deciding for themselves or on behalf of a group, we can only say at this point that the answer is not robustly formulated. More studies are needed in order to determine the importance of payment commonality, anonymity of group members' preferences, and group size on social preferences. For example Harrison et al. (2013) find no evidence for social risk preferences while studying groups of three, whereas Ertac & Gurdal (2012) find that individuals are more risk-averse while investing on behalf of a group of six.

2.3 Group Behaviour

While the economic literature on how groups of individuals make decisions is in its infancy compared to the attention and thought given to individual decisions, there are studies to point us in the right direction. We will begin this section by presenting the literature on how groups make decisions. After discussing influences on group decisions, we turn our focus to how these decisions might differ from individual decisions. We round off by presenting literature on gender and group behaviour.

The group decision involves aggregating the preferences of group members to some extent. It is however not clear that individuals only value their own point of view. In line with the social preferences literature above an individual might also care whether the other group members are satisfied with the group decision or not. Furthermore competitive preferences are important in bargaining and negotiations for several reasons (Croson & Gneezy, 2009) – they imply that an individual will argue even stronger in favour of their own view on the issue at hand or in some other way try to bend the group decision in their own favour. It is interesting to ask that, left to their own devices, how do groups arrive at their decisions? Committees for example often vote by way of simple majority on decisions to be taken. In this instance the most popular (or least dissatisfying) path for the group will be taken. Important decisions for example changes to an EU treaty must often be taken with unanimity amongst all group members. Not all group decisions have to be fair however. A strong personality could act as a leader, bending the other members round to their way of thinking.

Zhang & Casari (2012) suggest that extroverts are more likely to lead the group outcome than conscientious subjects. This result provides grounding for an everyday observation. Those that are more outgoing are more likely to speak up, get their point across and drive group behaviour. As an interesting addendum they mention that in one out of five groups, the minority view in a group composed of three individuals prevailed (Zhang & Casari, 2012). This stands as evidence against the view that groups will always vote by majority. Finally with regards to who compromises their inert individual preferences most within a group, Masclet et al. (2009) show that relatively risk-loving subjects in the group are more willing to change their vote to conform to the group average risk decision than are relatively risk-averse players.

Having taken a brief look at how groups formulate their decisions we turn to how those decisions compare to individuals. A popular theory within the psychological literature on group decision making started with Stoner's (1961) finding that group choices differ from average individual choices of members. He observed both increased and decreased risk-aversion relative to the average of individuals. For the most part groups demonstrated a *risky shift*. Group choices on the whole reflect a greater willingness to take risk than the average

individual choices of the group members. Regardless of the direction, the deviations are inconsistent with the notion that groups simply take the average of the individual preferences.

More investigation in psychological research of how groups compare to individuals followed. Teger & Pruitt (1967) find that when the initial mean of individual choices is relatively risky group discussion causes shifts to the risker extreme. In contrast when the initial mean of individual choices is relatively cautious, group discussion results in even more cautious decisions (Teger & Pruitt, 1967). The term *group polarisation* was coined by Moscovici & Zavalloni (1969) to describe this behaviour. They hypothesised that group discussion moves decisions to more extreme points in the same direction as the average of the group members' initial individual choices.

Stoner's (1961) finding of a risky shift is to some extent maintained in recent economic publications. For example groups have exhibited a significant risky shift in lottery choice games (Zhang & Casari, 2012). Furthermore, the study by Sutter (2009) discussed in the previous section also investigates this issue. By comparing subjects who made joint decisions in groups of three to subjects who made the same decision individually he concludes that groups invest significantly more, and thus take on more risk than individuals.

The risky shift is at the same time challenged by studies demonstrating a directly contradictory *cautious shift* on the part of groups. Prominent papers using lottery-choice methods to elicit risk preferences all documented instances where groups exhibited more risk-aversion than the average individual in their choice of lottery (Baker et al., 2007; Shupp & Williams, 2008; Masclet et al., 2009).

In light of the apparently contradictory evidence, a general reconciliatory explanation exists that is advocated by multiple authors. It is fundamentally to do with the relative riskiness of the situation. In high risk situations groups are more risk-averse than individuals, conversely in low risk situations groups are less risk-averse than individuals (Shupp & Williams, 2008; Masclet et al., 2009; He et al., 2012). What constitutes high and low risk lotteries appear to be fairly arbitrarily defined. For example Shupp & Williams (2008) define low risk lotteries as those where you win the prize more than 80 per cent of the time and high risk lotteries where you win less than 40 per cent of the time. Although this conclusion appears to be well replicated the strength of the argument would benefit from more rigorously defined high/low risk situations. An exact description of how groups' risky decisions compare to individuals contains ambiguities – it is not apparent whether groups take more or less risk – however one could state that they behave differently with some confidence.

Moving on to the role of gender in groups, we start from the dichotomy that women tend to have stronger social preferences and weaker competitive preferences than men (Croson & Gneezy, 2009). Charness & Rustichini (2011) observe such tendencies in a strategic Prisoners' Dilemma game. They find that males cooperate substantially less when observed by their peer group, while females cooperate substantially more. Following the theme of behaviour in groups, Sjögren-Lindquist & Säve-Söderbergh (2011) make use of a natural experiment where they examine behaviour amongst contestants of the US TV-show *Jeopardy*. At some point in the show contestants have an opportunity to bet some of their points on the outcome of one question. If they answer correctly then they double their points, incorrectly then they lose. In this risky decision Sjögren-Lindquist & Säve-Söderbergh (2011) note that females are more conservative when playing in the presence of just males. Even

though the male contestants have no say or stake in the outcome they manage to influence the females' decisions.

In a simple competitive game where subjects solve maze problems Gneezy et al. (2003) find that females underperform relative to males in mixed-gender groups, this effect disappears in all-female groups. This is indicative of a gender effect component to group behaviour, even the presence of males induces females to act in a different manner, in this instance they suppress their competitive spirit. The root cause of this appears to be that males are more confident in their abilities than women during competitive situations (Niederle & Vesterlund, 2011). This could be detrimental to female interests in group negotiations where one often has to compete to get one's voice heard. Croson & Gneezy (2009) mention that women might suffer relative to men in negotiations because men are more competitive and make larger demands in negotiations, whereas women are more concerned for the other party. If, as Babcock et al. (2003) state, women do not assert their preferences then they are less able to shape the group decision in a favourable direction.

In addition to gender differences in social and competitive preferences there are other aspects of gender that might affect group behaviour. A growing field is *identity economics*, introduced by Akerlof & Kranton (2010). It aims to incorporate the idea that individuals gain utility from behaving according to the norms of their gender, class or other social groups. They refer to this as gaining *identity utility*, and furthermore recognise that it can have important implications in group settings as individuals might want to act in a certain way in order to fit in with a social group that they belong to. For example men might act in a way that is thought of as typical male behaviour in the presence of others if they want to increase their sense of belonging to this social group (Akerlof & Kranton, 2010). This literature would suggest that males behave riskier in group settings than they would when they are not observed by anyone.

The literature on the role of gender in a group setting is developing. Previous works indicate that some of the gender differences identified in individuals carry over to the group setting. There are several factors that might simultaneously influence behaviour within groups, e.g. competitive, social, and individual risk preferences as well as identity considerations. We believe an interesting discussion is to be had on the role of the gender composition in group decision making, at present the literature has very little to say on this matter (He et al., 2012).

2.4 Peer Effects

This area links in closely with the previous section on group behaviour. The interaction with a group has implications not only for the group decision at hand but also for future decisions taken individually and in groups. A peer effect is when an individual's behaviour is influenced by interaction with a group. In a rather negative example of a peer effect, the fact that "everyone was doing it" (Economist, 2013) is routinely offered as an excuse for drug taking among cyclists. Seeing other athletes within their professional sporting group take risks in this manner may motivate an athlete to adopt a risky practice they were previously averse to.

To give us a theoretical grounding an influential paper by Charles F. Manski (2000) distinguishes between different types of peer effects (or social interactions). An *endogenous interaction* is where "the propensity of a person to behave in some way varies with the

behaviour of the group" (Manski, 2000: p23). A *contextual interaction* is where "the propensity of a person to behave in some way varies with exogenous characteristics of the group members" (Manski, 2000: p23), for example socioeconomic background or physical appearance. Finally *correlated effects* means that "persons in the same group tend to behave similarly because they have similar individual characteristics or face similar institutional environments" (Manski, 2000: p24). Manski (2000) also distinguishes different channels through which these interactions can affect behaviour; preferences (utility functions), expectations (subjective probability distributions), or constraints (choice sets).

There is a difficulty in distinguishing between both endogenous and contextual interactions, as well as preference interactions and expectation interactions in outcome data Manski (2000). Appropriate policy recommendations require one to identify the type of interactions. For example assume that endogenous interactions are an important determinant of drug use. To formulate effective policy it is crucial to know whether these endogenous interactions are influencing the drug users' preferences, expectations, or constraints. An informational campaign about the consequences of drug addiction (which will not change a drug user's inert desire for drugs or their ability to obtain drugs) might be useful only if it has an effect on the drug users' expectations (in this case the perceived riskiness of taking drugs) (Manski, 2000).

Turning to the experimental evidence, Sacerdote (2001) reports that students at Dartmouth College are strongly influenced by their peers. He describes how the peers that first year students are randomly assigned to living with have an impact on an individual's GPA and decision to join a fraternity (Sacerdote, 2001). This seems to indicate that decisions of individuals are linked to the behaviour of others. In such an uncontrolled environment however one cannot distinguish between endogenous and contextual interactions. These results were also observed from students that live and work in close proximity to one another. We may question how it applies to those who take work related decisions together but can remain emotionally and privately detached from one another.

Gardner & Steinberg (2005) find that people take riskier individual decisions when they are in a peer group compared to when they are alone. In their experiment they elicit risk preferences from how subjects play video games rather than using any monetary incentives. Whilst this may not perfectly translate over to risky behaviour in an investment game, the observation that people make riskier decisions when they are in a peer group is robust to age (Gardner & Steinberg, 2005). Another finding is that peer effects were stronger in young people. When faced with behavioural decisions in a peer group, adolescents were more easily swayed to a risky group choice (Gardner & Steinberg, 2005). This is of consequence in itself, however it also highlights that a researcher wishing to extend their findings on peer effects to the population from a student sample should account for this.

In a lottery choice experiment, Baker et al. (2007) have subjects make three decisions; first individually, in a group, then individually again. They find that making the group decision has a significant impact on the subsequent individual decision relative to the initial individual decision. In support of this – when making the investment decision detailed by Gneezy & Potters (1997) – Sutter (2009) finds that individual decisions after group interaction are significantly different from individual decisions before group interaction. However both Sutter (2009) and Baker et al. (2007) do not control for any trend in investments, we are thus sceptical as to whether they identify a pure peer effect. It is especially important to control for such trends in Sutter's (2009) experiment since subjects are continuously paid throughout the

nine rounds of the experiment – any wealth effects would bias the finding that individuals increase their investments because of group interaction.

To conclude there is relatively strong evidence that people change their individual behaviour under the influence of a group. However there is little conclusive research both on whether endogenous or contextual interactions matter, and whether peer effects are manifested through preference, expectation or constraint changes. Furthermore there is no research on whether peer effects vary systematically by gender. In order for research on peer effects to have implications for policy, such distinctions are crucial.

3 Research Hypotheses

Based on the motivations presented in the introduction and the findings of previous research we have formulated the following research hypotheses that relate to our research questions:

Hypothesis 1: *Female subjects take less risk in individual investment decisions than male subjects.*

Hypothesis 2: *On average, there is no change in the amount of risk taken neither by male nor female subjects when investing on behalf of a group including themselves.*

Hypothesis 3: *Investment decisions that are commonly reached by a group of subjects are lower in the level of risk as the share of females in the group increase.*

Hypothesis 3.1: *The fact that females are more risk-averse than males fully explains why groups with a larger share of females take less risk in financial investments.*

Hypothesis 4: *Groups take the same amount of risk in investment decisions as do individuals independent of the share of females in the group.*

Hypothesis 5: *After interacting with a group, subjects' risk preferences are affected in the direction of their group members' risk preferences.*

Hypothesis 5.1: *There is no systematic difference in the size of peer effects between male and female subjects.*

4 Experimental Design and Procedure

To test our research hypotheses we design an experiment where subjects make the investment decision (Gneezy & Potters, 1997) under varying degrees of social interaction. The design allows us to study gender effects in individual and social risk preferences, group behaviour and peer effects. Below we present our experimental design in detail. This is followed by a

description of the experimental procedure, how subjects were recruited and how experimental sessions were run.

