# Measuring Group Selection Effects on Attitudes toward Uncertainty: Experimental Evidence from Bangladesh

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July 10, 2018

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## Abstract

In this paper, we address several interesting issues on measuring attitudes toward uncertainty using 206 Bangladeshi farmers in a field experiment. Using a slightly modified version of the original multiple price list (MPL) approach of Holt and Laury (2002), we first measure farmers' risk and ambiguity aversions when subjects make decision alone. Secondly, for risk experiments only, we investigate the subjects' attitudes toward uncertainty with different winning probabilities (p=0.3, 0.5, and 0.7) as probabilities of winning are unknown for ambiguity experiments. Finally, we attempt to investigate the effects of communications on individuals' attitudes toward uncertainty. In order to do so, we conduct all these variations of experiments allowing farmers to make decisions in groups of three. In order to measure group selection effects on attitudes toward uncertainty we allow fifty percent of the farmers to form groups on their own while we assign the remaining farmers to random peers. Our experiments provide results with several notable features. First, most Bangladeshi farmers are moderately to highly risk averse but ambiguity neutral to mildly ambiguity averse. Women generally tend to be more risk and ambiguity averse than men. Second, farmers exhibit substantially higher risk and slightly higher ambiguity aversions when they make choices in groups compared to when they choose alone. Third, farmers are less risk averse when group members are self-selected relative to when they are randomly assigned. This indicates that when making decisions in consultation with self-selected peers who are likely to be friends and/or neighbors, farmers tend to take more risks than when making decisions in consultation with randomly assigned group members. Finally, farmers are more ambiguity averse when making decisions in consultation with self-selected peers compared to when making decisions in consultation with randomly assigned group members. The opposite selection effects suggest that Bangladeshi farmers in general view and act differently when probability distribution of uncertain prospect is known compared to a scenario when the probability distribution is unknown.

**Keywords:** Risk aversion; Ambiguity aversion; selection effect

**JEL Code:** C91, C92, C93, D81, D83.

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## 1. Introduction

The literature studying the effect of individuals' risk attitudes on certain choices, such as, technology adoption is common. On the other hand, the impact of ambiguity attitude, a second type of uncertainty, is not so common, especially in developing countries. The motivation for the paper sprouts from here. Analyzing risk attitudes is relevant when outcome is uncertain with known distribution and investigating ambiguity attitudes becomes important when not only the outcome is uncertain but also the distribution of outcomes is unknown. Decisions such as adoption of brand new technology certainly involves risk and ambiguity attitudes as both the outcome and the distribution of outcome of the new technology are unknown to the decision makers prior to using it. Potential omitted variable bias problem can arise if only risk attitude is included in the adoption model whereas the ambiguity attitude is also an inherent component of the choice. Conclusion based on such biased estimate may lead to wrong policy recommendations and formulation. Furthermore, economic agents in the real world can communicate among themselves when making a choice which may affect their attitudes toward uncertainty, ambiguity in particular which is mainly the subjective belief, and in turn can alter their adoption decision. The issue is more important as individuals' attitudes may change in a certain direction depending on who they communicate with leading to a selection effect on individuals' attitudes toward uncertainty. Consequently, it is also important to investigate and measure the impact of selection of groups on individuals' attitudes toward uncertainty. A thorough investigation of group selection effects may be helpful in formulating policy and designing interventions for any specific groups of people to attain the desired outcome.

Building on the above-mentioned issues, we address several interesting issues in this paper. Employing a field experiment using Bangladeshi farmers, we first measure Bangladeshi farmers' attitudes toward uncertainty – both risk and ambiguity preferences – by giving them choices between lotteries and incrementally-increasing-certain outcomes. In case of risk experiments where probability distributions are known, we vary the probability of winning in different lotteries ($p=0.3$, 0.5, and 0.7). In order to investigate the effects of communication on attitudes toward uncertainty, we conduct all these variations of experiments allowing farmers to make decisions alone and in groups of three. In doing so, fifty percent of the farmers form groups themselves while the remaining are assigned to random peers. These two methods of group formation provide us with the scope of measuring group selection effects on attitudes toward uncertainty.

