Risk Preferences and the Impact of Credit and Insurance on Farm Technology Uptake

Martine Visser, Hafsah Jumare and Kerri Brick

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Abstract

We use a series of credit and insurance simulation games to test the role of access to credit and insurance on magnitude and timing of farm technology uptake with small-scale farmers in South Africa. Using Cumulative Prospect Theory 'CPT', we assess how insurance impacts technology uptake given risk preferences. Our findings suggest that risk aversion is linked to lower uptake of the insured technology. while loss averse farmers are more likely to adopt technology bundled with insurance. Higher weighting of small probability events leads to later uptake of the uninsured technology option. We further find that wealth is critical in uptake of technology, with cumulative experimental income and real household income stifling investment in insured and uninsured technology options even when real wealth is not at stake. Overall, we find that insurance is not sufficient to counter the behavioural factors linked to asset constraints and risk preferences that suppress modern farm technology uptake.

Key Words: *Risk Preference, Poverty-Trap, Insurance, Farm, Technology, Experiment*

JEL Classification: *D9, D2, D8, C6, C9, O1, Q1*

1 Introduction

Credit is increasingly being considered as the way out of poverty for poor farmers, due to the impact it has on farmers' ability to acquire working capital to enable growth in farm productivity. However the decision to take on credit in order to invest in productivity enhancing technology is dependent on a farmer's willingness to take on risk. Decision choice theories asserts that the greater the risk and the lower the net benefits associated with an investment, such as in the case of farm technology, the lower the likelihood that farmers will invest in that technology. Going by this premise, the introduction of tools that serve to

*Corresponding author. School of Economics, University of Cape Town, Cape Town, Private Bag X3, Rondebosch 7701, South Africa Tel: +27 21 6505241, Email: martine.visser@uct.ac.za

effectively mitigate risk will improve not only farmers' willingness to invest in new farm technology, but also establish pathways out of poverty for farmers.

One such tool that has gathered significant interest in recent times is weather index insurance; an insurance contract in which pay-outs are dependent on pre-de?ned weather indices which protects farmers against a common shock (Barnett and Mahul, 2007). Despite the potential benefits of such a scheme, almost universally, index insurance has been met with low demand when presented in the ?eld (Cole et al., 2013, Gine et al. 2009, Cole et al.; 2013, Hill et al. 2013) and even in some laboratory settings (McIntosh et al., 2015; Brick and Visser, 2015). Bundling index insurance with credit has even been discovered to reduce credit uptake (Gine and Yang, 2009; Banerjee et al., 2014). Two factors that have been identified as possible deterrents to index insurance uptake are basis risk and ambiguity aversion. The existence of basis risk implies that weather index insurance cannot provide protection against correlated risks to consumption unrelated to the index and may thus not be seen as effective a risk mitigation option (Barnett, Barrett, and Skees, 2008; Clarke, 2011), but evidence in lab experiments, where basis risk is eliminated, suggests that this explanation is not sufficient (Brick and Visser, 2015). The other factor, ambiguity aversion, implies that households do not perfectly understand the distribution from which outcome probabilities are drawn (Bryan, 2010). Both basis risk and ambiguity are eliminated in our study, with the only risk the subjects are exposed to being the yield income risk associated with rainfall variability. In addition, outcome probabilities are well defined and easily illustrated using a simple method of drawing a ball from a bag.

In this study, we primarily try to understand the impact of risk preferences on willingness to take up index insurance and credit. As secondary focus of research we also consider the existence of other behavioural elements more specific to the poor, that may be impacting demand for index insurance and credit. We compare differences between the richest and poorest in our sample to assess if any behavioral differences can be observed that is non-related to risk preferences. Some studies have found that differences in behviour between income groups may be attributed to aspirational failure and fatalistic beliefs associated within lower income groups. Dalton et. al. (2015) established a theoretical framework to analyse the psychology of poverty under the assumption that the rich and poor have the same preferences. They found that poverty has a tendency to intensify aspirational failure resulting in a behavioural poverty trap. Bernand and Tafferse (2014) find evidence of fatalistic beliefs among a substantial group of rural households in Ethiopia. This belief was prominent amongst poorer groups and also correlated with lower demand for credit. We thus use a simple wealth proxy (i.e. real life income elicited through survey responses) to assess behavioural differences between the richest and poorest in the sample, linked to technology and insurance uptake. Whether observed behvioural differences between these groups can be ascribed to differentials in aspirations and fatalistic beliefs, is a matter for future research.

Using Cumulative Prospect Theory, we elicit farmers risk preferences in the domain of rainfall variability and test the impact of insurance on credit uptake given these risk preferences. The risk preferences we consider are risk aversion, loss aversion and probability weighting. Risk aversion in behavioural studies is an observed phenomena where human beings are seen to exhibit preferences for ***certain*** outcomes as opposed to ***gambles*** with corresponding expected outcomes (Kahneman and Tversky, 1979; Binswanger and Sillers, 1983; Parks, 1995; Hill, 2005; Yesuf and Bluffstone, 2009; Tanaka et al., 2010; Brick and Visser, 2015). Loss aversion has also been observed in research and is described as the propensity for human beings to weight downside risk more heavily than an equivalent upside risk (Tversky & Kahneman, 1991; Thaler et al., 1997; Tanaka et al.; 2010, Ward and Singh, 2013; Liu, 2013). Research on human behaviour has established that people do not accurately perceive the probabilities of events. The consensus is that individuals have a tendency to overweight small probability events and underweight large probability events (Tversky and Kahneman, 1992; Humphrey and Verschoor, 2004; Ranjan and Shogren, 2006; Mahul and Stutley, 2010, Tanaka et al.; 2010).

We estimate risk preferences using the Tanaka, Cameren and Nguyen (TCN) method (Tanaka et al.; 2010). The TCN method uses outcome probabilities unlinked to real world occurrences. To capture domain specific probabilities, we therefore framed our experiments to reflect probabilities of rainfall. We then asked the subjects to make choices in insurance simulation games specific to the domain of rainfall risk. TCN, under the assumption of cumulative prospect theory (CPT), conducted experiments with villagers in North - and South-Vietnam. They presented subjects with three different multiple price lists with paired lottery choices. The experiment was framed in such a way that the switching point in each list could be used to evaluate the three prospect theory parameters based on a 'parsimonious three parameter cumulative prospect value function' (Hurley, 2010). TCN find that, on average, individuals are risk averse and overweight small probabilities whilst underweighting high probabilities. They find a high degree of loss aversion with approximately 90 percent of their sample exhibiting loss aversion.

Closer afield, Brick and Visser (2015) under the assumption of expected utility, use a simple gambling task with urban food growers in South Africa to elicit subjects' risk preferences which they applied to a series of framed insurance simulation games. While we follow their study in various respects, unlike Brick and Visser (2015), we elicit risk preferences under the assumption of cumulative prospect theory (CPT). This enables us to account not only for risk aversion, but also for probability weighting and loss aversion. Insurance decisions are made over a number of periods similar to Patt et al., (2010) who accommodate a more realistic scenario in which farming happens over seasons. In this study we specifcally also allow for bankruptcy and accumulation of assets over time. We account for non-random attrition resulting from bankruptcy in our sample by calculating and applying the inverse probability weights to the estimation of our multinomial logit models.

Our experiments are conducted with 125 farmers from farming communities in the Matzikama Municipality of Western Cape, South Africa. The paper comprises of 5 sections. Section 1 serves as introduction and presents a review of the current literature. Section 2 provides some background information on the sample. Section 3 demonstrates the methodology and experiment design. In Section 4, we present the results for the effect of credit and insurance on technology uptake. In Section 5, we provide a brief discussion of the findings. Section 6 concludes.

2 Background

The data used in this analysis includes survey collection, as well as, risk and insurance simulation games carried out with small-scale farmers in the Matzikama Municipality of the Western Cape, South Africa. The area which is mostly dominated by viniculture, vegetables, citrus fruits and livestock production is characterised by arid terrains and cool temperatures (Matzikama IDP, 2009-2010). Agriculture in the municipal area is sustained by the Clanwilliam Dam and Olifants River. Our sample consists of 125 farmers from the towns of Vanrhynsdorp, Lutzville, Klawer, Clanwilliam and Wupperthal solicited through the Matzikama Emerging Farmers Forum. Subjects were selected based on being involved in small scale farming and being able to read and write. All subjects who showed up on the day of the experiments were allowed to participate.

Background summary statistics are presented in Table 1. Average payment received per person for the experimental sessions was R175 (including a R20 show-up fee) which is more than 1.5 times the daily household income amongst subjects in this sample.

Table 1 also presents the summary statistics of risk preferences estimates generated in the subsequent section.

3 Methodology and Experimental Design

3.1 Eliciting Preferences

Similar to TCN (Tanaka et al, 2010), the Matzikama farmers were given three sets of multiple price lists (MPLs) with pair wise lotteries sheets. The first two lists (i.e. Series 1 and 2) had a series of 14 decision rows each, with both being gain only lotteries. The third sheet (Series 3) had both gain and loss lotteries with 7 decision rows[1]. Subjects had a choice between lottery A or lottery B in each row. The lotteries were framed to represent farming seasons with lottery A representing the outcome if farmers chose to use traditional seeds and lotteries B representing the outcome if farmers chose to use improved seeds. The payoffs are dependent on whether or not there is sufficient rainfall for yields to be good. The premise of this framing is that improved seeds require more rain relative to traditional seeds. The probabilities in the lotteries represented the probabilities of good rainfall for the high payoffs and probabilities of bad rainfall for the low payoffs. The payoffs represent the yields in a farming season. The MPL

[1] Sample of the MPL's are can be found in Appendix V.

lotteries in TCN were structured so that the switching points of the 3 series produce a permutation of the prospect theory parameters: risk aversion, non-linear probability weighting and loss aversion. Rainfall probabilities were also denoted by 10 numbered balls. For example, for traditional seeds in series 1, 3 balls represented good rainfall levels while 7 balls represented poor rainfall levels. The rainfall level is determined by one of the subjects selecting a ball from the bag.