4.1 Experimental Design

As decisions made under risk are at the heart of our proposition the experiment requires a decision that allows subjects to vary the amount of risk they wish to take. It is also important that the decision is applicable to different scenarios. In our case we aim to vary the level of interaction between subjects whilst maintaining the same fundamental decision. The decision should be equally appropriate for a group decision making mechanism as it is for an individual.

There are several different methods of eliciting or inferring risk preferences in the literature, and in order to place our method in context it is useful to provide a brief summary of the most popular. *Lottery-choice* is a prevalent technique where subjects are presented with a menu of paired lotteries – one safe lottery and one relatively risky – and asked to choose between them. Holt & Laury (2002) popularised the lottery-choice (or Multiple Price List) structure with a design that is widely replicated (Baker et al., 2007; Masclet et al., 2009; He et al., 2012). An alternative way to estimate the same risk parameter is to use *certainty equivalents* (Kachelmeier & Shehata, 1992; Schubert et al, 1999; Shupp & Williams, 2008). In this approach subjects are in a lottery to win a cash prize, they are then asked what would be the lowest amount they would accept in exchange for their shot at the prize. Both methods essentially measure the same thing. The certainty equivalent relative to the expected value gives the researcher an idea of the subject's risk preferences.

In addition to controlled laboratory experiments there have been various attempts to make use of *field data*. The advantage of this being that a researcher can observe how subjects actually behave in real-life scenarios rather than inferring this behaviour from abstract experiments. Bajtelsmit & VanDerhei (1997) looked at the defined contribution pension allocation for 20,000 employees at a large US company. The chosen composition of their pension plan is deemed to indicate risk preferences. In a similar vein, other papers have analyse data on the relative amount of an individual's wealth held in certain assets (Jianakopolos & Bernasek, 1998; Halko et al., 2012). A recent occupation is to study behaviour in game-shows as a novel way to determine risk preferences. Using similar logic to the certainty equivalent laboratory experiments, Post et al. (2008) investigate behaviour with regards to risky decisions in *"Deal or No Deal"* for example.

In this study we adapt the investment decision introduced by Gneezy & Potters (1997), which is outlined in the sub-section below. Given the dearth of appropriate existing field datasets that allow us to control for group interaction, a laboratory experiment is more convenient for our purposes than field data. Our study is focussed on examining differences between individuals and groups with respect to gender, and in their summary of risk preference elicitation methods Charness et al. (2013) advise that laboratory experiments are the most appropriate for examining differences. The investment decision yields more information in terms of risk preferences than binary lottery-choice methods; however we must be aware of regression to the mean in repeated choices using a continuous-like distribution of decisions (Garcia-Gallego et al., 2011). A problem in the individual risk preferences literature is the diversity of methods used to study the phenomenon that makes comparison difficult (Charness & Gneezy, 2012). Using the same decision problem as a number of other papers

that study gender differences allows us to compare our results and place them in context within the literature.

4.1.1 The Investment Decision

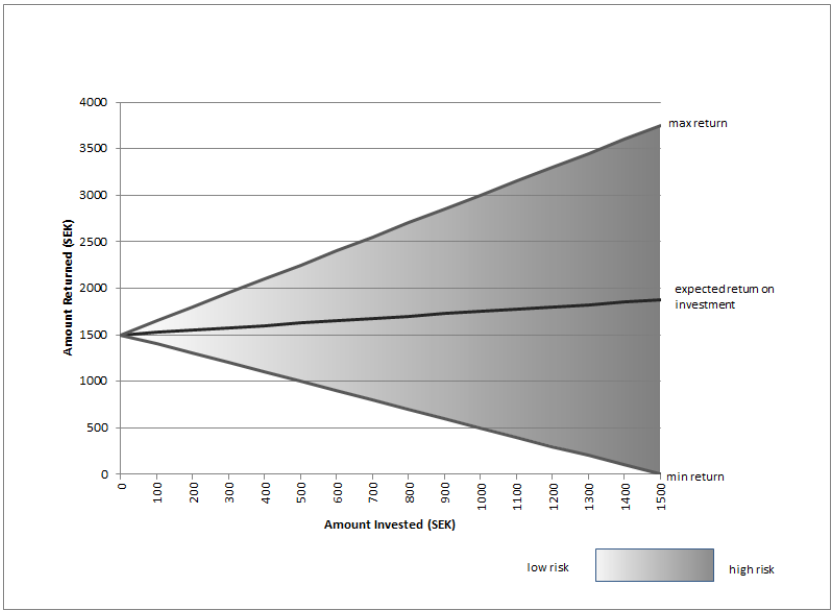
In experiments using the *investment decision* subjects are given an endowment of X *SEK* of which they must decide how to allocate. They can invest an amount x *SEK* of the endowment in a risky option. This amount can be nothing, the whole amount or any integer in between ($0 \leq x \leq X$). The investment achieves a return kx *SEK* (where $k > 1$) with probability p and the investment yields 0 with probability $(1 - p)$. The money that is not invested $(X - x)$ *SEK* is kept by the subject with certainty. The associated payoffs are then $(X - x + kx)$ *SEK* with probability p and $(X - x)$ *SEK* with probability $(1 - p)$. Gneezy & Potters (1997) specify that that p and k should be chosen such that $pk > 1$. This makes the expected value of investing higher than that of not investing. A risk-neutral or risk-loving individual will have the incentive to invest the maximum possible (X *SEK*), whereas a risk-averse individual will choose x so as to trade off the increased return from higher investment with the heightened risks.

We set k equal to 2.5 in line with Gneezy & Potters' (1997) original specification. This means that, if successful, the subject's investment (x) is multiplied by 2.5 and added to what they did not invest $(X - x)$. Whether the investment is successful is decided by the flip of a coin ($p = 0.5$) in the manner of Apicella et al. (2008). The probabilities of a coin-toss are widely understood, the outcome of a coin-toss can be clearly related to the binary win/lose investment outcome and a fair coin-toss is easily verifiable by the subject.

The subject's investment decision is graphically illustrated below in Figure 1. We can see that the expected return on investment is increasing over the range of possible investments that the subject can make. This is necessary if we make the assumption that most individuals in society are to some extent risk-averse in financial investments. Several experiments have shown that on average individuals exhibit some form of risk-aversion when making this investment decision (Charness & Gneezy, 2012). It has also been empirically shown that individuals exhibit risk-averse behaviour when facing lotteries that yield positive outcomes with medium to high probability (such as our investment decision where $p = 0.5$) (Blavatskyy & Pogrebna, 2008). Using the set-up with an increasing expected value over the range of investments allows for discrimination between different levels of risk-aversion. A disadvantage of this set up is that we cannot discriminate between risk-loving and risk-neutral individuals.

It is apparent from Figure 1 that as more of the endowment is invested the variance between the two possible outcomes increases i.e. the outcome becomes more risky. A subject making this decision will trade off risk and return.

Figure 1: The Individual Investment Decision



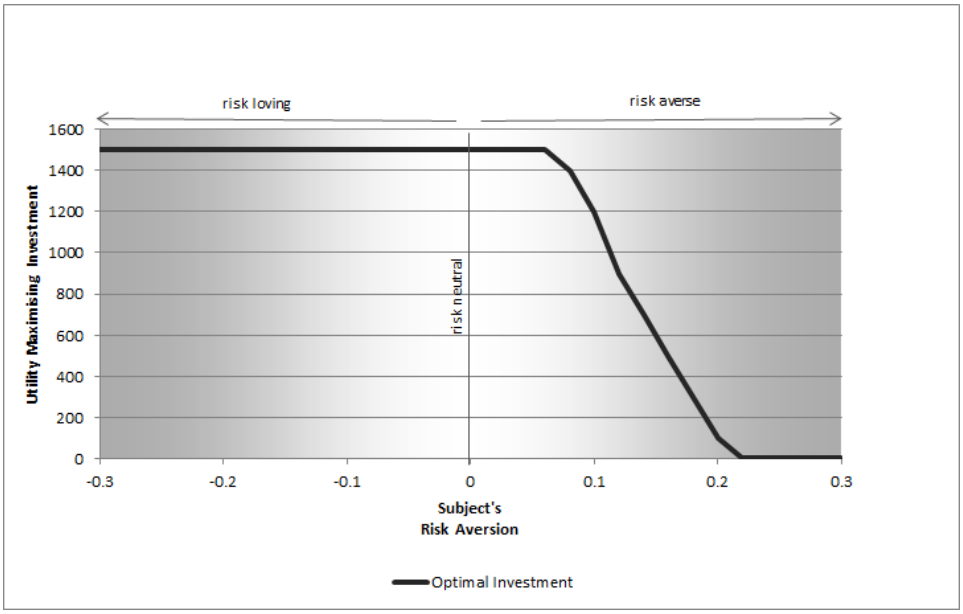
4.1.2 Risk Preferences and the Utility Function

To illustrate how risk preferences will affect the investment decision taken we present a commonly used utility function with constant relative risk-aversion. Subjects choose the level of investment in order to maximise their utility:

$$u(x) = \frac{[(p * kx)^{1-\gamma} + ((1-p) * (X-x))^{1-\gamma}]}{1-\gamma}$$

Where x is the investment decision made from an endowment of X and u(x) is the utility the subject gains from that risky investment. The key parameter γ is a measure of the subject's relative risk-aversion. When $\gamma = 0$ subjects are risk-neutral, when $\gamma \geq 0$ they are categorised as risk-averse. We expect this parameter to vary across subjects in the experiment and that this will influence the size of investments. The probability of a successful investment is denoted by p. Figure 2 graphs the relationship between levels of risk-aversion and the optimal level of investment using this utility function (p is set equal to 0.5). We can see that risk-neutral and some risk-averse subjects will invest everything however as γ increases the optimal level of investment decreases.

Figure 2: Risk Preferences & Optimal Investment



Having used this specification we would like to stress that this should not be taken as an accurate model of behaviour under risk (which our paper does not intend to calibrate). This is merely an illustration of how the level of risk-aversion can influence the amount an individual chooses to invest. The debate over what constitutes an accurate model of behaviour under risk is on-going. Advocates of theories that incorporate loss-aversion and mental accounting (e.g. Prospect Theory) state that the previous dictum of Expected Utility Theory is incoherent with empirical observations (Rabin, 2000; Rabin & Thaler, 2001; Post et al., 2008). They argue that risk-aversion under the low stakes used experimentally imply implausibly high risk-aversion for moderate or high stakes (Rabin, 2000), with results from the field suggesting the importance of reference points when making risky decisions (Post et al., 2008). In opposition to this view, the argument is made that the observed loss aversion is inconsistent with some models of expected utility but not with expected utility *theory* per se (Cox & Sadiraj, 2002). A calibration experiment on risk preferences by Holt & Laury (2002) suggests an expected utility model with increasing relative risk-aversion and decreasing absolute risk-aversion as the most appropriate specification. We do not draw any particular conclusions on this matter but will remark that the above utility function is likely to be too simplistic for reality.

4.1.3 A Multi-Round Experiment

As an overview, the experiment we design consists of four rounds in which we vary the level of social interaction as subjects make the aforementioned investment decision. In Round 1 the subjects make an *individual investment decision*, in Round 2 subjects make a *social investment decision* (a decision on behalf of themselves and two other people), in Round 3 they make a *group investment decision* and finally in Round 4 they make an *individual investment decision* again identical to Round 1. We will describe the rounds in detail below. The endowment per person is 1500 SEK throughout the rounds, group size is set to three, and subjects are informed that three subjects in the experiment as a whole will receive real

payment according to their decision in one of the four rounds. The choice of endowment, group size and payment structure will be discussed in subsequent sections.