Our experiments provide results with several notable features. First, most Bangladeshi farmers are moderately to highly risk averse but ambiguity neutral to mildly ambiguity averse. Women generally tend to be more risk and ambiguity averse than men. Second, farmers exhibit substantially higher risk and slightly higher ambiguity aversions when they make choices in groups compared to when they choose alone. Third, farmers are less risk averse when group members are self-selected relative to when they are randomly assigned. This indicates that when making decisions in consultation with self-selected peers who are likely to be friends and/or neighbors, farmers tend to take more risks than when making decisions in consultation with randomly assigned group members. Finally, farmers are more ambiguity averse when making decisions in consultation with self-selected peers compared to when making decisions in consultation with randomly assigned group members. The opposite selection effects suggest that Bangladeshi farmers in general view and act differently when probability distribution of uncertain prospect is known compared to a scenario when the probability distribution is unknown.

## 2. Literature Review

Since excluding measuring risk preferences from a study involving choice can potentially pose an omitted variable bias problem, inclusion of risk preference in literature of technology choice can be traced as back as Sandmo (1971), Srinivasan (1972), and Feder (1980). Binswanger (1980, 1981) was among the earliest experimental researchers to measure risk aversion of farmers in developing countries. Studies in the literature focusing on risk preferences differ in methods for data collection and include analyses based on experimental lotteries as well as the analysis of production decisions based on data collected from household surveys. Among studies using experimental lotteries, some have been based on hypothetical lotteries (Hill, 2009; de Brauw and Eozenou, 2014), some on real lotteries (Miayata, 2003; Wik *et. al*., 2004; Liu, 2013; Yesuf and Bluffstone, 2009; Tanaka *et al*,. 2010; Harrison *et al*,. 2010), and some on both (Binswanger, 1981; Holt and Laury, 2002; Mosley and Verschoor, 2005). In addition to differences in experimental set up, the conceptual framework for characterizing risk preferences varies from expected utility theory (EUT) to prospect theory (PT).

Experimental designs vary for measuring attitudes toward uncertainty. The designs include lotteries that hold outcome probabilities constant and vary payouts (Binswanger, 1980, 1981; Miayata, 2003; Barr, 2003; Wik *et al*., 2004) or that uses a multiple price list (MPL) approach in which probabilities vary with payouts held constant (Holt and Laury, 2002; Eckel *et al*., 2002; Harrison *et al*., 2005; Harbaugh *et al*., 2002). In the MPL approach, participants are shown certain lottery pairs at once (i.e., on a sheet or computer screen, similar to Table A1 in the appendix), and are asked to mark their preferences (lottery A or lottery B) in each row.

Though less common, studies investigating attitudes toward ambiguity have conducted experiments using college student populations in developed countries. Experimental studies that measure attitudes toward ambiguity in farming societies in developing countries are few. Among the few experimental studies of ambiguity attitudes of farming societies are Henrich and McElreath (2002), Akay*et al.*, (2012), Ward and Singh (2015), and Engle-Warnick *et al*., (2011). Other literature focuses on measuring the attitudes toward uncertainty in the presence of social exchanges. The idea behind including social exchanges among subjects in experiments is that agents often coordinate among themselves in the real world before making a decision. By doing so, they attempt to reduce ambiguity as well as cost that are related to gathering information (Alpizar *et al*., 2011).

## 3. Experimental Design and Procedure

Much of the literature on risk elicitation procedures follow either the pioneering work of Binswanger (1980) or of Holt and Laury (2002). Our instrument is different from the one employed by those authors. We follow the approach of Akay *et al.*, (2012), Capon (2009), and Ross *et al.*, (2012) and ask respondents to directly compare certain amounts and lotteries. The experimental design is similar to that of Barham *et al*., (2014) and Akay *et al*., (2012). Subjects reveal certainty equivalents (CE) for the lotteries. A CE is a certain payoff such that the expected utility obtained from the lottery and the utility derived from the certain payoff are equal to each other. The elicited CEs can be used to measure the coefficients of relative risk aversion for each subject. CEs allow risk preferences across respondents to be compared as well. The same exercise was conducted with subject groups of 3 to investigate the behavioral pattern of the subject alone and in groups of peer farmers.