The MPL lotteries in TCN are structured so that the switching points of the 3 series produce a permutation of the prospect theory parameters risk aversion, non-liner probability weighting and loss aversion. Series 1 and 2 estimate the parameters sigma (the measure of risk aversion) and alpha (the measure for probability weighting). In Series 1, a set of sigma and alpha ($\sigma\alpha$) combinations that rationalise the switching points are estimated. Another combination of sets that justifies the switching point is found for series 2. For example, if a subject switched in row 6 of series 1, the values of sigma and alpha that can rationalise the switch is: (0.5, 0.4) (0.6, 0.5), (0.7, 0.6), (0.8, 0.7), (0.9, 0.8), (1.0, 0.9). If a subject switched in row 6 in series 2, the combination of sigma and alpha that can rationalise the switch is: (0.5, 1), (0.6, 0.9), (0.7, 0.8), (0.8, 0.7), (0.9, 0.6), (1, 0, and 0.5). The crossing point is thus (0.8, 0.7). In TCN, the coefficient of loss aversion (λ) is derived from Series 3: conditional on the value of sigma derived from Series 1 and Series 2, the switching point in Series 3 implies a range of values for λ. The TCN method produces interval values for the loss aversion parameter.

3.2 Estimating Preferences

The experiments in this study were modelled after the design of Tanaka, Camerer and Nguyen (2010) (TCN) assuming cumulative prospect theory (CPT). TCN use a series of gain-only and gain-and-loss pair-wise lotteries with both a risky and safe option (similar to Holt and Laury (2002)). They assume the following utility function:

$$U(x, p; y, q) = \begin{cases} v(y) + \pi(p)(v(x) - v(y)) & x > y > 0; x < y < 0 \\ \pi(p)v(x) + \pi(q)v(y) & x < 0 < y \end{cases} \tag{1}$$

U(x,p;y,q) denotes the expected value linked to prospects (x, p; y, p), p and q are the probabilities of receiving outcomes x and y, respectively. The power function $v(x) = x^\sigma$ for gains ($x > 0$) and $v(x) = -\lambda(-x^\sigma)$ for losses ($x < 0$) is assumed with σ being the risk aversion parameter (i.e. measure of the concavity of the value function) and λ the parameter for loss aversion. The risk aversion parameter (σ) is presumed to be identical in both gains and losses; the inequality $\sigma > 1$ implies risk seeking preferences and $\sigma < 1$ implies risk averse behaviour. Our estimate of σ is 0.51 implying that on average the subjects in our sample are risk averse. For λ, $\lambda > 1$ ($\lambda < 1$) implies greater sensitivity to losses (gains) compared to gains (losses). Our mean estimate of λ is 2.55 implying that on average the subjects in our sample are loss averse.

TCN use the nonlinear probability weighting function of Prelec (1998) where $\pi(\mathrm{p}) = \exp\left[-\left(-\ln \mathrm{p}\right)^{\alpha}\right]$ with the function being linear if $\alpha = 1$. In the case that both $\alpha = 1$ and $\lambda = 1$; the model reduces to expected utility. If $\alpha < 1$ the function is an inverted S-shape. The inverted S-shape indicates that small probabilities are overweighed and large probabilities are underweighted. The function is S shaped if $\alpha > 1$, indicating that small probabilities are underweighted and large probabilities are overweighted. We estimate α to be equal to 0.75 which implies that on average our subjects overweight small probability events.

3.3 Insurance Simulation Games

A series of insurance simulation games were conducted to assess whether or not the availability of insurance has an impact on the willingness of farmers to take up a loan in order to invest in technology (high yielding seeds). The farmers in the experiment were provided with three choices, namely traditional seeds, high yielding seeds which require securing a loan and improved seeds with an insured loan option.

At the start of the games, the subjects were informed that the experiments would be carried out over 8 rounds with each round representing a farming season. The subjects were told that their income in each round would be dependent on the type of seed they choose and the amount of rainfall. They were further told that there were 3 rainfall levels which had an equal (a probability of 0.33) chance of occurring. Rainfall levels were represented by 3 balls placed in a bag: a blue ball, a yellow ball and a red ball, signifying good rainfall levels, low rainfall levels and very poor rainfall levels.

In terms of income received during the session, it is important to note the following: Firstly, all subjects received a R20 show-up fee on arrival at the experimental session. Subjects then participated in the first series of risk experiments (MPLs) (for which they only learnt their earnings at the end of the session) before starting with the simulated (or framed) experiments. For the framed experiments subjects did not receive an initial endowment, but since it was possible to get negative pay-offs based on a combination of bad weather and choosing the uninsured loan, repondents we told that they would receive R15 to covers such losses[2].

Further to this, a bankruptcy rule was implemented in the experiment which mandated that a participant could only move on to the next round if the cumulative income from previous rounds could cover the losses at the end of the current round[3].

Players learnt their pay-off after each round and could therefore keep track of their cumulative experimental income over rounds. In this study one of our aims

[2] Based on the expected average and minimum income in the games, subjects could not obtain losses greater than R15.

[3] Subjects who did not secure enough earnings to move on to the next round were disqualified from the games. A small percentage of subjects went bankrupt based on choosing the uninsured loan in the first two rounds, prior to accumulating income. These subjects were not allowed to participate in further rounds of the game. Nonetheless any potential negative income accumulated in the process were then covered by the R15 "earmarked" for such losses.

were to determine the impact of accumulated income during the experiment on behaviour over rounds.

Once the participant had indicated that they understood the games and after several examples, the experiment commenced. One of the farmers was randomly chosen to pick a random ball from the bag on behalf of the subjects. The colour of the selected ball was entered into a spreadsheet and the subjects were able to view their earnings for a particular round, after each round. The payoff from each option are as follows:

Traditional seeds: These are considered to be seeds that farmers save from their previous harvests and thus cost nothing. The payoff from these seeds after each season is R10 and this outcome does not vary. The traditional seed option is a riskless option with expected earnings or certainty value in each round being R10 regardless of rainfall level. We assume that the farmer does not incur a cost in using traditional seeds.

High yielding seeds: These are assumed to be drought resistant seeds with a farming season payoff of R40 when rainfall is good. With low rain, the payoff is R30 which is more than the R10 the subjects receive if they choose traditional seeds but when rainfall is very low, however, the payoff from these seeds is R0.

- *Loan:* If the participant chooses to buy high yielding seeds, they have to take out a R10 loan from the bank to purchase these seeds in each season. This loan is to be paid back at the end of each season with R1 interest. So in total the improved seed option cost R11. The expected earnings for high yielding seeds with a loan are R29, R19 and –R11 for good rainfall, low rainfall and very low rainfall respectively. Thus, total expected earnings are R12.33 for uptake of high yielding seeds with loan.

- Insurance: With the exception of round 1, subjects are also given an option of buying rainfall insurance at a cost of R2 at the start of each round. Since subjects had no initial endowment in the first round so they could not purchase insurance. Thus insurance pays subjects R4 when rainfall is low and R8 when rainfall is very low. However, no payoff is given when the rainfall level is good. The expected earnings for improved seeds with a loan and insurance is R27, R21 and -R5 for good rain, low rain and very low rain, respectively. Thus total expected earnings is R14.33 for uptake of high yielding seeds with the loan and insurance. A breakdown of the payoffs in each round is presented in Appendix II.

4 Results

4.1 Uptake in Rounds

Figure 1 and Table 2 show the percentage uptake in each round of the game. From this point onwards we will refer to 'Traditional Seeds' as TS, 'High Yielding Seeds with Uninsured Loan' as HYL and 'High Yielding Seeds with Insured

Loan' as HYLI. Results from non-parametric Wilcoxon sign-ranked tests are reported in Appendix IV.

In round 1, when the purchase of HYLI is not possible due to income constraints, we see that the majority (69.6 percent) of subjects take up the least risky option, TS. When the they are able to purchase insurance in round 2, the uptake of TS declines by about 25 percent and 12.8 percent of the sample take up HYLI *(Round1→Round2: Wilcoxon p-value*$_{TS}$ *= 0.0095).* The uptake of HYL does not change significantly between round 1 (30.4%) and round 2 (31.2%) *(Wilcoxon p-value*$_{HYL}$ *=0.9093)* therefore we can infer that those taking up HYLI in round 2 are mostly moving from TS. The uptake of HYLI thus signifies an overall rise in technology uptake between round 1 and round 2 due the introduction of insurance.

Analysing this trend we further observe a significant decline in uptake of TS and HYL and an increase in the uptake of HYLI between rounds 2 and 8 *(Wilcoxon, p-value*$_{TS}$ *= 0.0811, p-value*$_{HYL}$ *= 0.2253, pvalue*$_{HYLI}$ *= 0.0526),* with more people choosing the insured technology option over time.

One factor (that we investigate further in the paper) that should predictably increase the uptake of HYLI is the increasing average cumulative income accrued by the farmers over time (i.e. with each round) which may create an endowment effect.

In Appendix III, the percentage uptake over rounds is broken down into above and below the median level of 4 categories: risk aversion, probability weighting, loss aversion and income level[4]. We discuss differences in trends between these groups in the following sections.

4.2 Effects of Credit and Insurance on Technology Uptake

The determinants of uptake are obtained using Multinomial Logit regressions as shown in Table 3. Random effects are accounted for using generalised multilevel structural equation modelling. The dependent variables are dummy variables for bankruptcy (with bankruptcy = '1' if the individual went bankrupt and bankruptcy = '0' if the individual did not), high yielding seeds with uninsured loan (HYL = '1' for uptake and HYL= '0' for no uptake) and high yielding seeds with insured loan (HYLI = '1' for uptake and HYLI= '0' for no uptake). The base case is TS (TS = '1' for uptake and TS= '0' for no uptake). The independent variables are: σ (risk aversion parameter which signifies increasing risk aversion), α (probability weighting parameter which represents an increase in the weighting of small probabilities), λ (loss aversion parameter which indicates increasing loss aversion), rounds of the experiment, farmers age, gender (dummy variable equals to '1' if the farmer is female or '0' if the farmer is male), education level of the farmer, monthly household income and a dummy variable

[4] Given that most people in the sample, as in most other studies, fall within the category of risk aversion, loss aversion and high weighing of small probabilities, this sample is not sufficiently large to capture distinct traits of people in the minority end of the preference spectrums. We are therefore unable to meaningfully split and analyse the sample for instance into groups with values of σ above or below 1.

for household income level ('1' if monthly household income is below the median level or '0' if it is above the median).