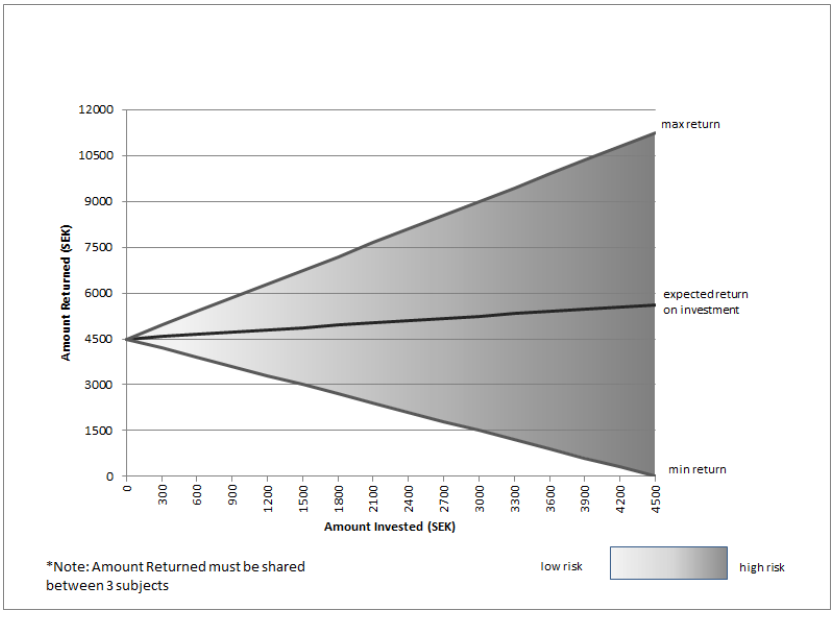
Round 1

In Round 1 subjects are making an individual investment decision. They are given an endowment X_1 = 1500 SEK and asked how much they would like to invest($0 \leq x_1 \leq 1500$). The probable outcomes (in terms of gains and losses) of the investment are laid out in an instructional table (see Appendix A: Table 1). The aim of this round is to test Hypothesis 1: *Female subjects take less risk in individual investment decisions than male subjects.* In context of the rest of this experiment, individual investment decisions in this round will be used as a control for individual risk preferences to test the remaining hypotheses.

Round 2

In Round 2 subjects are making a social investment decision. They are given a larger endowment (X_2 = 4500 SEK) of which they can invest any amount ($0 \leq x_2 \leq 4500$) in the same risky asset. Subjects are informed that they are investing on behalf of a group consisting of themselves and two other anonymous subjects. Any successful investment ($2.5x_2$) and any retained endowment ($X_2 - x_2$) must be shared equally between the three group members. The underlying structure of the investment is the same – i.e. successful investments are multiplied by 2.5 and the probability of a successful investment is 0.5 – however the magnitude of the endowment is now multiplied by 3. The investment decision is identical to Round 1 when assessed on a per-person basis. A graphical representation of the exact decision subjects face can be seen in Figure 3.

Figure 3: The Social & Group Investment Decisions



We use the results in this round and Round 1 to test Hypothesis 2: *On average, there is no change in the amount of risk taken neither by male nor female subjects when investing on behalf of a group including themselves.* The underlying difference between Rounds 1 and 2 is that in Round 2 subjects have to consider that others will be affected by the decision they

make, as such we can isolate any potential general social effect. This effect would have become mixed up with any effects of gender composition if we had chosen to reveal the gender of the other two subjects at this stage. We do not attempt to isolate an effect of altruistic social risk preferences as one cannot distinguish between such change in behaviour and regression to the mean using this investment decision. As such we test whether subjects on average increase or decrease the risk they take when investing on behalf of others. Round 2 will also be used as a control for social risk preferences when investigating group decisions and peer effects.

Round 3

In Round 3 subjects are making a group investment decision. Individuals are randomly assigned to groups of three, and each group is given an endowment (X_3 = 4500 SEK) of which they can invest any amount ($0 \leq x_3 \leq 4500$). Group members must discuss and together reach a decision on how much to invest; this decision then applies to all members of the group. The numbers of the investment decision are identical to Round 2 and are graphically represented by Figure 3. Again any successful investment ($2.5x_3$) and any retained endowment ($X_3 - x_3$) must be shared equally between the three group members.

This round first allows us to test Hypothesis 3: *Investment decisions that are commonly reached by a group of subjects are lower in the level of risk as the share of females in the group increase.* By categorising groups that subjects are assigned to in terms of the number of females in the group we can determine whether groups with relatively more females take less risk in financial investments. Furthermore we use results from Round 1 and Round 2 to test Hypothesis 3.1: *The fact that females are more risk-averse than males fully explains why groups with a larger share of females take less risk in financial investments.* At this stage Round 1 and Round 2 act as controls for individual and social risk preferences respectively. Using these controls will help us determine whether there are any other gender aspects apart from individual and social risk preferences affecting differences in risk taking between groups. Round 3 will further be used to study whether groups take more risk than individuals.

Round 4

In Round 4 subjects leave their group and return to making an individual investment decision identical to the Round 1 decision. They are given an endowment of X_4 = 1500 SEK and they can invest $0 \leq x_4 \leq 1500$. First, the results from this round and from Rounds 1 and 3 will be used to test Hypothesis 4: *Groups take the same amount of risk in investment decisions as do individuals independent of the share of females in the group.* Round 4 is necessary when testing this hypothesis in order to control for any trend in investments across rounds. Second, results from this round and Rounds 1 and 2 will be used to test Hypothesis 5: *After interacting with a group, subjects' risk preferences are affected in the direction of their group members' risk preferences,* and Hypothesis 5.1: *There is no systematic difference in the size of peer effects between male and female subjects.* In order to test these hypotheses we will make use of the fact that the risk preferences that an individual's two group members bring into Round 3 are exogenous to that individual's Round 4 decision.

4.1.4 Group Size

Given we are constrained by the amount of observations we can collect, increasing the number of group types reduces the number of observations in each for each type and the power of our tests. Based on projections for an achievable amount of subjects we decide to experiment on groups of three. This yields four possible group types based on gender composition:- three females, two females & one male, one female & two males, three males. The other option considered was groups of four. This would have added a group with equal gender distribution (two females and two males) to the analysis. Whilst this group is interesting enough for study the desire for power in testing make us settle on groups of three. In future we distinguish between group types by the number of females in the group {3; 2; 1; 0}.

4.1.5 Stake Size and Payment Mechanism

It is important to design the payment mechanism in such a way that subjects have the incentive to display their true preferences throughout the experiment. In the style of Apicella et al. (2008) we use a lottery whereby three subjects from the experiment are drawn to receive real payment. This reduces subjects' expected payoff from each decision considerably which could affect their motivation (Holt & Laury, 2002). They should however have the incentive to behave in a manner that is consistent with their risk preferences. A review of papers using random payment schemes by Camerer & Hogarth (1999) conclude that typically there is no change on average when making risky choices based on hypothetical and real stakes, however the variance seems to be larger when using hypothetical stakes. We also use a random lottery selection procedure to choose one out of the four rounds for real payment. An attraction of this procedure is that it allows one to collect more data at a lower cost, compare subjects' responses in several tasks and avoid wealth effects (from paying subjects in each round) (Starmer & Sudgen, 1991).

The investment decision is essentially the same in all four rounds and there is an equal chance for any round to be chosen for real payment. This means subjects have equal incentives to behave in a true fashion for each round in the experiment. The lottery is conducted after all subjects have taken part in the experiment so that they all had the same chance of winning.

A fixed experimental budget necessitates a trade-off between the size of the prize on offer from the investment decision and the chance of the decision being chosen in the lottery.[2] The goal is to elicit the risk preferences subjects would display if they actually faced this decision with certainty. Our concern is that when stakes are small, subjects that are maximising their utility may essentially be risk-neutral (Rabin, 2000). If the majority of subjects act in a risk-neutral manner under small stakes there would be very little variation in our data. To counter this we consider the value of using a large 'potential' prize.

[2]As an illustrative example suppose 300 people participate in the experiment. If the endowment is set at 1500 SEK per person then we are able to pay 3 people. This means there is a 1 per cent chance that a subject will be drawn and that their decisions will actually matter; there is a 0.5 per cent chance that they will win and a 0.5 per cent chance they will lose the investment. Instead suppose the endowment is set at 150 SEK per person, then 30 people could receive real payment. This means that there is a 10 per cent chance that one of a subject's decisions will actually matter; 5 per cent that their investment will be successful and 5 per cent that it will not.

The argument in favour of a large potential prize is that subjects focus on this amount rather than the probability of actually winning. The stakes seem large so subjects are motivated to display their true risk preferences. This argument rests on the assumptions that hypothetical large stakes can have the same effect as actual large stakes in financial investment, and that large stakes drive individuals to display their true risk preferences. As stated above this may be true when studying risky choices (Camerer & Hogarth, 1999). The argument for higher probability of the decision being chosen is that the subject will realise that their decision is actually more likely to matter and so they behave like they would if they actually face this decision. We favour a higher potential prize and lower probability of winning in order to elicit the subjects' risk preferences.

4.2 Procedure

The experiment proceeded in three distinct phases:- subject recruitment, the experimental sessions and the payment lottery.

4.2.1 Subject Recruitment

It was the intention to gather data on 200-300 subjects at the outset of this experiment. The main method of recruitment was a general email to the student population at Stockholm School of Economics (SSE). Students that read the email were given basic information about the experiment and the potential gains on offer. They were directed to a website where they could learn more about the experiment and sign up should they be interested. The general emails were complemented by postings on social network sites for SSE, the Royal Institute of Technology and Stockholm University. These postings, providing as a hook the same information contained in the general emails, also directed those interested in participating to the website.

Once on the website potential subjects were asked to fill out a form. In this form they self-reported their email address, telephone number, age, gender, the institution they attended and the times that they were available to participate. In all, 389 individuals registered to participate in the experiment. Subjects were randomly assigned to experimental sessions. There were 30 experimental sessions in total, and they were run primarily at SSE (24) and latterly at Stockholm University Library (6). When at SSE it was the intention to have 15 individuals participate in each session. Given a drop out of registered participants of around 30 per cent this was not always possible. Space constraints at the Stockholm University Library meant the maximum number that could participate in any session was 9. Subjects were informed by email of the session they had been assigned to. They were also reminded by email and SMS (if they had disclosed their number) on the morning of the session.

In summary 279 subjects participated in our experiment. Of these 52 per cent were male and 48 per cent were female. The mean age of subjects was 23.4 years (min 18; max 33). The majority of subjects (71 per cent) were recruited from the Stockholm School of Economics (SSE), 24 per cent came from Stockholm University and the remaining 5 per cent came from either the Royal Institute of Technology or the Karolinska Institute. To get an indication of the representativeness of the sample we compared subjects from SSE to the overall student population at SSE. The gender distribution of the SSE student population as a whole is 43 per cent females and 57 per cent males, compared to 45 per cent and 55 per cent respectively in our sample. The mean age at SSE is 23.0 years (SCB, 2009), compared to 23.3 years in our

sample. Furthermore our sample on individual level is relatively large, and we are able to replicate results on gender differences in risk taking from previous studies. As we will show in the *Results* section, students at SSE do not behave significantly different to non-SSE students in terms of individual risk preferences. If one believes that there is no difference in risk preferences between business school students (in our case SSE) and students in general we are confident that our sample is representative of the student population in Stockholm at large. However if there is reason to doubt this result we can only state that our sample is representative of business students in Stockholm, as the majority of our sample consists of SSE-students. We will return to this issue in the Discussion section of this thesis.

4.2.2 Experimental Sessions

When at SSE subjects were directed to a large lecture theatre. On arrival at the experiment subjects were asked their email address, they were then issued with an identification (ID) number and asked to take a seat and read through the experimental overview sheet (See Appendix A: General information about the experiment). The ID number – that they were instructed to write at the top of each decision sheet – was matched with their email address and other reported information. Once all subjects were in place the experimental overview sheet that each subject had in front of them was read out loud by one of the experimenters. Reading the instructions out loud emphasised that the 4 rounds in the experiment were independent of one another and that they should be approached as such. It also allowed the experimenters to explain the nature of the lottery more clearly. [3] The subjects were not aware of the design for any round before they received the instruction sheet for that round.