The experiment is designed to elicit the participant's *certainty equivalents* for both the risky and ambiguous prospects. There are two uncertain prospects: one risky and the other ambiguous. In both the prospects, we ask the participants to draw a ball (Pink or Green) from a bag containing a total of 10 balls.[2] If the participant is successful in drawing a Pink ball, s/he wins the lottery. We alter the probability of winning in different games by changing the color combinations of the balls. The probabilities assigned in our risk games are 0.3 (3 Pink balls, 7 Green balls), 0.5 (5 Pink balls, 5 Green balls) and 0.7 (7 Pink balls, 3 Green balls). In the ambiguous prospect, on the other hand, the color combination of the 10 balls is unknown. Each ball can be either Pink or Green and therefore the probability of winning is unknown to the subject. The participant can win 1000 Bangladeshi Taka (BDT) by predicting the color correctly[3]. A choice list is used to elicit each participant's certainty equivalence at switching points for the two prospects.

Participants were provided 21 choices between a certain payoff and the risky prospect with the certain payoff increasing in 50 BDT increments from 0 BDT to 1000 BDT. For small certain payments, it is expected that most participants will prefer to play the lottery. However, when the certain payoff is large, it is expected that participants will opt to take the payment instead of playing the lottery. Given this expectation, participants' risk preferences should be revealed at the point where they switch from playing a lottery to the sure thing. Following Eggert and Lokina (2007), and Akay *et al*., (2012), the CE for each participant in each game is calculated as the midpoint between the lowest certain payoffs for which the participant chooses the sure thing and the highest certain payment for which (s)he chooses to play lottery.

A constant relative risk aversion (CRRA) utility function is assumed for the agents, i.e., $u(x) = x^{1-\gamma}$ where $\gamma$ is the coefficient of the relative risk aversion. The ambiguity aversion can be estimated using the elicited certainty equivalent for both the risk and ambiguous situations using the following formula (Akay *et al*., 2012).

$$Ambiguity\ aversion\ (\theta) = \frac{CE_R - CE_A}{CE_R + CE_A} \quad (1)$$

where $CE_R$ = Certainty equivalent amount of money for the risky prospect, and $CE_A$ = Certainty equivalent amount of money for the ambiguous prospect. This measure ranges from -1 (ambiguity loving) to 0 (ambiguity neutrality) to 1 (ambiguity averse). Similar to Engle *et al*., (2013), our

[2] This may be very simple game, but it is reasonable to get their behavior elicited provided that the farmer group has little to no formal education. With sophisticated lotteries, it might be difficult for farmers to understand the situation and hence to elicit their true attitude.

[3] The daily wage for an unskilled labor in this region is BDT 250-400 depending on the season. So Tk. 1,000 is a pretty large sum.

experimental design provides the scope for measuring ambiguity aversion based on switchover points in both risky and ambiguous lotteries. The relative location of the switch-over point in the ambiguity instrument as compared to the switch-over point in the risk instrument reveals the subject's ambiguity preferences.

In our study, we make sure initially that the participants do not communicate with other participants about their choices. After the first round of each risk and ambiguity experiment is finished, following Alpizar et al., (2011), Engle et al (2013), we conduct the same exercise with subject groups of 3 to investigate the behavioral pattern when the subject is alone versus being with peer farmers. Two types of groups were formed: Half of participants were grouped randomly and the remaining participants chose their peers in groups. Doing this help us measure the group selection effects on risk preferences. In the group experiments, we tell them that each of the participants in a group can make their own choices separately and the choices of each participant in the group may be same as or different from the choices of the other participants. In order to ensure incentive compatibility, we randomly choose 20 farmers for payment. For each chosen farmer, we pick a round randomly for payment[4]. Finally, from the selected round, a choice from the choice list is randomly picked for payment. If anyone of the selected farmers during the interview had chosen the sure payout in the selected round, we give her/him that amount. Otherwise, s/he received the amount based on the result of the lottery. In this way, we provide a monetary incentive to participants to elicit their attitudes toward uncertain situations.

## 4. Data Description and Results

Our sample of 206 farmers includes individuals with a wide array of varying attributes. The age of the farmers ranges between 17 and 80 with the average being 37 years. 84% of the respondents are male and 57% can read and/or write. The farmers on average have 4.7 years of schooling. The respondents vary greatly in terms of farming experience ranging from a few months[5] to 65 years, with the average being 17 years. 84% of the respondents are married and the average family consists of approximately 5 members. Only 33% of the farmers have a bank account and each on average owns about 50 decimals of land. Table 1 reports descriptive statistics on some important relevant variables.