Given that the risk preference variables may be correlated with the other explanatory variables in the data, we regressed σ (risk aversion parameter), α (probability weighting parameter) and λ (loss aversion parameter) on the explanatory variables to determine if a degree of collinearity exists that warrants re-estimation of our model. The VIF indicating collinearity between a) σ and other RHS variables = 1.089, b) α and other RHS variables = 1.028, and c) for λ[5]: LLambda and other RHS =1.083072; ULambda and other RHS =1.110371. The estimated Rsquared and variance inflation factors (VIF) indicate very low collinearity. We therefore do not detect significant enough collinearity to warrant re-estimation (See results in Appendix 1).

Individuals in the sample becoming bankrupt is similar to a case of nonrandom attrition. If we assume the explanatory variables explain credit and insurance choice which in turn determines bankruptcy under certain weather conditions, we can assume those explanatory variables can explain bankruptcy. As in the case of testing for nonrandom attrition, we tested for attrition using the the Wald-test and BGLW tests (Becketti et al., 1988; Baulch and Quisumbing, 2011). First we construct an attrition probit (See Appendix VI) by regressing a dummy variable for bankruptcy on σ, α, λ, age, female, education level, income group, household income and a dummy variable for perceptions of rainfall change, as characteristics of the participants that may be associated with bankruptcy. The pseudo R-squared from the attrition probit suggests that the baseline variables explain about 10,66% of panel attrition in the data. The resulting Chi-squared statistic of 108.97 with 9 degrees of freedom indicates these variables are jointly statistically different from zero at the highest level of significance (the P-value is 0.000), so we can conclude these are significant predictors of attrition.

Given that bankruptcy is non-random, we therefore have to control for bias using inverse probability weights to estimate the multinomial logit regressions. The procedure involves estimating two probit regressions (with bankruptcy the dependant variable): we estimate one regression with and one regression without variables that are significantly associated with attrition. Then using the ratio of predicted probabilities from these regressions we re-weight the observations in the original model (with technology choice as dependant variable).

Table 3 presents the results of the model corrected for attrition bias. Results of the non-weighted model and the attrition probit are presented in Appendix VI. &VII.

The exponential coefficients on the multinomial logit regressions are the change in the relative probability or odds of taking up an option relative to the base case, TS, due to a unit change in the explanatory variable. Non-parametric Chi2/Fisher Exact tests and Mann-Whitney U tests in this section are reported in Appendix VII.

[5]Given that interval regressions do not produce an Rsquared, we estimated the degree of correlation of LLambda, ULambda with the predicted value of Lambda from the interval regressions and use the measure of correlation as a pseudo Rsquared.

Our findings reveals that an increase in risk aversion decreases the relative likelihood of uptake of HYLI relative to TS (Columns 3 & 4; p-values =*0.0167; 0.0143*),indicating that even when technology is bundled with insurance it may prove too risky for risk averse individuals to persue.These results are also reflected in Appendix III which presents the percentage uptake broken down by risk aversion levels (i.e. the most risk averse half:"High Risk Aversion" vs. the least risk averse half :"Low Risk Aversion" of the sample). This finding supports the theory that risk averse behaviour has a dampening effect on investment in technology. The opposite effect is found for loss aversion, we find evidence to show that the higher the loss aversion the greater relative likelihood of taking up HYLI (Column 3 & 4; p-values =*0.0586; 0.00285*),indicating that access to insurance can help facilitate technology uptake amongst this group.We found no statistically significant effects on the probability weighting measure.

In considering the other explanatory variables, we find that inertia or habit formation may affect those who take up traditional seeds (TS) in round 1, since they have a smaller relative likelihood of taking up HYL subsequently (Columns 1 & 2; p-values =*0.0122, 0.0165)* While the effect of choosing TS in round 1 on uptake of HYLI is positive and significant as seen in Column 3 (p-value =*0.0000*),once we control for other covariates its impact become insignificant (Column 4). More educated individuals are also less inclined to take up HYL (Columns 1; p-value = 0.0987).

Contradicting our earlier expectations about the role of (and potential endowment effect associated with) the cumulative experimental earnings on technology uptake, we see here that an increase in cumulative income (earned over rounds of the experiment) decrease the relative likelihood of taking up HYL relative to TS, although this is only weakly significant(Columns 2; p-value = *0.0772).*

We do find that real income (elicited through survey questions) matters for technology uptake, in line with the poverty trap hypothesis discussed earlier. Specifically we find that being in the bottom half of the sample income distribution ("Low Income Group") decreases the relative likelihood of taking up HYLI (Column 4; p-value=*0.0000*) relative to TS. We also find that higher real life household income induces lower uptake of insurance (Column 4; p-value=*0.0000)* although the magnitude of this estimate is very small. In Appendix III, we construct income groups for those in the top half ("High Income Group") and bottom half ("Low Income Group"). Here it is apparent how distribution in uptake differs between both groups with much higher incidence of uptake of the improved options (HYL & HYLI) over time, by those in the "High Income Group" and this is further confirmed by non-parametric testing *(Round 8: chi2/Fisher Exact & Mann-Whitney U p-values = 0.0010; 0.0010)* for HYLI.

These findings that show a link between real world income of the farmers and experimental uptake suggest that there may be other psychological factors correlated with income levels that reinforce the effects of asset holding on farm technology investment. This is particularly apparent because the farmers do not have their real life income at stake in the experiments.

5 Discussion

Overall it is clear that both individual preferences and income (or being poor) are important drivers (or barriers) to technology uptake. We find that risk aversion results in lower uptake of technology tied to insured loans. Loss averse individuals in contrast are more likely to take up the insured loan option.

Our result with respect to the role of wealth on insurance uptake is somewhat mixed. We find that higher levels of cumulative income in the experiment does not significantly impact the uptake of the insured improved technology option and it weakly decrease the likelihood of taking up the uninsured option. On the other hand we further assess the role of real income on technology uptake by controlling for those in the sample with income below the median income as well as for household income. This result holds before and after we correct for attrition bias due to bankruptcy indicating that being poor (or below the median group household income) results in lower uptake of the insured loan/technology. These findings provide more evidence for the poverty trap hypotheses as posed earlier and its limiting role in technology uptake amongst small-scale farmers.

6 Conclusions

Limited access to credit and insurance markets have often been argued to curb productivity enhancing investments in new agricultural technology amongst small-scale farmers in developing countries. In the absence of these markets farmers are unable to overcome the asset or behavioural limitations that hinder investment in the face of risk. Even with credit available, farmers may be disinclined to take out loans because of the risk of losing resources. Many studies have advocated for the use of agricultural insurance in order to motivate farmers to acquire more rewarding but sometimes riskier investments.

To test the hypothesis that access to credit and insurance stimulates technology uptake, we use a series of insurance simulation games to determine their effects on farmers' asset and preference constraints and the resulting effect on uptake. We consider two technologies namely, traditional seeds and improved high yielding seeds respectively. Two options exist for taking up the new technology, either the farmers take it up by acquiring an uninsured loan or they do so with an insured loan.

Looking at the resultant effect of insurance and credit uptake related to risk preferences we find that, even with the insurance package, risk aversion is related to lower uptake of high yielding seeds (and that this is significant at the 1% level for both the uninsured- and insured technology options). These results confirm earlier findings by Brick and Visser (2015) pertaining to risk aversion and technology uptake. In this study, using a Prospect Utility framework, we are further able to consider the impact of probability weighting and loss aversion on technology adoption. Encouragingly our results show that loss averse individuals adopt technology bundled with insurance and that insurance may indeed have an important role in hedging against losses for such groups.

In keeping with previous discussions about poverty traps (such as the paper by Brick and Visser, 2015), we considered the role of cumulative experimental earnings, as well as real wealth measures, such as household income and being above or below the median group income (which is a proxy for asset holdings), in determining the uptake of both the uninsured and insured loan options (which are linked to higher yielding varieties, relative to traditional seeds).While cumulative experimental earnings actually turns out to have a weak negative impact on uptake of the uninsured loan (once we correct for attrition bias), we find that real wealth measures mentioned above does indeed have a significant influence on technology uptake. Those in the lower income group (below the median income) and were significantly less likely to take up the insured product. This finding is in line with the asset based approach to poverty traps which suggests that people with more accumulated assets are more likely to invest in and benefit from technology uptake.

Converse to this, poorer farmers are making choices that are indicative of under- or failed investment. We find that poorer farmers either prefer to adhere to a riskless but less productive option or take up a risky option without insurance, due to a lack of accrued income. Hence the farmers with lower cumulative income (i.e. lower asset levels) make choices that either maintain or worsen their poverty.

Given that there is no link between real life income and actual financial ability to invest in the experiment, we find that there is a further poverty-inducing psychological fallout to being in a household from a lower income group. This follows from our findings that those with low real income adheres to the riskless low productivity option during initial stages of the game and will only adopt improved technology at later stages. Further, those in the lower half of the income spectrum are significantly less likely to adopt productivity enhancing technologies, in particular if it requires costly insurance premiums. We thus find evidence of a psychological impact of real life income and income group/status that is independent of the actual direct or pecuniary impact of assets that reflect the ability to invest in productivity enhancing technologies.

Overall this study concludes that farmers' real life income and cumulative experimental income level has a substantial impact on investment behaviour. We find no evidence that the insurance contract explored here is sufficient to counter the effect of poverty traps on farm investment.