After the overview was read out loud subjects were issued with the Round 1 decision form (see Appendix A: Round 1). They were reminded that this decision was to be made individually and that speaking between subjects was not permitted. The decision sheet gave ample instruction about the nature of the decision to be made. It was accompanied by a table showing the potential outcomes of various investments (see Appendix A: Table 1). The Round 1 decision forms were folded and placed in a tray at the front of the lecture theatre. At the same time subjects were issued with the Round 2 decision forms. Again subjects were informed it was an individual decision round and that speaking was not permitted. The Round 2 decision form explained in detail the nature of the decision to be made and was accompanied by a table to ease understanding (see Appendix A: Round 2 and Table 2).

After each subject was finished with Round 2 they were informed that they would be divided into groups of three. The groups were randomly decided by placing all the ID numbers attending the session into a hat, these were then drawn out in batches of three. The groups of three were then led away to separate, private rooms where they found instructions for Round 3. Groups were placed in private rooms so that between-group communication could not occur. It was often the case that the number of subjects in a session was not divisible by 3. When this occurred the person(s) left over after the whole groups had been drawn were informed that they could not take part in Round 3 and that their Round 2 decision would apply to Round 3 should it be drawn in the lottery. They were then given the Round 4 decision sheet and performed this round while the groups made their decisions. During this

[3] Subjects did not know the exact probability that their decision will be chosen in the lottery however they are informed that between 200-300 people will take part in the experiment and that three people would be chosen to face a real decision from one of the four rounds.

time the Round 2 decision sheets were collected, folded and placed in the tray at the front of the lecture theatre.

When the groups entered the private rooms they found a table, three chairs and a single decision form with an attached table (see Appendix A: Round 3 and Table 3). They were instructed to read the instructions on the form, place all three of their ID numbers on the form and return to the lecture theatre once the decision had been made. The door was then closed and the groups were left in privacy for as long as necessary for them to reach a decision. When they returned to the lecture theatre the Round 4 decision forms were waiting at their respective places.

When they entered the lecture theatre subjects were informed that Round 4 was the final round, and that it was an individual decision round to be completed without talking. The decision form – that was identical to Round 1 – explained the decision to be made and was accompanied by a table to ease understanding (see Appendix A: Round 4 and Table 4). Once the subject had made their decision they came to the front, handed in their Round 4 decision sheet and collected a 50 SEK participation fee. They were then informed that their participation in the experiment had concluded. One experimental session lasted for approximately 30 minutes.

4.2.3 The Payment Lottery

After all experimental sessions had been run every subject was emailed inviting them to witness the live draw that would decide who would receive real payment. On March 12th at 12:15 the draw for the winners was made at SSE.

First and foremost it would be decided which round out of the 4 real payment would be based on. This was done by drawing numbers from a hat. If Round 1 was chosen then three separate individuals would then be drawn to receive payment based on their decisions in Round 1. If Round 2 was drawn then one subject would be drawn to receive payment based on their decisions in Round 2. A further two subjects would then be drawn to receive payment based on what the first person had decided. If Round 3 was drawn then one group would be drawn to receive payment based on their group decision. Should Round 4 be drawn then three separate subjects would be drawn for real payment. It transpired that Round 4 was drawn from the hat. Once the three winners had been drawn a coin was tossed to decide the result of the investment; the coin landed heads meaning that the amount invested ($x_{4,i}$) was multiplied by 2.5 and added to the amount not invested ($X_{4,i} - x_{4,i}$). The three subjects received ($X_{4,i} - x_{4,i}$) + ($2.5x_{4,i}$) SEK in cash. The end of the lottery concluded the experiment.

5 Results

In this section we report the findings from our experiment. We start by presenting descriptive statistics on investments in each round of the experiment. This is followed by statistical analysis structured around our research hypotheses. In order to make rounds comparable we report investments as a share of endowment given in each round.

5.1 Descriptive Statistics

Round 1

In Table 1 below we can see that the mean individual investment for females in our sample is 49.2 per cent, and 65.7 per cent for males. Looking closer into the distribution of Round 1 investments in Figures 4, we see that the modal investment for males is 100.0 per cent (1500 SEK) while it is 33.3 per cent (500 SEK) for females. Overall the modal investment in Round 1 is 100.0 per cent (1500 SEK).

Table 1: Individual Investment Decisions – Round 1

	Median	Mean	St. Dev.
All	0.533	0.573	0.271
Male	0.667	0.645	0.285
Female	0.467	0.497	0.232

Number of observations: 279

Round 2

The mean and median of social investment decisions in Round 2 are similar to the individual investment decisions from Round 1 (see Table 2 below). We note however that the modal investments have changed for females and for the sample as a whole, from 33.3 per cent to 66.7 per cent (Figure 5) and from 100.0 per cent to 66.7 per cent respectively (Figure 5). The modal investment for males is the same as in Round 1; 100.0 per cent (Figure 5).

Table 2: Social Investment Decisions – Round 2

	Mean Investment	
	Individual Decision	Social Decision
All	0.573	0.562
Male	0.645	0.641
Female	0.497	0.478

Number of observations: 279

Round 3

The mean of group investments seem to be decreasing with the number of females in the group as can be seen in Table 3 below. When breaking down the investment distributions by the share of females, it is apparent that a greater proportion of the all-male groups invest the maximum amount relative to the other groups (Figure 6). The modal investment across all group types is the same as in Round 2 (66.7 per cent) (Figure 6).

Table 3: Group Investment Decisions – Round 3

	Median	Mean	St. Dev.	Obs.
All groups	0.667	0.604	0.268	85
Groups with 0 females	0.667	0.725	0.221	17
Groups with 1 female	0.667	0.633	0.247	30
Groups with 2 females	0.511	0.516	0.343	21
Groups with 3 females	0.600	0.541	0.201	17

Round 4

In Table 4 we can see that the mean of individual investment decisions after group interaction is 66.5 per cent and 48.1 per cent for males and females respectively. These are similar to mean of individual investment decisions before group interaction (see Table 1). The modal investments in Round 4 are 66.7 per cent for all subjects, 100.0 per cent for males and 33.3 per cent for females (Figure 7).

Table 4: Individual Investment Decision – Round 4

	Median	Mean	St. Dev.
All	0.533	0.571	0.289
Male	0.667	0.655	0.288
Female	0.467	0.481	0.263

Number of observations: 255 (subjects who were in a group of less than three are excluded)

Figure 4: Distribution of Individual Investment Decisions – Round 1

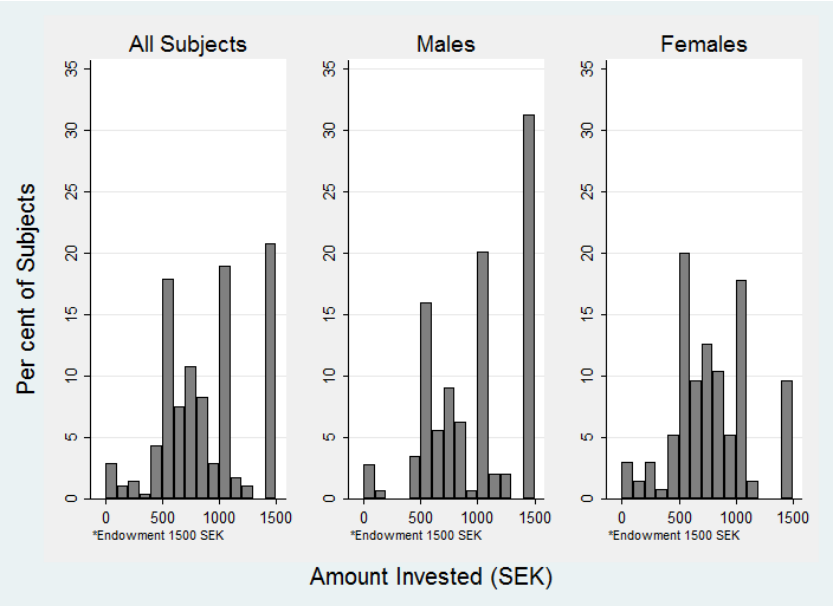


Figure 5: Distribution of Social Investment Decisions – Round 2

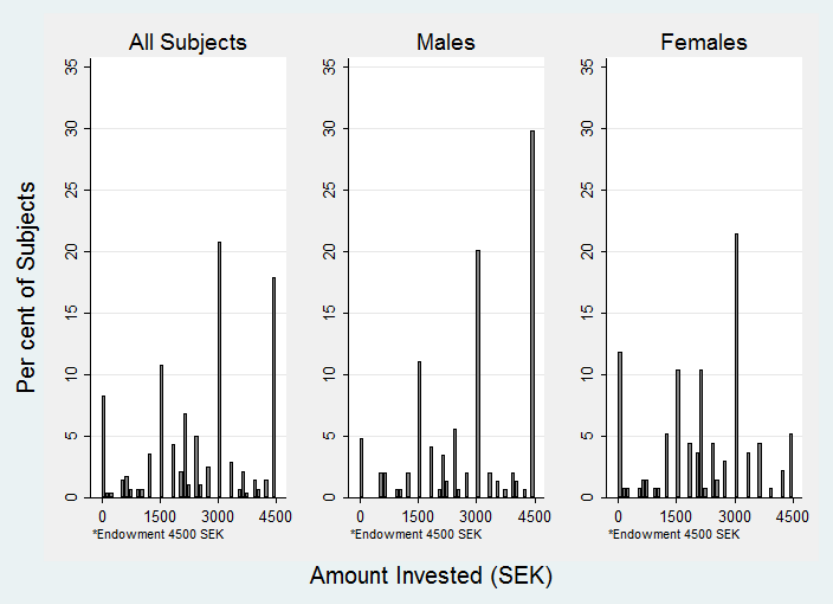


Figure 6: Distribution of Group Investment Decisions – Round 3

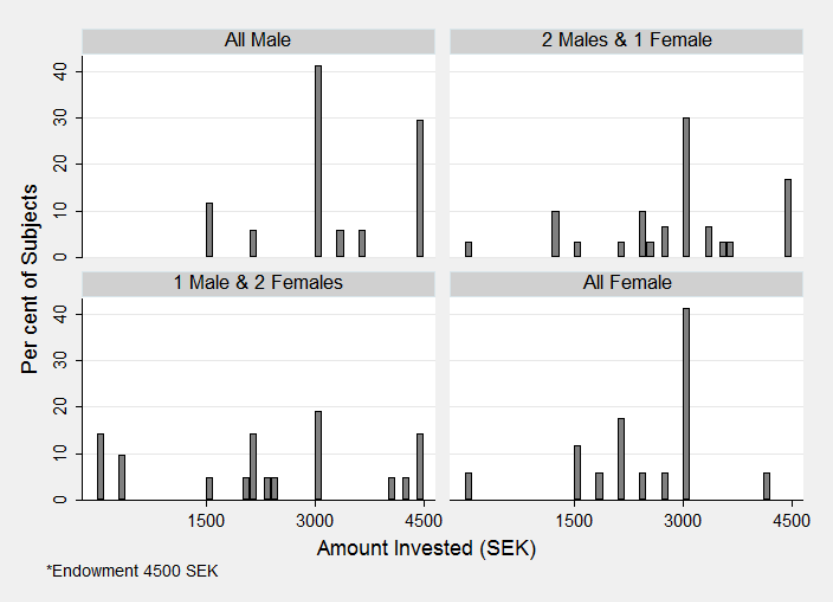
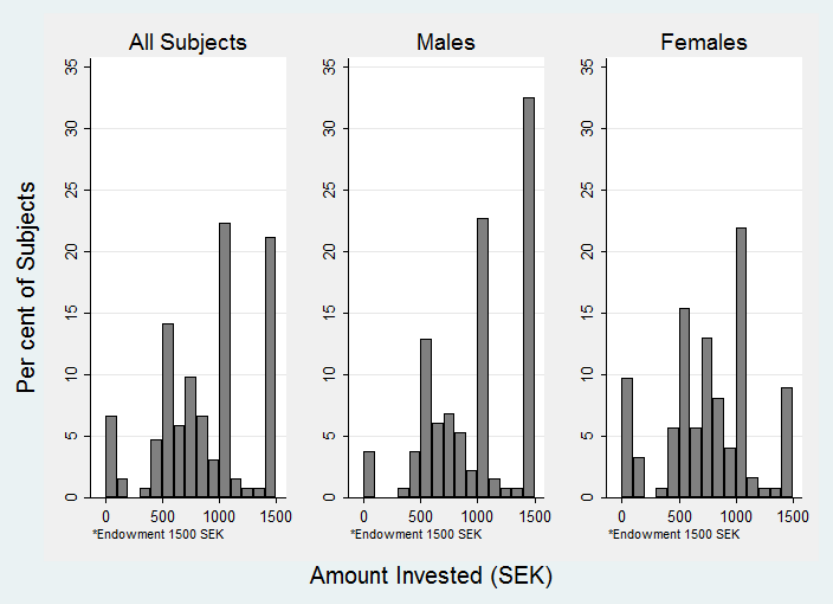


Figure 7: Distribution of Individual Investment Decisions – Round 4



5.2 Statistical Analysis

Hypothesis 1: *Female subjects take less risk in individual investment decisions than male subjects.*

To test Hypothesis 1 we use an independent sample t-test to assess whether mean individual investments for male and female subjects in Round 1 are significantly different from each other. As our data is not normally distributed we also report the results from a Wilcoxon-Mann-Whitney test, a non-parametric alternative to the t-test that compares medians instead of means.[4] The results of these tests can be seen in Table 5 below. Individual investments in Round 1 are estimated by both the t-test and the Wilcoxon-Mann-Whitney test to be significantly different for male and female subjects.