[4] This delivers very similar results to the alternative procedure of paying each subject with probability 1 (Laury, 2006).
[5] Experience of less than 6 months is rounded down to 0 in the table.

**Table 1:** Descriptive Statistics

| Variable | No. of Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Age (years) | 204 | 37.29 | 12.31 | 17 | 80 |
| Gender (1 = Male, 0 = Female) | 205 | 0.84 | 0.37 | 0 | 1 |
| If the person can read and/or write (1 = can, 0 = can't) | 205 | 0.57 | 0.50 | 0 | 1 |
| Education (Years of schooling) | 124 | 4.65 | 4.94 | 0 | 16 |
| Years of experience | 189 | 17.15 | 11.48 | 0 | 65 |
| Number of family members | 205 | 4.89 | 1.74 | 1 | 11 |
| Marital status | 205 | 0.84 | 0.36 | 0 | 1 |
| If the spouse can read and/or write (1 = can, 0 = can't) | 189 | 0.56 | 0.51 | 0 | 1 |
| If the person has a bank account (1 = has, 0 = doesn't have) | 205 | 0.33 | 0.47 | 0 | 1 |
| Land ownership (in decimal) | 201 | 50.34 | 82.91 | 0 | 600 |

### 4.1 Risk Aversion

Table 2 reports risk aversion coefficients both when farmers make decisions alone and when they make decisions in group. Coefficients for female respondents are reported separately. Table 3 reports distribution of risk aversion coefficients of Bangladeshi farmers compared to various estimates in the literature. Combining the results from the two tables, it's clear that Bangladeshi farmers are risk averse in general. In fact, among the six risk experiments reported in Table 3 (the bottom 6 rows), 61% to 96% of the farmers belong to the category of risk averse (risk aversion coefficient between 0.41 and 0.68) or highly risk averse (risk aversion coefficient greater than 0.68). In terms of individual decision making, risk aversion decreases with probability of winning. When deciding alone, male farmers tend to exhibit extreme risk loving behavior as reflected by the large negative minimum coefficient values. Such extreme behavior results in the mean risk aversion to be negative. Women are more risk averse than men and prone to less extreme behavior.

**Table 2:** Risk aversion coefficients

| | | Individual decision making | | | Group decision making | | |
|---|---|---|---|---|---|---|---|
| | | p=0.3 | p=0.5 | p=0.7 | p=0.3 | p=0.5 | p=0.7 |
| **Whole sample** | Mean | -0.64 | -1.8 | -1.77 | 0.89 | 0.93 | 0.88 |
| | Median | 0.81 | 0.73 | 0.73 | 0.50 | 0.50 | 0.50 |
| | Min. | -26.37 | -26.37 | -26.37 | -1.41 | -1.41 | -1.41 |
| | Max. | 0.81 | 0.81 | 0.81 | 4.11 | 4.11 | 4.11 |
| **Female** | Mean | 0.65 | 0.34 | -0.49 | 0.75 | 0.82 | 0.74 |
| | Median | 0.81 | 0.81 | 0.81 | 0.50 | 0.50 | 0.50 |
| | Min. | -0.76 | -2.60 | -26.38 | 0.50 | 0.50 | 0.50 |
| | Max. | 0.81 | 0.81 | 0.81 | 1.69 | 1.85 | 1.44 |