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References

[1] Adato, M., Carter, M. R., & May, J. (2006). Exploring poverty traps and social exclusion in South Africa using qualitative and quantitative data. *The Journal of Development Studies*, 42(2), 226-247.

[2] Barham, Bradford L, Jean-Paul Chavas, Dylan Fitz, Vanessa Rıos Salas, and Laura Schechter. 2014. "The roles of risk and ambiguity in technology adoption." Journal of Economic Behavior & Organization 97:204–218.

[3] Barnett, Barry J. and Olivier Mahul. 2007. "Weather Index Insurance for Agriculture and Rural Areas in Lower-Income Countries." American Journal of Agricultural Economics 89 (5):1241–1247.

[4] Barnett, B.J.., Barret, C.B. & Skees, J.R. (2008). Poverty Traps and Index-Based Risk Transfer Products. *World Development*, 36(10), 1788-1785.

[5] Barrett, C.B. & Carter, M.R. (2013). The Economics of Poverty Traps and Persistent Poverty: Empirical and Policy Implications. *The Journal of Development Studies*, 49(7), 976-990.

[6] Barseghyan, Levon, Francesca Molinari, Ted O'Donoghue, and Joshua C Teitelbaum. 2013. "The nature of risk preferences: Evidence from insurance choices." American Economic Review 103 (6):2499–2529.

[7] Becketti, Gould, Lillard & Welch, (1988). The Panel Study of Income Dynamics after Fourteen Years, An Evaluation, *Journal of Labor Economics,* 6:472-92

[8] Binswanger, H. P., & Sillers, D. A. (1983). Risk aversion and credit constraints in farmers' decision-making: A reinterpretation. *The Journal of Development Studies*, *20*(1), 5-21.

[9] Bryan, Gharad. 2010. "Ambiguity and insurance." Unpublished manuscript, https://pdfs.semanticscholar.org/131f/224c121a377b0d675f43155f0f2245a3041a.pdf accessed 30.07.2018

[10] Brick, K., & Visser, M. (2015). Risk preferences, technology adoption and insurance uptake: A framed experiment. *Journal of Economic Behavior & Organization*, *118*, 383-396.

[11] Carter, M. R., and Barrett, C.B. (2006). The economics of poverty traps and persistent poverty: An asset-based approach. *The Journal of Development Studies* 42(2), 178-199.

[12] Carter, M. R., & Barrett, C. B. (2007). Asset Thresholds and Social Protection: A 'Think-Piece'. *IDS Bulletin*, 38(3), 34-38.

[13] Carter, M., Barret, C. B., Bouche, S., Chantarat, S., Galarza, F., Mcpeek, J. & Trivelli, C. (2008). Insuring the Never Before Insured: Explaining Index Insurance through Financial Education Games. Basis Brief, 7, 1-8.

[14] Cole, S., Gine, X., Tobacman, J., Topalova, P., Townsend, R., and Vickery, J. (2013). Barriers to household risk management: evidence from India. *American Economic Journal*: *Applied Economics*, 5(1):104–35.

[15] Dercon, S., & Christiaensen, L. (2011). Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. *Journal of Development Economics*, 96(2), 159-173.

[16] Dinku, T., Giannini, A., Hansen, J., Holthaus, E., Ines, A., Kaheil, Y. Vicarelli, M. (2009). Designing Index-based Weather Insurance for Farmers in Adi Ha, Ethiopia. International Research Institute for Climate and Society, New York

[17] Duclos, Jean-Yves, and Stephen A. O'Connell. (2009) "Is Poverty a Binding Constraint on Growth in Sub-Saharan Africa?", Research Gate Working Paper, DOI: 10.1093/acprof:oso/9780198728450.003.0003.

[18] Duflo, E., Kremer, M., & Robinson, J. (2011). Nudging farmers to use fertilizer: Theory and experimental evidence from Kenya. *American Economic Review*, 101(6), 2350-2390.

[19] Engle-Warnick, J., Escobal, J., & Laszlo, S. (2007). Ambiguity Aversion as a Predictor of Technology Choice: Experimental Evidence from Peru. CIRANO- Scientific Publications.

[20] Feder, G. (1980). Farm size, risk aversion and the adoption of new technology under uncertainty. *Oxford Economic Papers*, *32*(2), 263-283.

[21] Feder, G., Just, R. E., & Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change*, 255-298.

[22] Fernandez-Cornejo, J., Daberkow, S., & McBride, W. D. (2002). Decomposing the size effect on the adoption of innovations. *Agbioforum,* 4(2), 2.

[23] Foster, A. D., & Rosenzweig, M. R. (2010). Microeconomics of technology adoption. *Annual Review of Economics*, 2(1), 395-424.

[24] Giné, X., & Yang, D. (2009). Insurance, credit, and technology adoption: Field experimental evidence from Malawi. *Journal of Development Economics*, 89(1), 1-11.

[25] Hazell, P., & Diao, X. (2005). The role of agriculture and small farms in economic development. *The future of small farms*, 23.

[26] Hill, R. E. (2005). Risk, production and poverty: a study of coffee in Uganda. Doctoral dissertation, University of Oxford.

[27] Hill, R. V., Hoddinott, J., and Kumar, N. (2013). Adoption of weather-index insurance: Learning from willingness to pay among a panel of households in rural Ethiopia. *Agricultural Economics*, 44:385–98.

[28] Humphrey, S. J., & Verschoor, A. (2004). The probability weighting function: experimental evidence from Uganda, India and Ethiopia. *Economics Letters*, *84*(3), 419-425.

[29] Just, R. E., & Zilberman, D. (1983). Stochastic structure, farm size and technology adoption in developing agriculture. *Oxford Economic Papers*, *35*(2), 307-328.

[30] Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the econometric society*, 263-291.

[31] Leibbrandt, M., Wegner, E., & Finn, A. (2011). The policies for reducing income inequality and poverty in South Africa. SALDRU

[32] Liu, E. & Huang, J. (2010). Risk preferences and pesticide use by cotton farmers in china. *Journal of Development Economics*. 103 (2013) 202 -215

[33] Liu, E. M. (2013). Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in china. *Review of Economics and Statistics*, 95(4), 1386-1403.

[34] Mahul, O., & Stutley, C. J. (2010). Government support to agricultural insurance: challenges and options for developing countries. *World Bank Publications*.

[35] McIntosh, Craig, Povel, Felix and Sadoulet, Elisabeth, (2015), Utility, Risk, and Demand for Incomplete Insurance: Lab Experiments with Guatemalan Cooperatives, Department of Agricultural & Resource Economics, UC Berkeley, Working Paper Series, Department of Agricultural & Resource Economics, UC Berkeley, https://EconPapers.repec.org/RePEc:cdl:agrebk:qt89k8r3qf.

[36] Mosley, P. & Verschoor, A. (2005). Risk Attitudes and the Vicious Circle of Poverty. *The European Journal of Development Research,* 17(1):59 – 88

[37] Mwabu, G. & Thorbecke, E. (2004) 'Rural Development, Growth and Poverty in Africa', *Journal of African Economies*, 13 (Supplement 1): 116–65.

[38] Panda, A., Sharma, U., Ninan, K. N., & Patt, A. (2013). Adaptive capacity contributing to improved agricultural productivity at the household level: Empirical findings highlighting the importance of crop insurance. *Global Environmental Change*, 23: 782-790,

[39] Parks, P. J. (1995). Explaining" irrational" land use: risk aversion and marginal agricultural land. *Journal of Environmental Economics and Management*, *28*(1), 34-47.

[40] Patt, A., Suarez, P., & Hess, U. (2010). How do small-holder farmers understand insurance, and how much do they want it? Evidence from Africa. *Global Environmental Change,* 20(1), 153-161.

[41] Peterson, N. & Mullally, C. (2009). Index Insurance Games in Adi Ha Tabia, Tigray Regional State, Ethiopia. Oxfam America, Boston.

[42] Prelec, D. (1998). The probability weighting function. *Econometrica* 66 (3), 497:527.

[43] Ranjan, R., & Shogren, J. F. (2006). How probability weighting affects participation in water markets. *Water resources research*, *42*(8).

[44] Ravallion, M. (2001). Growth, Inequality, and Poverty: Looking beyond Averages. *World Development* 29 (11): 1803–15.

[45] Simtowe, F. (2006). Can risk-aversion towards fertilizer explain part of the non-adoption puzzle for hybrid maize? Empirical evidence from Malawi. *Journal of Applied Sciences,* 6(7), 1490-1498.

[46] Smit, B., & Skinner, M. W. (2002). Adaptation options in agriculture to climate change: A typology. *Mitigation and Adaptation Strategies for Global Change*, 7(1), 85-114.

[47] Tanaka, T., Camerer, C., Nguyen, Q. (2010). Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam. *American Economic Review*, 100(1):557 – 571.

[48] Tanaka, T., Camerer, C. F., & Nguyen, Q. (2016). Risk and time preferences: linking experimental and household survey data from Vietnam. In *Behavioural Economics of Preferences, Choices, and Happiness* (pp. 3-25). Springer Japan. (Matzikama IDP, 2009-2010).

[49] Thaler, R. H., Tversky, A., Kahneman, D., & Schwartz, A. (1997). The effect of myopia and loss aversion on risk taking: An experimental test. *The Quarterly Journal of Economics*, 647-661.

[50] Thorbecke, E. (2013). The Interrelationship Linking Growth, Inequality and Poverty in Sub-Saharan Africa. *Journal of African Economies,* Vol 22(Supplement 1): i15–i48

[51] Tversky, A., & Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. *The Quarterly Journal of Economics*, 1039-1061.

[52] Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and uncertainty*, *5*(4), 297-323.

[53] Ward, P. S., & Singh, V. (2013). Risk and ambiguity preferences and the adoption of new agricultural technologies: Evidence from field experiments in rural India. In Paper selected for presentation at the Agricultural and Applied Economics Association 2013 AAEA & CAES Joint Annual Meeting, Washington, DC.

