Risk, Credit, and Insurance in Peru: Field Experimental Evidence*

Francisco B. Galarza†
Universidad Francisco Marroquín, Guatemala

This Version: April, 2010
August, 2009

Abstract

This paper reports the results of behavioral economic experiments conducted in Peru to examine the relationship amongst risk preferences, loan take-up, and insurance purchase decisions. This area-based yield insurance can help reduce people's vulnerability to large scale covariate shocks, and can also lower the loan default probability under extreme negative covariate shocks. In a context of collateralized formal credit markets, we provide suggestive evidence that insurance may help reduce the fear of losing collateral that prevents potential borrowers from taking loans. Framing these experiments to recreate a real life situation, we started with a *Baseline Game* where subjects had to choose between a fallback production project and an uninsured loan.We then introduced a third project choice—loan with yield insurance (*Insurance Game*)—which allows us to measure the effect of introducing insurance on the demand for loans. Overall, more than 50 percent of the subjects are willing to buy insurance in this insurance game. Further, controlling for the number of peers in the ag network, wealth, and choices made in the baseline game, we find that the project choice decision is predicted by a judgement bias known as hot-hand effect and risk aversion. In the latter case, the shape of the relationship is quadratic, meaning that highly risk averse subjects will prefer switching to the risky project (uninsure loan), while those showing low and moderate risk aversion will stick to the safer (fallback or insured loan) projects.

Keywords: area-yield insurance, credit, covariate risk, idiosyncratic risk, risk aversion, experimental economics, Peru.

JEL classification numbers: C93, D81.

*I am indebted to Michael R. Carter for his continuous encouragement and suggestions. I also thank Brad Barham, Jed Frees, Paul Mitchell, and Laura Schechter for helpful comments, and seminar participants at the University of Wisconsin, Wesleyan University, and the 2009 Agricultural and Applied Economics Annual Meeting, for their suggestions. Steve Boucher, Carlos de los Ríos, Conner Mullally, and Carolina Trivelli provided helpful feedback on the experimental design. Ramón Díaz, Oscar Madalengoitia, Roberto Piselli, Chris Rue, Raphael Saldaña, Jessica Varney, Josh Weinberg, and especially Johanna Yancari, provided a valuable assistance in the field. Financial support from the USAID Cooperative Agreement No. EDH-A-00-06-0003-00 through the Assets and Market Access Collaborative Research Support Program is gratefully acknowledged. Usual disclaimer applies.

†E-mail: fbgalarza@uwalumni.com.

1 Introduction

Risk is widespread in less developed economies, where low-income people living in rural areas are exposed to several potentially catastrophic hazards, such as severe weather events, which are often more detrimental than the series of idiosyncratic shocks that periodically affect them. In order to manage and deal with risk, those people have traditionally used a series of *ex-ante* and *ex-post* strategies,[1] with less than desired results. Despite the substantial efforts made to reduce their vulnerability to negative economic shocks, recent evidence suggests that the consumption variability at the individual level still remains high in the developing world (Dercon, 2005; Morduch, 1995). Depending on the nature and magnitude of those shocks, this lack of appropriate equipment may lead people to chronic poverty, thus affecting their possibilities to engage in an economically viable growth path.[2]

In addition to individual specific efforts displayed to handle risk, innovative financial products, such as uncollateralized microloans and index-based insurance, have been designed and implemented from the supply side. On the one hand, in the wake of the so-called microfinance revolution, poor people, typically unable to offer collateral, have become eligible to get credit access and take advantage of business opportunities. On the other hand, moral-hazard proof insurance written on average aggregate indices has emerged with the promise of helping households keep valuable assets which could otherwise be lost as a result of extreme negative shocks.

Besides smoothing consumption over time, index-based insurance may also have an appealing property in a scenario where a significant proportion of potential borrowers are discouraged from applying for loans because of their fear of losing collateral in case of default: by reducing the likelihood of a loan default, it may stimulate a proportion of those fearful producers to enter the credit market. Given that such voluntary withdrawing from the credit market, termed as *risk rationing* (Boucher et al., 2008), has been shown to be an empirically relevant phenomenon in Peru, where we conduct our research,[3] it is expected that the introduction of such an insurance scheme would have a positive effect on the expansion of the credit market.