*Note:* p denotes probability of winning

**Table 3:** Distribution of CRRA parameters of Bangladeshi farmers compared to estimates in literature

| Study | Risk Neutral/loving $\gamma^* \leq 0.15$ (%) | Mildly risk averse $0.15 < \gamma \leq 0.41$ (%) | Risk averse $0.41 < \gamma \leq 0.68$ (%) | Highly risk averse $\gamma > 0.68$ |
|---|---|---|---|---|
| (1) Dutch students (n=79) | 19 | 35 | 44 | 1 |
| (2) U.S. students (n=93) | 19 | 19 | 23 | 39 |
| (3) Bangladeshi students (n=194) | 20 | 4 | 6 | 70 |
| (4) Bangladeshi students (n=194) | 15 | 13 | 7 | 65 |
| (5) Bangladeshi farmers (n=104) | 11 | 30 | 43 | 16 |
| (6) Bangladeshi farmers (n=104) | 27 | 17 | 32 | 24 |
| (7) Bangladeshi farmers (n=104) | 8 | 23 | 47 | 22 |
| (8) Ethiopian Farmers (n=92) | 22 | 11 | 10 | 58 |
| (9) Bangladeshi farmers (n=206, p=.3) [a] | 22 | 10 | 10 | 58 |
| (10) Bangladeshi farmers (n=206, p=.5) [a] | 30 | 6 | 14 | 50 |
| (11) Bangladeshi farmers (n=206, p=.7) [a] | 33 | 6 | 10 | 51 |
| (12) Bangladeshi farmers (n=206, p=.3) [b] | 4 | 0 | 55 | 41 |
| (13) Bangladeshi farmers (n=206, p=.5) [b] | 4 | 0 | 49 | 47 |
| (14) Bangladeshi farmers (n=206, p=.7) [b] | 5 | 0 | 50 | 45 |

*$\gamma$ denotes CRRA coeeficient; [a] When farmers make decisions alone; [b] When farmers make decisions in group

Comparing our risk aversion measures with other studies, it seems that Bangladeshi farmers' risk behavior as a whole differs quite a bit from participants in the developed world (rows 1 and 2 of Table 3). If we consider individual decision making with a 30% probability of winning (row 9 of Table 3), then Bangladeshi farmers' risk aversion behavior looks almost identical to the Ethiopian farmers (row 8 of Table 3) as reflected in the distribution of risk aversion measures. However, the distribution changes for the other risk experiments (rows 10 – 14 of Table 3).

Table 4 reports risk aversion coefficients for group decision making including results for randomly formed groups and self-selected group while Table 5 reports the group effects and the selection effects.[6] As per the total group effects reported in Table 5, both men and women become more risk averse when making decision in a group as opposed to deciding alone. The group effects are significantly larger for men. Overall, for both men and women group effects increase with probability of winning. Average risk aversion increases as the presence of group members curtails the tendency towards extreme behavior (see the minimum values in Table 2).

**Table 4:** Risk aversion coefficients when decisions are made in groups: random vs. self-selected group formation

| | | | p=0.3 | p=0.5 | p=0.7 |
|---|---|---|---|---|---|
| **Whole sample** | Group: overall | Mean | 0.89 | 0.93 | 0.88 |
| | | Median | 0.50 | 0.50 | 0.50 |
| | Group: randomly assigned members | Mean | 0.96 | 0.96 | 0.96 |
| | | Median | 0.50 | 0.50 | 0.50 |
| | Group: self-selected members | Mean | 0.84 | 0.89 | 0.78 |
| | | Median | 0.50 | 0.50 | 0.50 |
| **Female** | Group: overall | Mean | 0.75 | 0.82 | 0.74 |
| | | Median | 0.50 | 0.50 | 0.50 |
| | Group: randomly assigned members | Mean | 0.74 | 0.88 | 0.79 |
| | | Median | 0.50 | 0.50 | 0.50 |
| | Group: self-selected members | Mean | 0.76 | 0.76 | 0.67 |
| | | Median | 0.50 | 0.50 | 0.50 |

*Note:* p denotes probability of winning

[6] Total group effect = Risk aversion when deciding in group - Risk aversion when deciding alone; Selection effect = Risk aversion when deciding in self-selected group - Risk aversion when deciding in randomly formed group

As reported in Table 5, selection effects for both men and women are mostly negative implying farmers are less risk averse when group members are self-selected relative to when they are randomly assigned. This indicates that when making decisions in consultation with self-selected peers who are likely to be friends and/or neighbors, farmers tend to take more risks than when making decisions in consultation with randomly assigned group members. Overall, the negative selection effects are larger for men than women.