[54] Yesuf, M., & Bluffstone, R. A. (2009). Poverty, risk aversion, and path dependence in low-income countries: Experimental evidence from Ethiopia. *American Journal of Agricultural Economics*, *91*(4), 1022-1037.

[55] Ziervogel, G., Bharwani, S., & Downing, T. E. (2006). Adapting to climate variability: pumpkins, people and policy. *Natural resources forum,* 30(4), 294-305. Blackwell Publishing Ltd.

Table 1: Summary Statistics

Variable	Mean	Standard Deviation
Sigma	0.51	0.34
Alpha	0.75	0.30
Lambda	2.55	3.13
Age	42.951	16.337
Female	44%	50%
Male	56%	50%
No Schooling	3%	18%
Some Primary School	34%	48%
Complete Primary School	16%	37%
Some Secondary School	36%	48%
Matric Certificate	9%	0.281
Higher Education	2%	13%
Household Income	R2365.273	R3237.302
Median hhIncome	R1500	
Perceived change in rainfall	68.8%	46.52%

Sample Size: 125

Table 2: Percentage Uptake in Rounds (n=125)

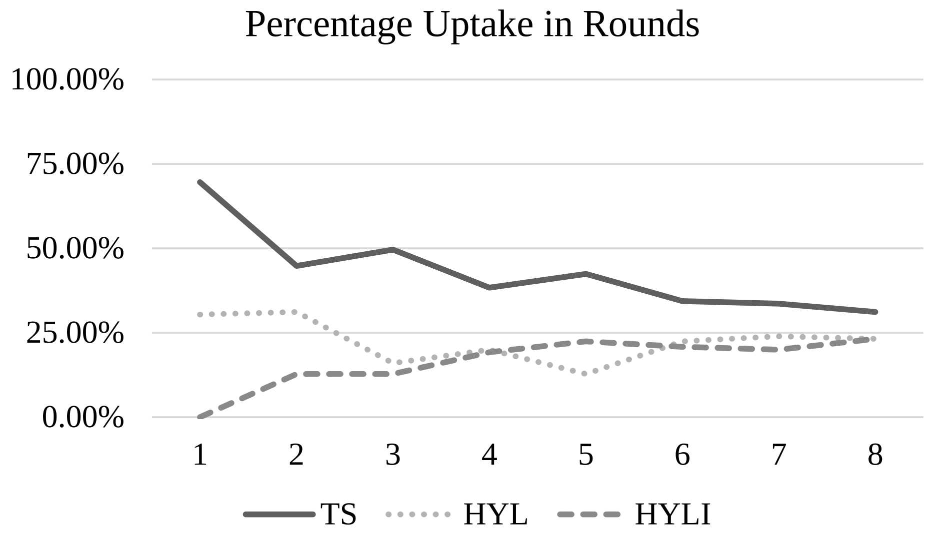
Round	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
TS	69.6	44.8	49.6	38.4	42.4	34.4	33.6	31.2
HYL	30.4	31.2	16.0	20.0	12.8	22.4	24.0	23.2
HYLI	0.0	12.8	12.8	19.2	22.4	20.8	20.0	23.2
Bankrupt	0.0	11.2	21.6	22.4	21.6	22.4	22.4	22.4

Table 3: Determinants of Uptake

	(1)	(2)	(3)	(4)
VARIABLES	**HYL**		**HYLI**	
Sigma (Risk Aversion)	-0.140	-0.914*	-0.747+	-1.264**
	(0.734)	(0.0190)	(0.0969)	(0.00973)
Alpha (Probability Weighting)	0.00862	-0.0647	0.188	0.370
	(0.981)	(0.847)	(0.719)	(0.458)
Lambda (Loss Aversion)	0.0184	0.0564	0.0927+	0.191**
	(0.732)	(0.277)	(0.0716)	(0.000396)
Cumulative Income	0.00860*	0.00524	0.0173**	0.0161**
	(0.0441)	(0.233)	(0.000107)	(0.000250)
Traditional Seeds in Round 1	-1.688**	-1.599**	-0.963**	-1.024**
	(3.24e-10)	(1.81e-08)	(0.00353)	(0.00317)
Round	0.00937	0.0307	0.192*	0.203**
	(0.866)	(0.603)	(0.0123)	(0.00954)
Shock in Previous Round	-0.471+	-0.453	-0.139	-0.126
	(0.0876)	(0.138)	(0.682)	(0.708)
Age		-0.0173		-0.000487
		(0.102)		(0.968)
Female		0.163		0.0758
		(0.506)		(0.790)
Education Level		-0.229**		-0.0484
		(0.000103)		(0.465)
Lower Income Group		-0.736*		-1.402**
		(0.0318)		(0.00111)
Log of Household Income		-0.0256		-0.00304
		(0.891)		(0.985)
Perceived change in rainfall		0.854**		0.358
		(0.00627)		(0.367)
Constant	0.185	2.359	-2.658**	-2.225
	(0.749)	(0.217)	(0.000710)	(0.279)
Log pseudolikelihood	-1073.81	-1014.9858	-1073.81	-1014.9858
Observations	671	671	671	671

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

Figure 1: Percentage Uptake in Rounds



Appendix I

Determinants of risk preferences

VARIABLES	Sigma	Alpha	Lambda
Age	-0.00722**	-0.000545	-0.0245
	(0.00115)	(0.000929)	(0.0160)
Female	0.0206	0.0551**	-0.536
	(0.0260)	(0.0200)	(0.375)
Education Level	-0.0163*	-0.00779+	-0.0453
	(0.00657)	(0.00410)	(0.0932)
Lower Income Group	-0.0137	-0.0525+	0.935+
	(0.0335)	(0.0285)	(0.478)
Household Income	-0.0142	-0.0256*	-0.289
	(0.0137)	(0.0106)	(0.182)
Perceived Rainfall Change	0.178**	-0.0569*	0.133
	(0.0298)	(0.0283)	(0.509)
Constant	-0.0918	-0.439**	5.238*
Lnsigma			1.595**
			(0.0509)
Observations	800	800	800
R-squared	0.082	0.032	
Prob > F	0.0000	0.0000	
Wald chi2(6)			20.06
Prob > chi2			0.0027

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

Given that the risk preference variables may be correlated with the other explanatory variables in the data, we regressed sigma, alpha and lambda on the explanatory variable to determine if a degree of collinearity exists that warrants re-estimation of our model. The VIF indicating collinearity between a) Sigma and other RHS variables = 1.089325, b) Alpha and other RHS variables = 1.03316, c) LLambda and other RHS =1.065416; ULambda and other RHS =1.087666. For Lambda, given that interval regressions do not produce an Rsquared, we estimated the degree of correlation of LLambda, ULambda with the predicted value of Lambda from the interval regressions and use the measure of correlation as a pseudo Rsquared. Both Rsquared and variance inflation factors VIF indicate very low collinearity. We therefore do not detect significant enough collinearity to warrant re-estimation using instrumental variables.