Table 5: Gender Differences in Individual Investment Decisions – Comparison of Means

	H_0: Round1(j)=Round1(k) j=male subjects, k=female subjects H_a: Round1(j)≠Round1(k) j=male subjects, k=female subjects				
	Mean Round1(j)	Mean Round1(k)	Obs.	T-statistic[1]	Wilcoxon-Mann-Whitney[2]
j = male subjects, k = female subjects	0.645	0.497	279	4.750 (0.000)	4.375 (0.000)

1) Two independent samples t-test, p-value in parenthesis

2) Two-sample Wilcoxon rank-sum (Mann-Whitney), p-value in parenthesis

[4] A Shapiro-Wilk test rejects the null hypothesis that the population is normally distributed (z = 4.132, p-value = 0.00).

In addition to the t-test and Wilcoxon-Mann-Whitney test we use OLS to regress individual investments in Round 1 on FEMALE (a dummy that equals 1 if the subject is female) and add the controls SSE (a dummy that equals 1 if the subject attends Stockholm School of Economics) and AGE (which specifies the age of the subject). If females are more or less likely to attend SSE, and if attending SSE is correlated with risk preferences, the estimated gender difference will be biased. In the same manner this result will be biased if females in our sample differ from males in age, and if age is correlated with risk preferences. As an overview, there is a significant gender difference across all regressions conducted. The point estimate on FEMALE in Model 1 (Table 6) suggests that a female invests 14.8 p.p. less than a male on average. Adding SSE and AGE as controls does not have an effect on the estimated gender difference in risk preferences. A complete list of the variables used across all regressions in this section can be found in Appendix C.

Table 6: Gender Differences in Individual Investment Decisions – OLS

	Coefficients		
Dependent Variable: Round 1	MODEL 1	MODEL 2	MODEL 3
FEMALE	-0.148***	-0.148***	-0.147***
	(0.0311)	(0.0311)	(0.0311)
SSE		0.00453	0.00692
		(0.0319)	(0.0320)
AGE			0.00810
			(0.00579)
CONSTANT	0.645***	0.642***	0.450***
	(0.0238)	(0.0316)	(0.141)
OBSERVATIONS	279	279	279
R^2	0.075	0.075	0.082
ADJUSTED R^2	0.0720	0.0687	0.0715

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In parallel to literature using the Gneezy & Potters (1997) investment decision (e.g. Apicella et al, 2008) we also estimate Tobit regressions as a robustness check to OLS. In our experiment we use investment decisions as a measure for risk preferences, but as mentioned in the Experimental Design section all risk-loving and risk-neutral subjects should invest the maximum amount. These subjects are constrained from demonstrating their full appetite for risk taking by the nature of the investment decision. Tobit estimations assume that the sample distribution is censored (in our case by the upper limit 1500 SEK and the lower limit 0 SEK), and that there is an underlying latent variable that is continuously distributed over positive values, (Wooldridge, 2009). In other words, we cannot observe the range of risk preferences of subjects who invested the maximum or minimum amount. The Tobit regressions made for this and other rounds are all placed in the Appendix for reference (see Appendix B – Additional Statistics). Results from the Tobit regressions (Appendix B: Table 13) to test

Hypothesis 1 are consistent with OLS; the estimated effect of being female on risk preferences is stable across all models.

Finding 1: *We cannot reject Hypothesis 1 - female subjects take less risk in individual investment decisions than male subjects.*

Hypothesis 2: *On average, there is no change in the amount of risk taken neither by male nor female subjects when investing on behalf of a group including themselves.*

To test Hypothesis 2 we use paired t-tests and Wilcoxon signed rank sum tests to ask whether individual investments (Round 1) are significantly different on average from social investments (Round 2), both at an aggregate level and for male and female subjects separately. These tests compare two observations for the same individual rather than between independent groups of individuals as above.

Table 7 below reports the outcomes of the two tests. The t-test and the Wilcoxon test give the same result; the null hypothesis that Round 1 investments are equal to Round 2 investments cannot be rejected. This result also holds when performing the same tests for male and female subjects separately.

Finding 2: *We cannot reject Hypothesis 2 – there is no change in the amount of risk taken neither by male nor female subjects when investing on behalf of a group including themselves.*

Table 7: Social vs. Individual Investment Decisions – Comparison of Means

	Mean Round 1	Mean Round 2	Obs.	T-statistic[1]	Wilcoxon[2]
All	0.573	0.562	279	0.724 (0.470)	-0.877 (0.381)
Male	0.645	0.641	144	0.187 (0.852)	-0.808 (0.419)
Female	0.497	0.478	135	0.856 (0.394)	-0.361 (0.718)

1) Paired t-test, p-value in parenthesis

2) Wilcoxon signed rank sum test, p-value in parenthesis

Hypothesis 3: *Investment decisions that are commonly reached by a group of subjects are lower in the level of risk as the share of females in the group increase.*

By categorising groups in Round 3 by the number of females in the group we can treat them as independent samples. To test Hypothesis 3 we begin by conducting a one-way ANOVA test and a Kruskal-Wallis test of whether the number of females as a whole has an effect on how much risk a group takes. The one-way ANOVA test is used to compare whether the means of two or more independent samples are the same (the independent t-test is a special case of the one-way ANOVA and the Kruskal-Wallis test is the non-parametric equivalent of the one-way ANOVA). As can be seen in Table 8 below the group type (i.e. share of females

in the group) has a significant effect on how much the group invests in Round 3 at the 10 per cent level.

Table 8: Gender Effects in Group Investment Decisions – Comparison of Means

H_0: Round3(j)=Round3(k), j≠k for all j H_a: Round3(j)≠Round3(k), j≠k for at least one j			
	Obs.	ANOVA[1]	Kruskal-Wallis[2]
Group Type	85	2.45 (0.069)	7.595 (0.055)

1) One-way ANOVA F-statistic, p-value in parenthesis

2) Kruskal Wallis chi-squared, p-value in parenthesis

To estimate the size of these effects we run OLS regressions where the dependent variable is the group investment in Round 3 and key independent variables are the number of females in the group. The dummy 1FEMALE is equal to 1 if the group consists of one female and two males, 2FEMALES is equal to 1 if the group consists of two females and one male, and 3FEMALES is equal to 1 if the group consists of three females. We use the all-male group as baseline.

Point estimates in Model 1 (Table 9) suggest that substituting one male in the all-male group for a female yields a 9.2 p.p. decrease in share of endowment invested. Adding yet another female yields a 20.9 p.p. decrease in investments compared to the all-male group, and substituting all males for females yields an 18.4 p.p. decrease in investments. The coefficient on 1FEMALE is not significantly different from 0 but its sign and magnitude are suggestive. We remark however that we have not estimated a linear trend between the share of females in a group and the risk taking in financial investments.

The regressions give us an indication of whether groups with at least one female are significantly different from the all-male group, however they say nothing of differences between the groups with at least one female. In order to get information about whether there are significant differences across other group types as well we conduct a Wald test, which is a test of whether point estimates in a regression are significantly different from each other (Wooldridge, 2009). As can be seen in Table 9 none of the mean investments in groups with one to three females are significantly different from each other. However the statistical power of these Wald tests suffers due to a small number of observations.

Finding 3: *We cannot reject Hypothesis 3 – investment decisions that are commonly reached by a group of subjects are lower in the level of risk as the share of females in the group increase.*

Hypothesis 3.1: *The fact that females are more risk-averse than males fully explains why groups with a larger share of females take less risk in financial investments.*

To investigate Hypothesis 3.1, we include a number of controls that reflect individual risk preferences to Model 1 above (Table 10). If we estimate a significant effect for 1FEMALE, 2FEMALES or 3FEMALES after controlling for individual risk preferences then the fact that groups with more females take less risk is not fully explained by gender differences in

individual risk preferences. As measures for individual risk preferences we use AVG_ROUND1 and AVG_ROUND2 which are the average of the group members' Round 1 investments and the average of the group members' Round 2 investments respectively. Initially Round 2 was supposed to act as a control for social risk preferences, but as we find no evidence for a change in the amount of risk taken between individual and social investment decisions we can treat investment decisions in Round 2 as an additional measure for individual risk preferences. We expect some noise in our data which implies that AVG_ROUND1 and AVG_ROUND2 will contain some measurement error. We can seek to reduce this measurement error by taking the average of AVG_ROUND1 and AVG_ROUND2 as an additional measure for individual risk preferences. This variable which we denote AVG_ROUND12 may be more robust than AVG_ROUND1 and AVG_ROUND2 separately.

Models 2, 3 and 4 (Table 9) control for AVG_ROUND1, AVG_ROUND2 and AVG_ROUND12 respectively. In all models the coefficients on these variables are positive and highly significant. If the subjects in a group have taken more risk-averse individual decisions on average then the group is also likely to take a more risk-averse decision and vice-versa. A comparison of the adjusted R^2 for these models suggests that the measure AVG_ROUND12 takes account of more relevant information than the other two variables. As an illustration the estimated effect of AVG_ROUND12 tells us that a 1 p.p. increase in the average of individual decision over Rounds 1 and 2 leads to a 0.9 p.p. increase in the group decision. In general the magnitudes of the coefficients on AVG_ROUND1, AVG_ROUND2 and AVG_ROUND12 are relatively high. This is indicative of strong relationship between individual and group decisions.

After controlling for average individual risk preferences, the point estimates for 1FEMALE, 2FEMALES and 3FEMALES all decrease relative to Model 1 and turn insignificant (Table 9). The Tobit estimations are consistent with the OLS coefficients in terms of sign and significance (Appendix B: Table 14). To increase the statistical power we also run the same set of regressions as in Table 9 where we pool group types according to the majority gender in the group. These regressions yield the same results, and can be found in Appendix B: Table 15 & Table 16.

As stated in Finding 3 above – less risk is taken by groups with more females. However the effect of gender composition is not significant when we control for individual risk preferences. We thus find no evidence that differences in group investment decisions between groups with different numbers of females is explained by anything other than differences in individual risk preferences.