**Table 5:** Group effects and group selection effects on risk aversion

| | | **Whole Sample** | | **Female** | |
|---|---|---|---|---|---|
| **Probability of winning** | | Mean | Median | Mean | Median |
| p=0.3 | Total group effect* | 1.54 | -0.31 | 0.10 | -0.31 |
| | Selection effect** | -0.12 | 0 | 0.02 | 0 |
| p=0.5 | Total group effect | 2.73 | -0.23 | 0.48 | -0.31 |
| | Selection effect | -0.07 | 0 | -0.12 | 0 |
| p=0.7 | Total group effect | 2.65 | -0.23 | 1.23 | -0.31 |
| | Selection effect | -0.18 | 0 | -0.12 | 0 |

* Total group effect = Risk aversion when deciding in group - Risk aversion when deciding alone

** Selection effect = Risk aversion when deciding in self-selected group - Risk aversion when deciding in randomly formed group

### 4.2 Ambiguity Aversion

Table 6 reports ambiguity aversion coefficients both when farmers make decisions alone and when they make decisions in group. Coefficients for female respondents are reported separately. The results suggest that Bangladeshi farmers – both men and women – mostly exhibit mild ambiguity averse to ambiguity neutral behavior, which is consistent with studies that investigate ambiguity aversion (see, e.g., Engle-Warnick et al., 2007; Alpizar et al., 2011; Akay et al., 2012; Ross et al., 2012, and Ahsanuzzaman and Norton, 2016).

**Table 6:** Ambiguity aversion coefficients

| | | Individual decision making | | | Group decision making | | |
|---|---|---|---|---|---|---|---|
| | | p=0.3 | p=0.5 | p=0.7 | p=0.3 | p=0.5 | p=0.7 |
| **Whole sample** | Mean | 0.10 | 0.08 | -0.005 | 0.10 | 0.11 | 0.02 |
| | Median | 0 | 0 | 0 | 0 | 0 | 0 |
| **Female** | Mean | 0.13 | 0.10 | -0.09 | 0.04 | 0.09 | -0.03 |
| | Median | 0 | 0 | 0 | 0 | 0 | 0 |

*Note:* p denotes probability of winning; Ambiguity aversion = $\frac{CE_R - CE_A}{CE_R + CE_A}$, where $CE$ denotes certainty equivalent and subscripts $R$ and $A$ indicate Risk and Ambiguity experiments, respectively.

**Table 7:** Ambiguity aversion coefficients when decisions are made in groups: Random vs. Non-Random group formation

| | | | p=0.3 | p=0.5 | p=0.7 |
|---|---|---|---|---|---|
| **Whole sample** | Group: overall | Mean | 0.10 | 0.11 | 0.02 |
| | | Median | 0 | 0 | 0 |
| | Group: randomly assigned members | Mean | 0.08 | 0.09 | -0.01 |
| | | Median | 0 | 0.14 | 0.00 |
| | Group: self-selected members | Mean | 0.12 | 0.00 | 0.05 |
| | | Median | 0 | 0 | 0 |
| **Female** | Group: overall | Mean | 0.05 | 0.09 | -0.03 |
| | | Median | 0 | 0 | 0 |
| | Group: randomly assigned members | Mean | 0.05 | 0.08 | -0.10 |
| | | Median | 0 | 0 | 0 |
| | Group: self-selected members | Mean | 0.01 | 0.10 | 0.05 |
| | | Median | 0 | 0 | 0 |

*Note:* p denotes probability of winning

Table 7 reports ambiguity aversion coefficients for group decision making including measures for randomly formed groups and self-selected group and Table 8 reports the group effects and the selection effects.[7] Overall, farmers tend to show slightly more ambiguity aversion when deciding in groups than when deciding alone. However, as Table 8 suggests, the group effects in case of ambiguity aversion are considerably smaller than observed in case of risk aversion. For women, group effects in fact are negative (i.e., ambiguity aversion decreases when deciding in

[7] Total group effect = Ambiguity aversion when deciding in group - Ambiguity aversion when deciding alone; Selection effect = Ambiguity aversion when deciding in self-selected group - Ambiguity aversion when deciding in randomly formed group

group compared to when deciding alone) when probabilities of winning are 30% and 50% while group effect is positive when winning probability is 70%. The group effects for women are also much smaller than the group effects measured in risk experiments.

As reported in Table 8, as opposed to risk aversion scenario, selection effects in the case of ambiguity aversion for both men and women are mostly positive – the effects overall being larger for men. This implies that farmers become more ambiguity averse when making decisions in consultation with self-selected peers compared to when making decisions in consultation with randomly assigned group members. The opposite selection effects suggest that Bangladeshi farmers in general view and act differently when probability distribution of uncertain prospect is known compared to a scenario when the probability distribution is unknown.