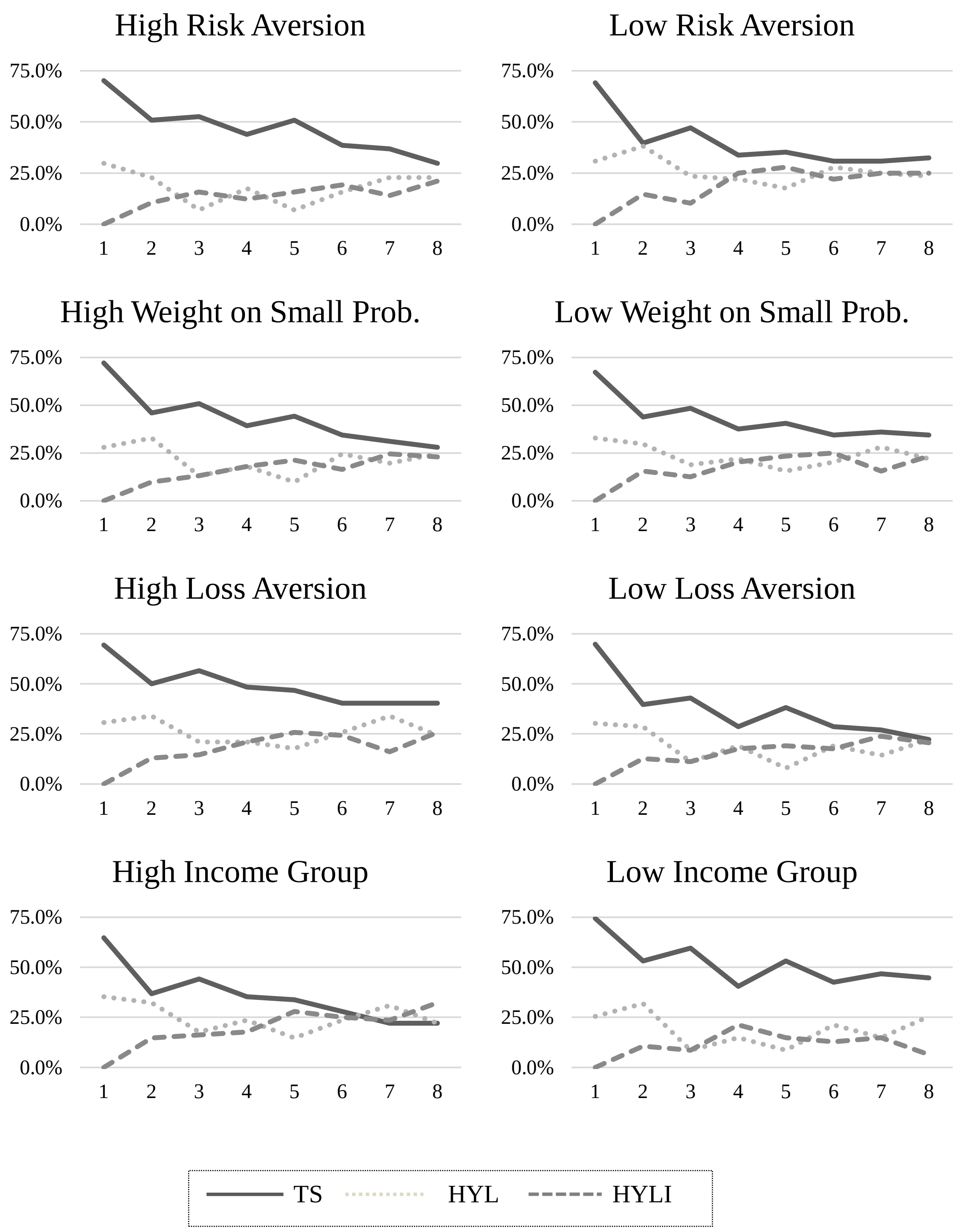
Appendix II

Payoff in Each Round

	OPTION	Earnings if blue ball is drawn	Earnings if yellow ball is drawn	Earnings if red ball is drawn
1	**Traditional seeds:**	R 10	R 10	R 10
	Income for this round:	R 10	R 10	R 10
2	**High yielding seeds with Uninsured Loan**	R 40	R 30	R 0
	Minus cost of loan (R10) plus interest (R1) = R11	R -11	R -11	R -11
	Income for this round:	R 29	R 19	R -11
3	**High yielding seeds with Insured Loan**	R 40	R 30	R 0
	Minus cost of loan (R10) plus interest (R1) = R11	R -11	R -11	R -11
	Minus cost of insurance	R -2	R -2	R -2
	Plus what you get back from insurance	R 0	R 4	R 8
	Income for this round:	R 27	R 21	R -5

Appendix III

Figure A: Categorical Uptake in Rounds



Appendix IV

Wilcoxon Signed-Rank Test P-Values			
		Round 1/ Round 2	**Round 2/ Round 8**
Whole Sample	TS	0.0095	0.0811
	HYL	0.9093	0.2253
	HYLI	0.0000	0.0526
High Risk Aversion	TS	0.1854	0.0768
	HYL	0.4652	1.0000
	HYLI	0.0143	0.1573
High Weight on Small Prob.	TS	0.0593	0.1011
	HYL	0.6219	0.3980
	HYLI	0.0143	0.0736
High Loss Aversion	TS	0.1630	0.4227
	HYL	0.7518	0.3173
	HYLI	0.0047	0.1025
Low Income Group	TS	0.1967	0.5553
	HYL	0.5637	0.5637
	HYLI	0.0253	0.5637

Appendix V

Experimental Instructions

Series 1

Once again please assume that it is planting season. You must decide whether you would like to plant traditional seeds or improved seeds.

This game consists of 14 rows. For **each** row, you must decide between planting traditional seeds or improved seeds.

Let's do an example [*turn to the poster*]. Look at row 1:

Let's start with traditional seeds. The level of rainfall will be enough for a high yield if you draw ball number 1, 2 or 3 out of this bag. If you draw ball number 4, 5, 6, 7, 8, 9 or 10 out of the bag, there is drought. If you planted traditional seeds and there is enough rain for a high yield, your harvest will be worth R20. If you planted traditional seeds and there is a drought, your harvest will be worth R5.

With improved seeds: there will be enough rain for a good harvest if you draw ball number 1 out of this bag. If you draw ball number 2, 3, 4, 5, 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you had planted improved seeds and there is enough rain for a good harvest, your harvest will be worth R34. If you had planted improved seeds and there is a drought, your harvest will be worth R2.50.

Now let's move to row 2:

Let's start with traditional seeds. There will be enough rain for a good harvest if you draw ball number 1, 2 or 3 out of this bag. If you draw ball number 4, 5, 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you planted traditional seeds and there is enough rain for a good harvest, your harvest will be worth R20. If you planted traditional seeds and there is a drought, your harvest will be worth R5.

With improved seeds: there will be enough rain for a good harvest if you draw ball number 1 out of this bag. If you draw ball number 2, 3, 4, 5, 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you had planted improved seeds and there is enough rain for a good harvest, your harvest will be worth R34. If you had planted improved seeds and there is a drought, your harvest will be worth R2.50.

Notice that the balls showing whether there is enough rain for a good harvest or whether there is drought stay the same throughout the game. The value of the harvest for planting traditional seeds also stays the same throughout the game. **The only thing that changes** is the value of the harvest for planting improved seeds **when there is enough rain for a good harvest**.

In the first row, if you plant improved seeds and there is enough rain for a good harvest, your harvest is worth R34. In the very last row, if you plant improved seeds and there is enough rain for a good harvest, you harvest is worth R850.

Remember, because the payoffs are so high for this game, if this game is chosen to be played for real money, two of you will randomly be chosen to play the game for money. We don't know who those 2 of you will be, so it is important to play this game as if you are playing for real money.

Just like before, we won't play all the rows for money. Once you have made your decisions, one of you will draw a ball from this bag which has 14 balls inside it. This will tell us which row you are playing for money. If ball number 1 is drawn from the bag, you will play row 1 for money. If ball number 2 is drawn from the bag, you will play row 2 for money. If ball number 14 is drawn from the bag, you will play row 14 for money.

Does anyone have any questions before we start?

Let's start. Please write the number we gave you at the start of the experiment on the top left hand side of the sheet where it says experiment number *[gesture to where they must put their number]*.

For each row in the sheet in front of you, indicate whether you would like to plant traditional seeds or improved seeds.

		Traditional Seeds	**Improved Seeds**
1	💧💧	R20 if ❶❷❸	R34 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
2	💧💧	R20 if ❶❷❸	R37.5 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
3	💧💧	R20 if ❶❷❸	R41.5 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
4	💧💧	R20 if ❶❷❸	R46.5 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
5	💧💧	R20 if ❶❷❸	R53 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
6	💧💧	R20 if ❶❷❸	R62.5 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
7	💧💧	R20 if ❶❷❸	R75 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
8	💧💧	R20 if ❶❷❸	R92.5 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
9	💧💧	R20 if ❶❷❸	R110 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
10	💧💧	R20 if ❶❷❸	R150 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
11	💧💧	R20 if ❶❷❸	R200 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
12	💧💧	R20 if ❶❷❸	R300 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
13	💧💧	R20 if ❶❷❸	R500 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿
14	💧💧	R20 if ❶❷❸	R850 if ❶
	💧	R5 if ❹❺❻❼❽❾❿	R2.5 if ❷❸❹❺❻❼❽❾❿

Answer:

I choose Traditional Seeds for rows 1 - [ ]

I choose Improved Seeds for rows [- 14]

Series 2

This game works exactly the same as the previous game. Once again please assume that it is planting season. You must decide whether you would like to plant traditional seeds or improved seeds. This game also consists of 14 rows. For **each** row, you must decide between planting traditional seeds or improved seeds.

Let's do an example [*turn to the poster*]. Look at row 1:
Let's start with traditional seeds. There will be enough rain for a good yield if you draw ball number 1, 2, 3, 4, 5, 6, 7, 8 or 9 out of this bag. If you draw ball number 10 out of the bag, there is a drought. If you planted traditional seeds and there is enough rain for a good yield, your harvest will be worth R20. If you planted traditional seeds and there is a drought, your harvest will be worth R15.

With improved seeds: there will be enough rain for a good yield if you draw ball number 1, 2, 3, 4, 5, 6, or 7 out of this bag. If you draw ball number 8, 9 or 10 out of the bag, there will be a drought. If you had planted improved seeds and there is enough rain for a good yield, your harvest will be worth R27. If you had planted improved seeds and there is a drought, your harvest will be worth R2.50.

Now let's move to row 2:

Let's start with traditional seeds. There will be enough rain for a good yield if you draw ball number 1, 2, 3, 4, 5, 6, 7, 8 or 9 out of this bag. If you draw ball number 10 out of the bag, there is a drought. If you planted traditional seeds and there is enough rain for a good yield, your harvest will be worth R20. If you planted traditional seeds and there is a drought, your harvest will be worth R15.

With improved seeds: there will be enough rain for a good yield if you draw ball number 1, 2, 3, 4, 5, 6, or 7 out of this bag. If you draw ball number 8, 9 or 10 out of the bag, there is a drought. If you had planted improved seeds and there is enough rain for a good yield, your harvest will be worth R28. If you had planted improved seeds and there is a drought, your harvest will be worth R2.50.

Notice that the balls showing whether there is enough rain for a good harvest or whether there is drought stay the same throughout the game. The value of the harvest for planting traditional seeds also stays the same throughout the game. **The only thing that changes** is the value of the harvest for planting improved seeds **when there is enough rain for a good yield**.

In the first row, if you plant improved seeds and there is enough rain for a high yield, your harvest is worth R27. In the very last row, if you plant improved seeds and there is enough rain for a high yield, you harvest is worth R65.

Just like before, we won't play all the rows for money. Once you have made your decisions, one of you will draw a ball from this bag which has 14 balls inside it. This will tell us which row you are playing for money. If ball number 1 is drawn from the bag, you will play row 1 for money. If ball number 2 is drawn from the bag, you will play row 2 for money. If ball number 14 is drawn from the bag, you will play row 14 for money.

Does anyone have any questions before we start?

Let's start. Please write the number we gave you at the start of the experiment on the top left hand side of the sheet where it says experiment number *[gesture to where they must put their number]*.

For each row in the sheet in front of you, indicate whether you would like to plant traditional seeds or improved seeds.

		Traditional Seeds	Improved Seeds
1	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R27 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
2	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R28 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
3	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R29 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
4	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R30 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
5	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R31 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
6	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R32.5 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
7	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R34 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
8	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R36 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
9	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R38.5 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
10	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R41.5 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
11	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R45 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
12	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R50 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
13	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R55 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿
14	💧💧	R20 if ❶❷❸❹❺❻❼❽❾	R65 if ❶❷❸❹❺❻❼
	💧	R15 if ❿	R2.5 if ❽❾❿

Answer:

I choose Traditional Seeds for rows 1 - [ ]

I choose Improved Seeds for rows [- 14]

Series 3
This game works exactly the same as the previous game.