Finding 3.1: *We cannot reject Hypothesis 3.1 – the fact that females are more risk-averse than males fully explains why groups with a larger share of females take less risk in financial investments.*

Table 9: Gender Effects in Group Investment Decisions – OLS

	Coefficients			
Dependent Variable: Round 3	MODEL 1	MODEL 2	MODEL 3	MODEL 4
1FEMALE	-0.092	-0.010	-0.064	-0.027
	(0.070)	(0.049)	(0.064)	(0.053)
2FEMALES	-0.209**	-0.091	-0.147	-0.101
	(0.092)	(0.085)	(0.094)	(0.087)
3FEMALES	-0.184**	-0.017	-0.07	-0.013
	(0.073)	(0.084)	(0.093)	(0.089)
AVG_ROUND1		0.832***		
		(0.164)		
AVG_ROUND2			0.653***	
			(0.185)	
AVG_ROUND12				0.907***
				(0.174)
CONSTANT	0.725***	0.154	0.312**	0.127
	-0.053	-0.121	(0.141)	(0.126)
OBSERVATIONS	85	85	85	85
R^2	0.084	0.299	0.246	0.313
ADJUSTED R^2	0.050	0.263	0.208	0.279
Wald Test				
H_0	p-values			
1FEMALE = 2FEMALES	0.184	0.307	0.300	0.343
1FEMALE = 3FEMALES	0.172	0.926	0.934	0.849
2FEMALES = 3FEMALES	0.784	0.437	0.413	0.355

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Hypothesis 4: *Groups take the same amount of risk in investment decisions as do individuals independent of the share of females in the group.*

To test Hypothesis 4 we use paired t-tests and Wilcoxon signed rank sum tests of whether the mean group investment in Round 3 is significantly different from the mean individual investments in Round 1 and Round 4. Round 4 is included to control for any trend in investments across rounds. We also include a comparison to a composite of Round 1 and Round 4, as it may serve as a less noisy measure of individual behaviour. These are denoted AVG_ROUND1, AVG_ROUND4 and AVG_ROUND14 in Tables 10 & 11 below. The Wilcoxon test estimates a significant difference between group investments and individual investments in all three cases, whereas the t-statistic does not estimate any significant differences.

From these results we can only conclude that there is a tendency for groups to take more risk than individuals. However, this result is not robust, as such we stress that this tendency is interpreted with caution.

Table 10: Group vs. Individual Investment Decisions – Comparison of Means

H_0: Round 3 = Round (i) H_a: Round 3 ≠ Round (i)					
(i)	Mean Round 3	Mean Round (i)	Obs.	T-statistic[1]	Wilcoxon[2]
AVG_ROUND1	0.604	0.576	85	1.150	1.861
				(0.253)	(0.063)
AVG_ROUND4	0.604	0.571	85	1.604	2.171
				(0.112)	(0.030)
AVG_ROUND14	0.604	0.573	85	1.429	2.202
				(0.157)	(0.028)

1) Paired t-test, p-value in parenthesis

2) Wilcoxon signed rank sum test, p-value in parenthesis

A one-way ANOVA test and a Kruskal-Wallis test are conducted to see whether the share of females in a group has as an effect on the difference between individual and group decisions. We conclude that this is not the case, as none of the tests yield significant results (Table 11).[5] The evidence presented leads us to cautiously conclude that there is a tendency for groups to invest more than individuals and that this is independent of the share of females in the group.

Finding 4: *We reject research Hypothesis 4 – that groups take the same amount of risk in investment decisions as do individuals independent of the share of females in the group – in favour of the alternative that there is a tendency for groups to take more risk than individuals in investment decisions independent of the share of females in the group.*

Table 11: Group vs. Individual Investment Decisions by Group Type – Comparison of Means

H_0: [Round 3 - Round(i)](j) = [Round 3 - Round(i)](k) j≠k for all j[1] H_a: [Round 3 - Round(i)](j) ≠ [Round 3 - Round(i)](k) j≠k for at least one j[1]			
(i)	Obs.	ANOVA[2]	Kruskal-Wallis[3]
AVG_ROUND1	85	0.57 (0.638)	1.001 (0.801)
AVG_ROUND4	85	1.44(0.239)	4.26(0.235)
AVG_ROUND14	85	0.91(0.440)	2.48(0,477)

1) Where j and k denote group type.
2) One-way ANOVA F-statistic, p-value in parenthesis.
3) Kruskal Wallis chi-squared, p-value in parenthesis.

Hypothesis 5: *After interacting with a group, subjects' risk preferences are affected in the direction of their group members' risk preferences.*

In order to test Hypothesis 5 we run OLS regressions of a subject's Round 4 investment on the risk preferences of their group members. As each subject in our experiment is randomly allocated into groups they are also randomly assigned two other group members. Given the

[5] Those interested in a comparison of the differences in individual and group decisions broken down by group type are referred to Table 17 in the Appendix B.

random assignment we can treat the group members' Round 1 and Round 2 investments as exogenous to a subject's Round 4 decision. Specifically, we can regress the average of the two group members' investments in Round 1 (PEER_ROUND1) and Round 2 (PEER_ROUND2) respectively on a subject's Round 4 investment. In the same manner as earlier we have also included a measure that is the average of PEER_ROUND1 and PEER_ROUND2 called PEER_ROUND12 in order to obtain a measure that might be more akin to the group members' true preferences.[6]

All measures of peer preferences are estimated to have a positive and significant effect on a subject's individual investment in Round 4 (Model 1, 3 and 5 in Table 12). As an example, the interpretation of the coefficient for PEER_ROUND1 is as follows; if the average of a subject's fellow group members' decisions from Round 1 increases by 1 p.p. then the subject will increase their Round 4 decision by 0.29 p.p. These results suggest a peer effect in risk preferences after the group interaction.

Finding 5: *We cannot reject Hypothesis 5 – after interacting with a group, subjects' risk preferences are affected in the direction of their group members' risk preferences.*

Hypothesis 5.1: *There is no systematic difference in the size of peer effects between male and female subjects.*

To evaluate Hypothesis 5.1 we add the control variables FEM_PEER_ROUND1, FEM_PEER_ROUND2 and FEM_PEER_ROUND12 to the regressions above. These controls are respective interactions between FEMALE and PEER_ROUND1, PEER_ROUND2 and PEER_ROUND12. Adding these interactions changes the interpretation of the coefficients for the above variables as they now measure the peer effect for males only. When we control for female interactions the magnitude of the peer effects measured by PEER_ROUND1, PEER_ROUND2 and PEER_ROUND12 increase suggesting that we underestimated the peer effect for male subjects in Models 1, 3 and 5. PEER_ROUND1 and PEER_ROUND12 remain significant in Models 2, 4 and 6 while PEER_ROUND2 turn insignificant.

The interaction variables FEM_PEER_ROUND1, FEM_PEER_ROUND2 and FEM_PEER_ROUND12 all have negative signs however only FEM_PEER_ROUND1 is significant. As an example, taken together with PEER_ROUND1 the coefficient on FEM_PEER_ROUND1 suggests that if the average of a female subject's fellow group members' decisions from Round 1 increases by 1 p.p. then she will increase her Round 4 decision by 0.09 p.p. (=0.433-0.343), while a male subject would increase his Round 4 investment by 0.43 p.p. We must be cautious in suggesting that a gender difference in peer effects exists however. Such a difference is not robust to different measures of peer preferences. The estimated coefficients from the Tobit regressions conform to the OLS results in terms of sign and significance for all variables of interest (see Appendix B: Table 18). Together, the evidence provides an indication of smaller peer effects for females however it is not strong enough for us to draw any conclusions upon.

Finding 5.1: *We cannot reject research hypothesis H5.1 – there is no difference in the size of peer effects between males and females.*

[6] To check the random assignment we regressed PEER_ROUND1, PEER_ROUND2 and PEER_ROUND12 on subject i's Round 1 and Round 2 decisions. None of the variables have a significant relationship with Round 1 or Round 2 decisions.

Table 12: Peer Effects in Individual Investment Decisions After Group Interaction – OLS

	Coefficients					
Dependent Variable: Round 4	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
PEER_ROUND1	0.290***	0.433***				
	(0.0883)	(0.113)				
FEM_PEER_ROUND1		-0.343*				
		(0.182)				
PEER_ROUND2			0.137*	0.148		
			(0.0808)	(0.111)		
FEM_PEER_ROUND2				-0.0268		
				(0.162)		
PEER_ROUND12					0.253***	0.337***
					(0.0945)	(0.127)
FEM_PEER_ROUND12						-0.202
						(0.194)
FEMALE	-0.156***	0.0396	-0.167***	-0.152	-0.160***	-0.0463
	(0.0343)	(0.111)	(0.0350)	(0.0951)	(0.0348)	(0.114)
CONSTANT	0.479***	0.392***	0.575***	0.569***	0.505***	0.455***
	(0.0591)	(0.0738)	(0.0545)	(0.0712)	(0.0621)	(0.0808)
OBSERVATIONS	255	255	255	255	255	255
R^2	0.128	0.140	0.100	0.100	0.116	0.120
ADJUSTED R^2	0.121	0.130	0.0931	0.0895	0.109	0.109

Robust standard errors in parentheses;
*** p<0.01, ** p<0.05, * p<0.1

6 Discussion

We will begin this section by answering the research questions formulated in the introduction and discussing how our findings relate to the literature around these research questions. We then go on to discuss potential weaknesses with and implications of our study. This section is rounded off with suggestions for further research.

First, we find that females take less risk than males in individual financial investments. The magnitude of this gender difference is 14.8 p.p., which is in line with other studies that use the same investment decision as we do. Charness & Gneezy (2012) report that previous studies have shown gender differences in this direction ranging between 12.5 p.p. and 32.0 p.p. The results in this study should not be interpreted as reflective of risk preferences in general, as we specifically investigate risk taking in financial investments. As Moore & Eckel (2003) argue, females might be more risk-averse in these settings but not necessarily when decisions are framed so as to elicit the loss domain rather than the gain domain.

Second, we find no evidence that individuals on average change the amount of risk they take when they are making financial investment decisions on behalf of a group including themselves. This is in line with Harrison et al. (2013) who also study groups of three, but who use a *lottery choice* in order to elicit risk preferences. Sutter's (2009) design is more similar to ours. In addition to studying groups of three he uses the same investment decision as we do. In contrast to us he finds that individuals take more risk when investing on behalf of a group, we however believe that this result relies on the fact that preferences of the other group members are communicated to the decision maker. In comparison to Harrison et al. (2013) and Sutter (2009) we furthermore show that our result is independent of gender.

A potential explanation to the finding that individual risk preferences seem to coincide with social risk preferences, provided by Harrison et al. (2013), is that any social preferences are dominated by the individual's financial incentives. With this in mind, an interesting comparison to our result is the study by Ertac & Gurdal (2012) who study groups of six using the same investment decision. They find evidence for less risk-taking by individuals when they invest on behalf of the whole group – perhaps this result is driven by the fact that their decision is applied to more subjects compared to our study. At the same time, there is evidence for more risk taking when investing on behalf of others when the consequences are not applied to the decision maker themselves (see Chakravarty et al., 2011). More research is needed in order to understand the role of payment commonality, group size and revealing others' preferences. Our study gives support for no average change in risk attitudes under payment commonality, anonymity of others' preferences, and when investments are made for a relatively small group. While we offer an opinion on the general effect of social risk preferences the design of our experiment is not appropriate to test altruistic risk preferences, we do not draw any conclusions in this direction.

Third, we find that groups with a larger share of females take less risk in financial investments. The differences in risk taking between groups are captured by gender differences in individual risk preferences – because females on average exhibit more risk-aversion than males, groups with more females on average take less risk. We are thus unable to support alternative explanations of gender effects in group decision making such as differences in social risk preferences, competitive preferences or identity considerations. If females had

exhibited stronger social risk preferences we would have expected them to move the group decision more to the preferences of others. This would have implied a riskier shift in investments for groups consisting of both males and females relative to other groups since males are on average less risk-averse than females. Furthermore had males been more competitive (Croson & Gneezy, 2009) and willing to get their opinion applied to the whole group (Ertac & Gurdal, 2012) we would have observed a riskier shift for groups with more males relative to other groups. Prior to carrying out the experiment we further reasoned that aspects of one's social identity, in particular gender, could have a significant impact on behaviour in a group. It was reasoned that individuals of both genders would feel a pressure to behave in line with contemporary norms (Akerlof & Kranton, 2010), e.g. males are more risk-loving than females and vice-versa. If identity considerations impact subjects' behaviour we would have observed riskier investment decisions in groups with more males and less risky investment decisions in groups with more females, controlling for individual risk preferences.

Since we cannot find differences in risk taking between groups of different gender composition not captured by individual risk preferences, we are unable to give evidential backing to any of the above explanations. However, we cannot rule out that they are important factors in group decision making in general. Had the coefficient on individual risk preferences been close to one we would have been certain that individual risk preferences fully explain group decisions, however as our fourth finding implies this is not the case.