**Table 8:** Group effects and group selection effects on ambiguity aversion

| | | **Whole Sample** | | **Female** | |
|---|---|---|---|---|---|
| **Probability of winning** | | Mean | Median | Mean | Median |
| p=0.3 | Total group effect* | 0 | 0 | -0.09 | 0 |
| | Selection effect** | 0.04 | 0 | -0.04 | 0 |
| p=0.5 | Total group effect | 0.03 | 0 | -0.01 | 0 |
| | Selection effect | -0.09 | 0 | 0.02 | 0 |
| p=0.7 | Total group effect | 0.02 | 0 | 0.06 | 0 |
| | Selection effect | 0.15 | 0 | 0.06 | 0 |

* Total group effect = Ambiguity aversion when deciding in group - Ambiguity aversion when deciding alone

** Selection effects = Ambiguity aversion when deciding in self-selected group - Ambiguity aversion when deciding in randomly formed group

## 5. Conclusion

Previous experimental literature focuses mostly in measuring risk attitudes among individuals and groups. Less studies have been conducted on the other type of uncertainty measurement, such as, ambiguity measurement, especially in the context of developing countries. Our study therefore focuses on rural farmers from Bangladesh in adopting new technological advancement where it measures the two types of uncertainty attitudes, such as, risk and ambiguity, and its impact on adopting new technology. Unlike risk attitude, in ambiguity attitude both the outcomes and the distribution of the outcomes are unknown. Technology adoption by farmers involves both risk and ambiguity aversion and dropping one of these leads to omitted variable biasness. Therefore, a thorough investigation on individual and group effects have been conducted to measure the two uncertainties that arise in adoption of new technology.

In this study we introduce some interesting features such as twenty-one lotteries vs. incrementally-increasing-certain outcome choices with varying probabilities of winning (p=0.3, 0.5, and 0.7) and allowing farmers to make decisions alone and in groups of three – both self-selected groups and randomly selected groups – to capture different attitudes towards uncertainty. The study also assesses whether male and female farmers vary in their attitudes toward uncertainty.

We find several interesting results. We find that while most Bangladeshi farmers exhibit moderately to highly risk averse behavior, they tend to show ambiguity neutral to mildly ambiguity averse behavior. Women are generally more risk and ambiguity averse than men. Farmers exhibit considerably greater risk and mildly higher ambiguity aversions when they make choices in groups compared to when they choose alone. They are less risk averse when group members are self-selected as opposed to when they are randomly assigned. We also find that farmers are more ambiguity averse when making decisions in consultation with self-selected peers compared to when making decisions in consultation with randomly assigned group members. The opposite selection effects suggest that Bangladeshi farmers generally behave differently when probability distribution of uncertain prospect is known compared to a scenario when the probability distribution is unknown.

**References *(incomplete)***

Baker II, Ronald, Laury, Susan and Williams, Arlington. “Comparing Small-Group and Individual Behavior in Lottery-Choice Experiments”. *Southern Economic Journal* 75, No. 2 (Oct., 2008): 367-382

Bryan, Gharad. “Ambiguity aversion decreases demand for partial insurance: Evidence from African farmers”. Technical report, LSE working paper (2014)

Holt, Charles, A., and Susan K. Laury. 2002. "Risk Aversion and Incentive Effects." *American Economic Review* 92, Vol. 5, (2002): 1644-1655’ DOI: 10.1257/000282802762024700

Haoran He, Peter Martinson and Matthias Sutter (2011). “Group decision making under risk: an experiment with student couples”. Working paper -519, University of Gothenburg.

Jianjun Jin, Rui He, Haozhou Gong, Xia Xu and Chunyang He. “Farmers’ Risk Preferences in Rural China: Measurements and Determinants”. *Int. J. Environ. Res. Public Health* 14, No.7 (2017), DOI:10.3390/ijerph14070713.

Steffen Keck, Enrico Diecidue and David Budescu. “Group decisions under ambiguity: Convergence to neutrality”. *Journal of Economic Behavior and Organization* 103 (2014): 60-71, DOI: org/10.1016/j.jebo.2014.03.026