Once again please assume that it is planting season. You must decide whether you would like to plant traditional seeds or improved seeds.

This game consists of 7 rows. For **each** row, you must decide between planting traditional seeds or improved seeds.

The difference in this game is that, now, you can **lose money**. Any money you lose will be taken from your earnings for this session.

Let's do an example [*turn to the poster*]. Look at row 1:

Let's start with traditional seeds. There is enough rain for a good yield if you draw ball number 1, 2, 3, 4 or 5 out of this bag. If you draw ball number 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you planted traditional seeds and there is enough rain for a good yield, your harvest will be worth R12.50. If you planted traditional seeds and there is a drought, you will lose R2.

With improved seeds: there is enough rain for a good yield if you draw ball number 1, 2, 3, 4 or 5 out of this bag. If you draw ball number 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you planted improved seeds and there is enough rain for a good yield, your harvest will be worth R15. If you planted improved seeds and there is a drought, you will lose R10.50.

Now let's move to row 2:

Let's start with traditional seeds. There is enough rain for a good yield if you draw ball number 1, 2, 3, 4 or 5 out of this bag. If you draw ball number 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you planted traditional seeds and there is enough rain for a good yield, your harvest will be worth R12.50. If you planted traditional seeds and there is a drought, you will lose R2.

With improved seeds: There is enough rain for a good yield if you draw ball number 1, 2, 3, 4 or 5 out of this bag. If you draw ball number 6, 7, 8, 9 or 10 out of the bag, there is a drought. If you planted improved seeds and there is enough rain for a good yield, your harvest will be worth R15. If you planted improved seeds and there is a drought, you will lose R10.50.

Just like before, we won't play all the rows for money. Once you have made your decisions, one of you will draw a ball from this bag which has 7 balls inside it. This will tell us which row you are playing for money. If ball number 1 is drawn from the bag, you will play row 1 for money. If ball number 2 is drawn from the bag, you will play row 2 for money. If ball number 7 is drawn from the bag, you will play row 7 for money.

Does anyone have any questions before we start?

Let's start. Please write the number we gave you at the start of the experiment on the top left hand side of the sheet where it says experiment number *[gesture to where they must put their number]*.

For each row in the sheet in front of you, indicate whether you would like to plant traditional seeds or improved seeds.

	Rainfall	Traditional Seeds	Improved Seeds
1	💧💧	R12.5 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R2 if ❻❼❽❾❿	-R10 if ❻❼❽❾❿
2	💧💧	R2 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R2 if ❻❼❽❾❿	-R10 if ❻❼❽❾❿
3	💧💧	R0.5 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R2 if ❻❼❽❾❿	-R10 if ❻❼❽❾❿
4	💧💧	R0.5 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R2 if ❻❼❽❾❿	-R8 if ❻❼❽❾❿
5	💧💧	R0.5 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R4 if ❻❼❽❾❿	-R8 if ❻❼❽❾❿
6	💧💧	R0.5 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R4 if ❻❼❽❾❿	-R7 if ❻❼❽❾❿
7	💧💧	R0.5 if ❶❷❸❹❺	R15 if ❶❷❸❹❺
	💧	-R4 if ❻❼❽❾❿	-R5.5 if ❻❼❽❾❿

Answer:

I choose Traditional Seeds for rows 1 - [ ]

I choose Improved Seeds for rows [- 7]

Insurance Games - Experiment Instructions

We will be completing 1 activity. This activity is played over eight rounds.

Let's begin. We will do **eight rounds** of this activity and **each round will represent a farming season.** In this exercise we are going to imagine that you are at the start of a farming season. You have to make a decision about the type of seeds you are going to use for this season. Your income will depend on what type of seed you plant and the amount of rainfall the district receives.

RAINFALL
To see how much rainfall there is for the round we will draw a ball from this bag. If we draw a blue ball that means the rainfall is good. If a yellow ball is drawn that means the rainfall is low and if a red ball is drawn the rainfall is very low. There are three blue balls in the bag, three yellow balls and three red balls. [SHOW THEM ALL THE BALLS THAT WILL GO INTO THE BAG]

Alright let me ask you a question. If I pull out a ball from the bag, is it more likely that it will be a blue ball, a yellow ball or a red ball?

[WAIT FOR RESPONSE]

[IF THEY GET IT RIGHT] That's right. There is an equal chance of drawing out a blue ball, a yellow ball or a red ball. Why? Because there are three balls of each colour.

[IF THEY GET IT WRONG] Actually, there is an equal chance of drawing out either a blue ball, a yellow ball or a red ball because there are exactly the same number of balls of each colour.

Let's do an example. Would anyone like to pull a ball out of the bag?

[PICK A VOLUNTEER]

You sir? You are going to draw a ball out of the bag. [HAVE HIM OR HER PULL OUT A BALL FROM THE BAG]. A [COLOUR OF BALL] ball. So is the rain collected by the rainfall meter good, low or very low? [WAIT FOR RESPONSE; HELP THEM IF THEY HAVE TROUBLE]. Yes, it will be [RAINFALL TYPE].

TRADITIONAL SEEDS:
You have always used a certain type of seed every year which we shall call traditional seeds. Compared with other types of seeds these traditional seeds give you a lower yield. However they always give you the same yield whether the rains are good, low or very low. In other words, you always know what to expect. If you decide to plant these seeds, come harvest time, you will receive R10 for your yield for this farming season if the rains are good, low or very low.

If you would like to stick with the traditional seeds there is no cost in using these seeds. We will assume that you have been storing some of these seeds after every farming season over the years. So you can go ahead and start planting.

NEW IMPROVED SEEDS:
On the other hand, you have heard that new types of seeds have been introduced in Matzikama and that only a few farmers have started using them. You have not yet used these seeds but you have heard great things about them and you are wondering if you should try them. The few farmers who have started using these new seeds have told you that the seeds are drought resistant and can increase the yield on your piece of land substantially.

If you choose to use these new seeds and if the rains are good you earn R40 in one farming season. If the rains are low you earn R30 which is more than the R10 you get from the traditional seeds. But, you are told that there is a disadvantage to using the new seeds. If the rains are very low you will not get any yield from your land. You have a decision to make. Do you want to plant traditional seeds which always give you the same yield when rains are good and even when they are bad? Or do you want to try the new seeds which give you a higher yield when the rains are good or low, but which give you a zero yield when the rains are very low?

LOAN FOR BUYING NEW IMPROVED SEEDS:
However, if you decide to grow the new seeds you will have to borrow money from the bank to buy these seeds. They are expensive because they give you higher yields than the traditional seeds in most cases. You are required to take out a R10 loan in order to buy these new seeds. At the end of the season you are required to pay back the R10 plus an additional R1, which is interest on the loan. So, in total, if you would like to purchase the new seeds, the loan will cost you R11.
Are there any questions?
[PAUSE TO ANSWER QUESTIONS]

LOAN AND INSURANCE
In addition to the loan, you can also buy insurance that will protect you from losing income if rainfall is low or very low. We will call this insurance "rainfall insurance."

We will first explain about the insurance. Insurance is a way to protect against losses. You pay a little bit before the season begins to protect against losses. In the case of rainfall insurance if the rains are low or very low in a particular farming season the insurance company will give you some money to make up for the losses due to not having enough rain. But if the rains are good you do not receive any money from insurance. Why? Because your crops received enough rainfall. Losses that you experience on your farm as a result of other things such as pests or crop disease are not covered by this type of insurance. Also, whether the rainfall is low or not you must always pay for the insurance before the round begins if you want this protection against losses.

The money that is paid out by the insurance to you is meant to protect against losses suffered due to the rains being below what you would normally expect. How does the insurance company decide if the rains are low or not? A container which measures rainfall is placed in a central location in each town and village in Matzikama. This container acts as a rainfall meter. It records how much rain you receive in the area during the rainy season. If the rains are good (a blue ball is drawn from the bag), the container will have a lot of water in it when the insurance company goes to check it.

If you decide to buy insurance, you will receive money from the insurance company only if [STRESS THIS POINT] the rain collected by the rainfall meter is low or very low; that is, if a yellow or red ball are pulled out from the bag in each round.

What the insurance company does not know is the actual crop yield you get on your farm. To do this they would have to go from farm to farm, asking everyone with insurance whether they had a large, average or small harvest. This would cost too much money and make the insurance very expensive. Therefore we will only use the amount of rainfall recorded at the rainfall meter to determine the amount you will receive from insurance.

So how does this really work? This figure [POINT TO FIGURE IN FRONT OF THE ROOM] explains how rainfall amounts are tied to insurance payments. Remember that if you want insurance payouts you must first pay for insurance at the beginning of the round. Insurance costs R2. Remember this is just an exercise, so the cost of insurance is very low here. It would be much more expensive if you were actually buying for your farm. Your payments from the insurance company would also be much larger.

Table 2: Insurance

	If a blue ball is drawn from the bag GOOD RAINFALL	**If a yellow ball is drawn from the bag LOW RAINFALL**	**If a red ball is drawn from the bag VERY LOW RAINFALL**
Cost of insurance:	**R2**	**R2**	**R2**
If you have bought insurance you receive:	**R0**	**R4**	**R8**

As I said earlier you only receive money from the insurance if rain collected by the rainfall meter is low or very low, or when a yellow or red ball is pulled from the bag.

As you can see from the chart you receive a big payment from insurance of R8 when a red ball is pulled out meaning rain is very low in the rainfall meter. You receive the smaller payment of R4 when a yellow ball is drawn out meaning rain is low in the rainfall meter. You will not receive anything from the insurance if a blue ball is drawn because this means that the rains were good. Remember that if you are interested in buying insurance, you always pay R2 for insurance at the beginning of the round.