Fourth, we find that there is a tendency for groups in general to take more risk in financial investments than individuals (significant only when using non-parametric tests). This risky shift is in accord with observations by Sutter (2009), who uses the same investment decision as we do and non-parametric tests to support his results. Furthermore, that this finding seems to be independent of the share of females in the group is supported by the previous finding that differences in investments between all-male groups and groups with more females are fully captured by individual risk preferences. When explaining the tendency of a risky shift we must also consider it in relation to the verdict that groups are less risk-averse than individuals in low risk situations (Shupp & Williams, 2008; Masclet et al., 2009; He et al, 2012). It may be the case then that subjects perceive the investment decision they make in our experiment to be low risk in relation to other situations, and as Shupp & Williams (2008) show subjects are more willing to take a gamble in low risk situations. If our design drives subjects to take more risk on average, the theory of Group Polarisation hypothesises that group discussion will move the decision in the risky direction.

To conclude our findings on group behaviour, we argue that differences in risk taking between groups of different gender compositions are explained by individual risk preferences, but that these risk preferences do not fully explain the risk taking of groups in general. In light of the finding by Zhang & Casari (2012) that extroverts are more likely to lead the group outcome, we conclude from our third and fourth finding that if this is the case in our experiment there is at least no difference between males and females in this regard.

Lastly we identify a peer effect in preferences for individuals after interacting with a group. Furthermore there is weak evidence that this effect is larger for males than for females. Looking at the effect of group interaction on individual preferences was not the main thrust of our analysis however it contributes nicely to a more rounded view of how individual risk preferences relate to the group decision making process. Our results clearly demonstrate that subjects' individual investment decisions are influenced by their fellow group members in a positive manner, i.e. they move in the direction of the others' individual investment decisions. Since we make use of the fact that the risk preferences of individuals' fellow group members

are exogenous to their investment decision post group interaction, we are able to control for any trend effects as opposed to Sutter (2009). In addition, potential trends might be less of a problem in our study since we do not pay subjects after each round and thus we avoid any wealth effects potentially causing subjects to take riskier decisions as accumulated wealth increases over rounds, as in Sutter (2009).

In the context of Manski's (2000) overview on peer effects, we are able to distinguish effects in preferences from expectations and constraints in our study. Both probabilities and choice sets are clearly stated and remained constant throughout our experiment, and thus we rule out any peer effects in expectations and constraints. Furthermore there are three potential explanations to this peer effect in preferences as outlined by Manski (2000):- endogenous, contextual and correlated interactions. As we show in this experiment that preferences do change, we find it appropriate to define preference interactions as endogenous rather than contextual, since contextual interactions imply exogenously given characteristics such as gender, age, and socioeconomic background.[7] We therefore conclude that we have identified an endogenous peer effect in preferences. We are unaware of any other economic studies that have identified such an effect.

Potential Weaknesses

As most studies using laboratory experiments, our study suffers from a relatively small number of observations. We have four independent types of groups (by gender composition) and given the amount of data collected we ended up with only 17 observations for two of the group types. Our results lack statistical power which could be remedied by more observations.

Another potential weakness in our study stems from the fact that we did not pay every subject based on their decisions. The lottery structure meant that every participant faced a low expected value for each decision made as only 1-1.5 per cent of subjects would receive real payment. This may have consequences for our result that there is a tendency for groups to take more risk in financial investments than individuals. Earlier in this discussion we posited that subjects may have interpreted our investment game to be a low risk situation making them less risk-averse on average; this is then exacerbated through Group Polarisation. As mentioned earlier in this thesis however, there is evidence in that risky decisions under hypothetical stakes do not differ from real stakes (see Camerer & Hogarth (1999)).

Another common criticism to internal validity is a potential *order effect*. This is relevant to our design given that it consisted of subjects making the same underlying decision multiple times. Subjects could learn about the experiment or become disillusioned about participating; both could affect their behaviour across rounds. However, the experiment did not take more than 30 minutes to complete and subjects received a 50 SEK show-up fee. In addition, post-experiment feedback suggested that subjects on the whole were enthused to be participating thus we do not believe that there are any order effects in our results.

Lastly, we would like to make a few general comments on extrapolation of our results. In relation to the student population as a whole, we believe that our results can be extrapolated unless we have a problem with selection into the experiment. For example that low-income students or students who enjoy participating in games are over-represented in our sample. Low-income subjects may demonstrate more risk-averse behaviour when making the

[7] We can rule out correlated interactions as an explanation since they manifest themselves already in Round 1, should they have any explanatory power to behaviour in our experiment.

investment decision, and subjects who enjoy participating in games may demonstrate less risk-averse behaviour on average. The fact that our results on gender differences in risk preferences are in line with previous research makes us inclined to believe that risk preferences demonstrated in this study can be extrapolated to the student population as a whole.

Implications

We believe the most interesting contributions of our study is the finding that group gender composition affects the level of risk taken by the group due to gender differences in individual risk preferences and the identification of a peer effect in preferences. When considering potential implications of our study we therefore focus our attention on these results.

The finding that group gender composition significantly affects the level of risk taken by the group has important implications for real groups in the economy. If it is desirable for a certain group in society to take more or less risky decisions, the gender composition of the group is something to keep in mind. However, as is generally the case with results from laboratory experiments there are some concerns around how they translate to the real world. A particular point to note in this respect is that risk preferences of those females that make it to the board room may systematically differ from the average female.

The identified peer effect in preferences has implications that transcend from the lab to the real economy. From this identified peer effect in preferences, practitioners should consider who interacts together in a group and the effect they have on one another. Homogeneity in a group may be a problem if the potential peer effects that emerge in a less homogenous group are considered valuable. More importantly, the finding that there are peer effects in preferences has implications for public policy. If this finding holds in general policy makers can trust that one can change people's behaviour by trying to alter their preferences, rather than expectations or constraints (even though we cannot draw any conclusions about the importance of these effects from our experiment). Endogenous peer effects in preferences also imply a social-multiplier effect to public policy. Policy that favourably changes the behaviour of one individual may also favourably affect the individual's peers at no extra cost.

Future Research

Several extensions to our study could make for interesting future research. The most natural is to gather more observations to delve deeper into the effects of gender composition. In addition, having identified a peer effect in preferences, we suggest future research focus on determining the importance of expectations and constraints in relation to preferences in order to further support the implications for policy makers.

7 Conclusion

The aim of this thesis was to investigate how risk preferences at the individual level translate to a group setting and to understand the role of gender in this process. To get a better understanding of this we conducted a laboratory experiment using the investment decision introduced by Gneezy & Potters (1997). From this experiment we have been able to draw

several conclusions on gender differences in group decision making. First, we find that females take less risk than males in individual financial investments. Second, we find no evidence that neither females nor males change the amount of risk they take when they are making financial investment decisions on behalf of a group including themselves. Third, we find that groups with a larger share of females take less risk in financial investments, and that this is captured by gender differences in individual risk preferences. Fourth, we find that there is a tendency for groups to take more risk in financial investments than individuals, and that this finding seems to be independent of the share of females in the group. Fifth, we identify a peer effect in preferences for individuals after interacting with a group.

Together these five findings contribute to the understanding of how individuals influence group decisions and how groups in turn influence individual decisions. Gender has a significant influence in some, but not all, aspects of this process.

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Appendix A – Experiment Information

This section contains copies of the information and material subjects were given during the course of the experiment. The information and material is presented in the order that subjects encountered them.

General information about the experiment

This experiment consists of 4 rounds. In each round you will make a decision involving money. *Every round is independent of each other. How you choose to use your money in each round will not affect your situation in the other rounds.*

There will be approximately 200-300 people participating in the same experiment as yourself. When everybody has completed the experiment (which will be sometime in March) we will randomly draw one round for real payment, and 3 people will be randomly drawn to receive real payment from this round.

So in addition to the participation fee that you will receive, you also stand a chance of winning a significant sum of money. Once all participants have taken part in the experiment we will email you inviting you to witness the draw for the 3 winners. We will also notify you by email of the results in the event that you cannot attend the session.

In each round you will be given a sheet of paper with instructions for that round. Please take care to write your identification number on each sheet of paper that you are given. This is how we will identify you for payment should you be one of the 3 winners. Should you have any questions (e.g. if you can't remember your identification number or if the instructions are unclear) please raise your hand to alert the experimenter.

Your identification number:

Round 1

Please fill out your identification number in the box above.

You have 1500 SEK as your stake in this round. You must decide how much of this amount (any amount between 0 SEK and 1500 SEK) to allocate to a risky investment. You will keep the amount not allocated to the risky investment. The outcome of your investment is decided as follows:

If the coin lands tails:

The amount of money you invested will be lost.

If the coin lands heads:

The amount of money you invested will be multiplied by 2,5.

This amount will be returned to you.

If this round is drawn for real payment we will carry out the coin toss after three participants are drawn to receive payment.

In Table 1 on the separate sheet of paper you can see examples of possible outcomes depending on how much you decide to allocate to the investment.

You are now asked to fill in the amount that you wish to invest in the box below. Once you have made your decision, please fold the paper and wait for us to collect it.

Amount to invest (between 0-1500 SEK):

Table 1

Amount invested	**Amount not invested**	**If the coin lands tails**		**If the coin lands heads**	
		Outcome of the investment	**Your total payment**	Outcome of the investment	**Your total payment**
0	1500	0	**1500**	0	**1500**
100	1400	0	**1400**	250	**1650**
200	1300	0	**1300**	500	**1800**
300	1200	0	**1200**	750	**1950**
400	1100	0	**1100**	1000	**2100**
500	1000	0	**1000**	1250	**2250**
600	900	0	**900**	1500	**2400**
700	800	0	**800**	1750	**2550**
800	700	0	**700**	2000	**2700**
900	600	0	**600**	2250	**2850**
1000	500	0	**500**	2500	**3000**
1100	400	0	**400**	2750	**3150**
1200	300	0	**300**	3000	**3300**
1300	200	0	**200**	3250	**3450**
1400	100	0	**100**	3500	**3600**
1500	0	0	**0**	3750	**3750**

Your identification number:

Round 2

Please fill out your identification number in the box above.

You will now make a decision that will apply to you and two other participants in this experiment. You have 4500 SEK (three times 1500 SEK) as your stake in this round. You must decide how much of this amount (any amount between 0 SEK and 4500 SEK) to allocate to a risky investment. You will keep the amount not allocated to the risky investment. This amount will be split equally between you and the two other participants. The outcome of your investment is decided as follows:

If the coin lands tails:

The amount of money you invested will be lost.

If the coin lands heads:

The amount of money you invested will be multiplied by 2,5.

This amount will be equally split between you and the two other participants.

If this round is drawn for real payment we will first draw one participant for real payment whose decision will apply to two other participants as well. We will draw these two participants after the first participant is drawn. We will carry out the coin toss after this is done.

In Table 2 on the separate sheet of paper you can see examples of possible outcomes depending on how much you decide to allocate to the investment.

You are now asked to fill in the amount that you wish to bet in the box below. Once you have made your decision, please fold the paper and wait for us to collect it.

Amount to invest (between 0-4500 SEK):

Table 2

Amount invested	Amount not invested	If the coin lands tails		If the coin lands heads	
		Outcome of the investment	**Your total payment***	Outcome of the investment	**Your total payment***
0	4500	0	**4500**	0	**4500**
300	4200	0	**4200**	750	**4950**
600	3900	0	**3900**	1500	**5400**
900	3600	0	**3600**	2250	**5850**
1200	3300	0	**3300**	3000	**6300**
1500	3000	0	**3000**	3750	**6750**
1800	2700	0	**2700**	4500	**7200**
2100	2400	0	**2400**	5250	**7650**
2400	2100	0	**2100**	6000	**8100**
2700	1800	0	**1800**	6750	**8550**
3000	1500	0	**1500**	7500	**9000**
3300	1200	0	**1200**	8250	**9450**
3600	900	0	**900**	9000	**9900**
3900	600	0	**600**	9750	**10350**
4200	300	0	**300**	10500	**10800**
4500	0	0	**0**	11250	**11250**

**Total payment will be equally split between you and the two other participants*

Id number:	Id number:	Id number:

Round 3

Please fill out each participant's identification number in the boxes above.