The extent to which insurance can help expand credit markets in less developed countries is an empirical question that has not sufficiently been investigated. With only a few index-based insurance programs operating in less developed countries, the literature on the linkage between credit and index insurance (or any type of insurance for that matter) is at best scant. To our knowledge, with the probable exceptions of a handful of works,[4] no other study has addressed, directly or

[1] Risk management, *ex-ante* strategies, may include income diversification, savings, insurance, participation in rotating saving and credit associations (ROSCAs); while risk coping, *ex-post* strategies, may include the use of informal loans, liquidation of assets, and reallocation of labor, among others.

[2] The literature on poverty has documented this case, in which when households fall below certain threshold—the Micawber Frontier—their prospects to escape from poverty are negligible (Carter and Barrett, 2006).

[3] In Peru, Honduras, and Nicaragua, risk rationed borrowers account for between 12 and 19 percent of the total sample of borrowers (Boucher et al., 2008).

[4] Cole et al. (2008) examined the obstacles to a wider insurance take up in India; Giné and Yang (2009) analyzed whether rainfall insurance can help increase demand for loans in a randomized control trial in Malawi; Giné et al. (2009) experimentally tested the demand for different microfinance contracts in urban Peru; and Lybbert (2006) designed experiments in Morocco to elicit willingness to pay for seeds that increase yields, reduce yields variance or yields skewness.

indirectly, the three issues that concern this paper: the interaction between risk preferences and demand for credit and insurance.

This paper uses a unique experimental data set gathered in Peru, where we set up an experimental economics laboratory and run experiments that examine the nature and main predictors of the demand for loans and index-based insurance; we label these behavioral experiments "farming experiments." We are particularly interested in examining the effect of risk preferences (estimated in a companion paper, Galarza [2009]) on the decision to purchase an innovative type of crop insurance.[5] Our farming experiments simulated farming decisions where our experimental subjects chose among alternative cotton production projects: fallback (low return, or safe), produce with an uninsured loan (high return, or risky), or produce with an insured loan (*less risky*). Using a payoffs scheme for each project in order to incentivize subjects to reveal their true preferences, this paper develops an approach that is also used as a tool to build people's comprehension of this new insurance product.

A novel feature of this experiment is that projects' profits depend on the realizations of two random shocks: a covariate, correlated shock, represented by the valley-wide average yield, and an idiosyncratic shock. Projects' profits, constructed using survey data from the Pisco valley, are such that the uninsured loan does not yield sufficient profits to fully repay the loan under a "very low" realization of the valley-wide average yield, regardless of the realization of the idiosyncratic shock. In contrast, the insured loan's profits guarantee full repayment of loans under every realization of the two random shocks. In order to reproduce the dynamic effects that defaulting on a collateralized loan involves, we imposed two consequences of not repaying a loan in the experiment: no future access to loans, and a depreciation of land.

Our sample includes 378 experimental subjects from rural Peru. The experiments started with a *baseline experiment*, where farmers had to choose between the fallback project and the uninsured loan project, in a series of repeated rounds that simulated single farming seasons. We then introduced the insured loan to the set of choices available (*insurance experiment*). This design allows us testing whether the introduction of insurance affects farmers' choice between the safe and the risky project.

Our findings are as follows. First, the experimentally-measured demand for valley-wide average yield insurance is fairly high: 57 percent of farmers demanded the insured loan project by the last two high-stake rounds, a proportion that remains rather steady during all the high stakes rounds. Second, our experimental results suggest that index yield insurance, by reducing the likelihood of loan defaults, may crowd-in credit markets by a sizeable proportion. We find that about 60 percent of the subjects who chose the fallback, safe project (i.e., 24 percent of the total subjects) in the baseline experiment switched to the insured loan project in the insurance experiment. This result indicates that insurance would allow almost 14 percent of the total number of subjects not to

[5] This research project was carried out in partnership with an insurance company in Peru and a vendor of insurance contracts bundled with loans that operates in our research site, the Pisco valley. At all times during the course of the experimental sessions, we emphasized the fact that our participation as researchers was simply intended to inform farmers about the main features of this new financial product and to examine their willingness to buy it. We also stressed the fact that participating in these sessions should not make them feel obliged to buy insurance.