BANKRUPTCY RULE:
At the end of every round we will give you information about what your earnings for that round was and also what your TOTAL EARNINGS for Activity 2 are so far. If at the end of any round in this activity, if you have made a loss you can still continue to the next round if your TOTAL INCOME for Activity 2 so far (which includes your income from previous rounds) can cover your losses. If not, you will be disqualified from the ACITIVTY 2, which means you will not be able to continue to the next round. **You will however each receive R15 at the end of this activity to cover you for such losses so that you will not lose any of your own money or money that you earned in ACTIVITY 1.**

EXAMPLE OF ACTIVITY 2:
So now that I have explained everything to you, lets do an example.

In this activity you have to decide if you want to use **traditional seeds** or **new seeds**. If you want to use the traditional seeds you do not have to worry about borrowing money or buying insurance.

If however you decide to use the new seeds you **will have to** [STRESS THIS POINT] borrow R10 from the bank to pay for the seeds. Remember that you will have to pay this back with **R1** interest at the end of the round. In total you will have to pay back R11.

If you want to use the new seeds you could in addition to taking out a loan, also buy insurance for R2 which will pay out R4 if the rainfall is low and R8 if the rain is very low.

The figure on this board (or wall) shows you exactly how this all works. Let's go over the figures in this table: [SHOW THEM THE TABLES]

INCOME IF YOU USE TRADITIONAL SEED:
If you decide to use traditional seeds you will receive R10 in the first round if the rains are good. If the rains are low, you will also receive R10 and when the rains are very low you will still receive R10. Are there any questions?

[PAUSE TO ANSWER QUESTIONS]

	OPTION	**Earnings if blue ball is drawn**	**Earnings if yellow ball is drawn**	**Earnings if red ball is drawn**
1.	If you choose to use traditional seeds you receive (for your harvest):	**R10**	**R10**	**R10**
	Income for this round:	**R10**	**R10**	**R10**
	Total Income for all previous rounds:	**…..**	**…..**	**…..**

2.	If you choose to take out a loan to buy improved seeds, you receive (for your harvest):	**R40**	**R30**	**R0**
	Minus cost of loan (R10) plus interest (R1) = R11	**-R11**	**-R11**	**-R11**
	Income for this round:	**R29**	**R19**	**-R11**
	Total Income for all previous rounds:	**…..**	**…..**	**…..**

3.	If you choose to take out a loan and to also buy insurance, you receive (for your harvest):	**R40**	**R30**	**R0**
	Minus cost of loan (R10) plus interest (R1) = R11	**-R11**	**-R11**	**-R11**
	Minus cost of insurance	**-R2**	**-R2**	**-R2**
	Plus what you get back from insurance	**+R0**	**+R4**	**+R8**
	Income for this round:	**R27**	**R21**	**-R5**
	Total income for all previous rounds:	…..	…..	…..

<u>INCOME IF YOU TAKE OUT A LOAN TO BUY NEW SEEDS</u>

If you decide to use new seeds you have to borrow R10 from the bank so that you can buy the new seeds. If the rains are good, that is, if a blue ball is drawn from the bag, you will receive R40. **However, from that R40 you will have to pay back the bank the R10 you borrowed at the start of the round plus an additional interest of R1. So in total you will owe the bank R11. You will be left with R29 after paying back the loan. This is your TOTAL INCOME for Activity 2 so far.**

If the rains are low, that is, if a yellow ball is pulled out, you will receive R30 at the end of the round. **Again you will have to pay back the R11 to the bank, leaving you with R19. This is your TOTAL INCOME for Activity 2 so far.**

If the rains are very low, that is, if a red ball is drawn out, you will not receive any income for your harvest. This is because your seeds failed to germinate. However, you still need to pay back the money you borrowed from the bank. So although you did not make any money, you still owe the bank the R10 you borrowed at the beginning of the round plus the R1 interest. **This leaves you with a LOSS (or negative income) of –R11 for this round.**

This is where the bankruptcy rule comes in. If you make a loss we will have to check if you have enough TOTAL INCOME (from previous rounds) to cover your losses and to continue. If you don't, you will not be able to continue to the next round, and you will be disqualified from the activity. [EXPLAIN TO THEM THAT IN THE FIRST ROUND THEY WILL NOT HAVE FUNDS FROM PREVIOUS ROUNDS TO COVER SUCH LOSSES]

As we explained before, even though you have made a loss – you will receive R15 at the end of Activity 2 to cover any such losses.

Are there any questions?
[PAUSE TO ANSWER QUESTIONS]

LOAN AND INSURANCE

If you decide to use new seeds and in addition to the loan you also want to buy insurance this will cost you an additional R2. In the first round none of you will be able to afford insurance, since you have not received any income for your harvest yet. Remember what we said about the insurance. You have to pay for it before the round begins if you are interested in insurance and this will cost you R2 at the beginning of the round. [SHOW THEM THE DISTRIBUTION CHART AGAIN]

So, if we draw out a blue ball this means that the rains are good and you receive R40 and the insurance pays out nothing. But remember that we will subtract the R11 you owe for taking out a loan, and that you already paid R2 for insurance coverage, so you income for this round is R27.

If the rains are low, that is, if we draw out a yellow ball, you will receive R30 and the insurance will pay out another R4.. **Again you will owe the bank R11, and remember that you paid R2 for insurance, so you income for this round will be R21.** [SHOW THEM THE DISTRIBUTION CHART AGAIN]

If we draw out a red ball, we assume that your crops failed and so you do not earn any money from your farm. Your seeds were unsuccessful and you did not make any money, but the insurance pays out R8. **Once again you owe the bank R11, and remember that you paid R2 for insurance coverage, so you make a loss (negative income) of –R5 for this round. [SHOW THEM THE DISTRIBUTION CHART AGAIN].**

Once again this is where the bankruptcy rule comes in. If you make a loss we will have to check if you have enough TOTAL INCOME (from previous rounds) to cover your losses and to continue. If you don't, you will not be able to continue to the next round, and you will be disqualified from the activity. [EXPLAIN TO THEM THAT IN THE FIRST ROUND THEY WILL NOT HAVE FUNDS FROM PREVIOUS ROUNDS TO COVER SUCH LOSSES]

As we explained before, even though you have made a loss – you will receive R15 at the end of Activity 2 to cover any such losses.

We have given you a lot of information today and I am sure there are some questions. If anything is unclear please feel free to ask before we begin the activity. Remember you are playing for real money so make sure you understand all this before you start playing.

[PAUSE TO ANSWER QUESTIONS]

The assistants will hand out new pieces of paper which you will use to indicate the option you want i.e. 1, 2 or 3 [ASSITANTS: HAND OUT SHEETS. POINT OUT DIFFERENT PARTS OF THE WORKSHEET AS EMCEE EXPLAINS THEM]. **At the end of each round, you will be asked to indicate your choice on this sheet of paper as you did in the first activity. After you've circled the option you want our assistants will come round to you and collect your answer sheets. We will work out how much each person gets. Before we move on to the next round we will give each person receipt feedback sheet which tells you how much money you earned in this round and what you TOTAL INCOME is for Activity 2 so far.**
Before we begin, let's do an example.

[EMCEE: PICK ANOTHER VOLUNTEER]. You sir. Please choose one of the three options. Now pick someone else to draw a ball from the bag. [PARTICIPANT DRAWS BALL]. You drew a [COLOUR OF BALL] ball from the bag. This means the rainfall for this round is [RAINFALL TYPE]. How much would he have earned if we were playing an actual round?

We need to explain here that in this activity only one person will draw out a ball for the entire group in each round. Why do you think this is the case? The reason is that if there is high rainfall in your town, you are all likely to receive the same amount or very similar amounts of rainfall on your farm. If there is low rainfall in the rainfall meter it is likely that you all received low rains on your farms, so we only need one person to draw out a ball for us.

Does anyone have any questions? Ok, we are ready to start this exercise. [ASSISTANTS SHOW YOUR GROUP MEMBERS HOW TO MAKE THEIR CHOICES]. After they have finished making their choices find a volunteer to draw out a ball for the group. Record earnings for the round.

[REPEAT AS IN ROUND 1 FOR ROUNDS 2-8]

Appendix VI: Attrition Probit	
VARIABLES	Bankrupt
Sigma	-0.000290
	(0.168)
Alpha	0.00516
	(0.205)
Lambda	0.0595**
	(0.0177)
Age	-0.0233**
	(0.00492)
Female	0.578**
	(0.107)
Education Level	-0.0553*
	(0.0245)
Lower Income Group	0.174
	(0.130)
Household Income	-0.000101*
	(4.24e-05)
Perceived change in rainfall	0.585**
	(0.139)
Constant	-0.295
	(0.455)
Pseudo R-squared	0.1066
chi2(9)	108.97
Prob > chi2	0.0000
Observations	800

Robust standard errors in parentheses

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

Appendix VII

Non Parametric Tests - Difference Within Rounds									
		Chi2/Fisher Exact Test P-Values				**Mann–Whitney U Test P-Values**		
	Round	**1**	**2**	**8**		**1**	**2**	**8**
High Risk Aversion/Low Risk Aversion	**TS**	0.8980	0.2110	0.7610		0.8985	0.2128	0.7621
	HYL	0.8980	0.0640	0.9240		0.8985	0.0648	0.9244
	HYLI	N/A	0.4860	0.6030		N/A	0.4878	0.6040
High Weight on Small Prob. /Low Weight on Small Prob.	**TS**	0.5480	0.8090	0.4330		0.5497	0.8097	0.4344
	HYL	0.5480	0.7090	0.7190		0.5497	0.7096	0.7203
	HYLI	N/A	0.3330	0.9490		N/A	0.3348	0.9488
High Loss Aversion/ Low Loss Aversion	**TS**	0.9530	0.2460	0.0290		0.9530	0.2480	0.0296
	HYL	0.9530	0.5230	0.7940		0.9530	0.5242	0.7949
	HYLI	N/A	0.9730	0.4930		N/A	0.9728	0.4952
High Income Group/Low Income Group	**TS**	0.2670	0.0810	0.0100		0.2692	0.0820	0.0105
	HYL	0.2670	0.9610	0.6660		0.2692	0.9607	0.6671
	HYLI	N/A	0.5240	0.0010		N/A	0.5261	0.0010