You are now in a group of 3 people. As a group you will make a decision together. You have 4500 SEK (three times 1500 SEK) as your stake in this round. You must decide how much of this amount (any amount between 0 SEK and 4500 SEK) to allocate to a risky investment. You will keep the amount not allocated to the risky investment. This amount will be equally split between the members of the group. The outcome of your investment is decided as follows:

If the coin lands tails:

The amount of money you invested will be lost.

If the coin lands heads:

The amount of money you invested will be multiplied by 2,5.

This amount will be equally split between the members of the group.

If this round is drawn for real payment we will draw one (1) group that will receive real payment. We will carry out the coin toss after this is done.

In Table 3 on the separate sheet of paper you can see examples of possible outcomes depending on how much you decide to allocate to the investment.

You are now asked to fill in the amount that you wish to bet in the box below. Once you have made your decision, please fold the paper and wait for us to collect it.

Amount to invest (between 0-4500 SEK):

Table 3

Amount invested	**Amount not invested**	**If the coin lands tails**		**If the coin lands heads**	
		Outcome of the investment	**Your total payment***	Outcome of the investment	**Your total payment***
0	4500	0	**4500**	0	**4500**
300	4200	0	**4200**	750	**4950**
600	3900	0	**3900**	1500	**5400**
900	3600	0	**3600**	2250	**5850**
1200	3300	0	**3300**	3000	**6300**
1500	3000	0	**3000**	3750	**6750**
1800	2700	0	**2700**	4500	**7200**
2100	2400	0	**2400**	5250	**7650**
2400	2100	0	**2100**	6000	**8100**
2700	1800	0	**1800**	6750	**8550**
3000	1500	0	**1500**	7500	**9000**
3300	1200	0	**1200**	8250	**9450**
3600	900	0	**900**	9000	**9900**
3900	600	0	**600**	9750	**10350**
4200	300	0	**300**	10500	**10800**
4500	0	0	**0**	11250	**11250**

**Total payment will be equally split between the members of the group.*

Your identification number:

Round 4

Please fill out your identification number in the box above.

You have 1500 SEK as your stake in this round. You must decide how much of this amount (any amount between 0 SEK and 1500 SEK) to allocate to a risky investment. You will keep the amount not allocated to the risky investment. The outcome of your investment is decided as follows:

If the coin lands tails:

The amount of money you invested will be lost.

If the coin lands heads:

The amount of money you invested will be multiplied by 2,5.

This amount will be returned to you.

If this round is drawn for real payment we will carry out the coin toss after three participants are drawn to receive payment.

In Table 4 on the separate sheet of paper you can see examples of possible outcomes depending on how much you decide to allocate to the investment.

You are now asked to fill in the amount that you wish to invest in the box below. Once you have made your decision, please fold the paper and wait for us to collect it.

Amount to invest (between 0-1500 SEK):

Table 4

Amount invested	**Amount not invested**	**If the coin lands tails**		**If the coin lands heads**	
		Outcome of the investment	**Your total payment**	Outcome of the investment	**Your total payment**
0	1500	0	**1500**	0	**1500**
100	1400	0	**1400**	250	**1650**
200	1300	0	**1300**	500	**1800**
300	1200	0	**1200**	750	**1950**
400	1100	0	**1100**	1000	**2100**
500	1000	0	**1000**	1250	**2250**
600	900	0	**900**	1500	**2400**
700	800	0	**800**	1750	**2550**
800	700	0	**700**	2000	**2700**
900	600	0	**600**	2250	**2850**
1000	500	0	**500**	2500	**3000**
1100	400	0	**400**	2750	**3150**
1200	300	0	**300**	3000	**3300**
1300	200	0	**200**	3250	**3450**
1400	100	0	**100**	3500	**3600**
1500	0	0	**0**	3750	**3750**

Appendix B – Additional Statistics

Table 13: Gender Differences in Individual Investment Decisions - Tobit

	Coefficients		
Dependent Variable: Round 1	MODEL 1	MODEL 2	MODEL 3
FEMALE	-0.192***	-0.191***	-0.189***
	(0.040)	(0.040)	(0.040)
SSE		0.010	0.013
		(0.040)	(0.040)
AGE			0.011
			(0.008)
CONSTANT	0.695***	0.688***	0.425**
	(0.034)	(0.041)	(0.184)
SIGMA	0.326***	0.326***	0.325***
	(0.019)	(0.019)	(0.019)
OBSERVATIONS	279	279	279

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Gender Effects in Group Investment Decisions - Tobit

Dependent Variable: Round 3	Coefficients			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
1FEMALE	-0.124	-0.025	-0.085	-0.043
	(0.095)	(0.068)	(0.087)	(0.074)
2FEMALES	-0.263**	-0.123	-0.188	-0.135
	(0.119)	(0.102)	(0.117)	(0.106)
3FEMALES	-0.247**	-0.037	-0.107	-0.036
	(0.096)	(0.099)	(0.115)	(0.106)
AVG_ROUND1		1.067***		
		(0.215)		
AVG_ROUND2			0.764***	
			(0.230)	
AVG_ROUND12				1.106***
				(0.223)
CONSTANT	0.780***	0.056	0.294*	0.051
	(0.078)	(0.144)	(0.174)	(0.153)
SIGMA	0.314***	0.272***	0.284***	0.270***
	(0.036)	(0.035)	(0.039)	(0.038)
OBSERVATIONS	85	85	85	85

Wald Test

H0	p-values			
1FEMALE = 2FEMALES	0.195	0.289	0.285	0.316
1FEMALE = 3FEMALES	0.125	0.882	0.797	0.931
2FEMALES = 3FEMALES	0.876	0.434	0.460	0.365

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 15: Gender Effects in Group Investment Decisions – OLS Pooling Group Types

Dependent Variable: Round 3	Coefficients			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
MAJORITY_FEMALES	-0.139**	-0.053	-0.073	-0.047
	(0.058)	(0.059)	(0.062)	(0.060)
AVG_ROUND1		0.817***		
		(0.157)		
AVG_ROUND2			0.641***	
			(0.172)	
AVG_ROUND12				0.886***
				(0.161)
CONSTANT	0.667***	0.157	0.279**	0.122
	(0.035)	(0.106)	(0.116)	(0.106)
OBSERVATIONS	85	85	85	85
R^2	0.067	0.290	0.229	0.300
ADJUSTED R^2	0.056	0.273	0.211	0.283

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Gender Effects in Group Investment Decisions – Tobit Pooling Group Types

	Coefficients			
Dependent Variable: Round 3	MODEL 1	MODEL 2	MODEL 3	MODEL 4
MAJORITY_FEMALES	-0.176**	-0.070	-0.098	-0.065
	(0.073)	(0.069)	(0.075)	(0.070)
AVG_ROUND1		1.052***		
		(0.211)		
AVG_ROUND2			0.755***	
			(0.217)	
AVG_ROUND12				1.085***
				(0.212)
CONSTANT	0.701***	0.049	0.245*	0.037
	(0.047)	(0.130)	(0.141)	(0.129)
SIGMA	0.317***	0.274***	0.287***	0.272***
	(0.036)	(0.035)	(0.039)	(0.037)
OBSERVATIONS	85	85	85	85

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 17: Group vs. Individual Decisions by Group Type

H_0: Round3=Round1
H_a: Round3≠Round1

	Average Round 3	Average Round 1	Obs.	T-statistic[1]	Wilcoxon[2]
Groups with 0 females	0.725	0.686	17	1,047 (0,311)	1,020 (0,308)
Groups with 1 female	0.633	0.587	30	1,62 (0,117)	1,649 (0,099)
Groups with 2 females	0.516	0.544	21	-0,388 (0,702)	-0,156 (0,876)
Groups with 3 females	0.541	0.485	17	0,887 (0,388)	1,350 (0,177)

H_0: Round3=Round4
H_a: Round3≠Round4

	Average Round 3	Average Round 4	Obs.	T-statistic[1]	Wilcoxon[2]
Groups with 0 females	0.725	0.692	17	1,098 (0,289)	1,202 (0,229)
Groups with 1 female	0.634	0.607	30	1,019 (0,317)	0,989 (0,323)
Groups with 2 females	0.516	0.537	21	-0,330 (0,745)	-0,035 (0,972)
Groups with 3 females	0.544	0.439	17	2,624 (0,018)	2,507 (0,012)

H_0: Round3=Average(Round 1 and Round4)
H_a: Round3≠Average(Round 1 and Round4)

	Average Round 3	Average Round 4	Obs.	T-statistic[1]	Wilcoxon[2]
Groups with 0 females	0.725	0.689	17	1.189 (0.252)	1.374 (0.170)
Groups with 1 female	0.634	0.596	30	1.405 (0.171)	1.420 (0.156)
Groups with 2 females	0.516	0.540	21	-0.370 (0.715)	-0.017 (0.986)
Groups with 3 females	0.544	0.459	17	1.692 (0.110)	1.799 (0.072)

1) Paired t-test, p-value in parenthesis, 2) Wilcoxon signed rank sum test, p-value in parenthesis

Table 18: Peer Effects in Individual Risk Preferences - Tobit

	Coefficients					
Dependent Variable: Round 4	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
PEER_ROUND1	0.418***	0.655***				
	(0.124)	(0.174)				
FEM_PEER_ROUND1		-0.547**				
		(0.248)				
PEER_ROUND2			0.188*	0.226		
			(0.108)	(0.159)		
FEM_PEER_ROUND2				-0.086		
				(0.213)		
PEER_ROUND12					0.357***	0.507***
					(0.130)	(0.187)
FEM_PEER_ROUND12						-0.349
						(0.260)
FEMALE	-0.217***	0.094	-0.232***	-0.184	-0.222***	-0.026
	(0.046)	(0.147)	(0.048)	(0.125)	(0.047)	(0.151)
CONSTANT	0.463***	0.321***	0.605***	0.583***	0.503***	0.415***
	(0.078)	(0.105)	(0.072)	(0.098)	(0.082)	(0.112)
SIGMA	0.350***	0.347***	0.356***	0.356***	0.353***	0.352***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
OBSERVATIONS	255	255	255	255	255	255

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix C – Variable List

1FEMALE	*a dummy that equals 1 for groups with 1 female and 2 males and 0 otherwise*
2FEMALES	*a dummy that equals 1 for groups with 2 female and 1 male and 0 otherwise*
3FEMALES	*a dummy that equals 1 for groups with 3 females and 0 otherwise*
AGE	*subjects' age*
AVG_ROUND1	*the average of the 3 group members' individual* ROUND1 *investments*
AVG_ROUND12	*the average of* AVG_ROUND1 *and* AVG_ROUND2
AVG_ROUND14	*the average of* AVG_ROUND1 *and* AVG_ROUND4
AVG_ROUND2	*the average of the 3 group members' individual* ROUND2 *investments*
AVG_ROUND4	*the average of the 3 group members' individual* ROUND4 *investments*
FEM_PEER_ROUND1	*interaction between the variables* FEMALE *and* PEER_ROUND1
FEM_PEER_ROUND2	*interaction between the variables* FEMALE *and* PEER_ROUND2
FEM_PEER_ROUND12	*interaction between* FEMALE *and* PEER_ROUND12
FEMALE	*a dummy that equals 1 when the subject is female and 0 otherwise*
MAJORITY_FEMALES	*a dummy that equals 1 for groups with 2 or more females and 0 otherwise*
PEER_ROUND1	*the average of individual Round 1 investments of the 2 subjects that an individual has been paired with in Round 3*
PEER_ROUND2	*the average of individual Round 2 investments of the 2 subjects that an individual has been paired with in Round 3*
PEER_ROUND12	*the average of* PEER_ROUND1 *and* PEER_ROUND2
ROUND1	*the amount invested individually in Round 1 as a percentage of endowment*
ROUND2	*the amount invested individually in Round 2 as a percentage of endowment*
ROUND3	*the amount invested by the group in Round 3 as a percentage of endowment*
ROUND4	*the amount invested individually in Round 4 as a percentage of endowment*
SSE	*a dummy for subjects who attend Stockholm School of Economics*