withdraw from the credit market.[6] While such estimated magnitude may be used with caution, it is suggestive that insurance could encourage the undertaking of riskier but potentially more profitable production projects thanks to new funds coming from a loan. Third, controlling for wealth and choices made in the baseline experiment, we find evidence of 'hot-hand' effects (stemming from an underestimation in the autocorrelation of the sequence of 'very bad' years) in project choice, while static risk preferences estimated under Expected Utility Theory (EUT) appear to have a quadratic (concave) shape with project choice, meaning that highly risk averse subjects will prefer switching to the risky project (uninsured loan), while those showing low and moderate risk aversion will stick to the safer (fallback or insured loan) projects. This result offers novel evidence about the relationship between risk aversion and preferences for innovative financial instruments.

The remainder of this paper is organized as follows. Section 2 discusses our experimental design in the context of related works. Section 3 describes the experimental procedures followed and the data used; and also presents a descriptive analysis of the results. Section 4 analyzes the main econometric results and Section 5 concludes.

2 Related Studies and Our Experimental Design

In this section, we review the literature relevant to our research (section 2.1) and then discuss the distinctive features of our experimental design in that context (section 2.2). Using the terminology coined by Harrison and List (2004), our farming experiments are *framed* field experiments, as they concern valuations over a real commodity (cotton) and involve tasks similar to those performed by the experimental subjects acting in their usual production environment.

2.1 Related Studies

In recent years, we have witnessed a rapid growth in the number of experimental studies in development economics. Although these works have analyzed a wide gamut of topics, there still remains much to be done in terms of applying the laboratory experimental tools in the analysis of development issues. In a survey of the literature about experiments conducted in less developed countries, Cardenas and Carpenter (2005) report that three of the main topics studied are the measurement of trust, cooperation, and risk preferences; none of these studies investigates the role of elicited risk preferences in explaining the demand for financial contracts.

A more recent set of behavioral field experiments that concern the topics analyzed in this paper involve testing the demand for microfinance contracts (Giné et al., 2009) and the willingness to pay for seeds that stabilize yield distributions (Lybbert, 2006), using in both cases a payoffs scheme to incentivize subjects' truthful preference elicitation. Two other works that used randomized control trials to examine the demand for weather-based insurance in India and Malawi, respectively (Cole et al., 2008; Giné and Yang, 2010), will also be discussed below.

[6] After this round in default, farmers are left with no choice but to do the fallback project. The quantitative importance of this finding increases to about 20 percent when we use the *modal* choice during the high-stake rounds.

Lybbert (2006) investigates farmers' preferences about three desirable properties of cotton seeds in India: an increase in average yields, a reduction in yields' variance, and a reduction in yields' skewness. Using the Becker-DeGroot-Marchak method (Becker et al., 1964) to elicit the maximum willingness to pay for those traits, where farmers were given the payoff distributions related to each type of seed before making their bid,[7] Lybbert shows that farmers value seeds that increase the expected returns, but no evidence about their valuation of the other two traits of seeds was found. As Lybbert acknowledges, the lack of valuation of yield's risk reduction (i.e., less variance) may be explained by the inability of the experimental design to control for the relevant factors that affect farmer's valuation of crop yield distributions. Lybbert's results further show no statistically strong relationship between any individual characteristic (such as wealth) and expected returns, a result that the author claims could be due to the existence of credit constraints.

Giné and Yang's (2010) randomized control trial in Malawi examine whether insurance can induce farmers to take loans to adopt a new, high-yielding seed variety. The control group was offered a loan to purchase a high-yielding seed; while the treatment group was offered an identical loan contract but was *required* to buy actuarially fair rainfall-indexed insurance *if* they took the loan. This insurance can allow to partially or fully repay the loan, depending on how low the rainfall is. Thus, while assuming a risk averse behavior, one could expect insured farmers to be more willing to take out a loan in order to undertake a potentially more profitable investment (i.e., buying the high-yielding seed), Giné and Yang find exactly the opposite result: loan take-up rates are much lower for the treatment group (17.6 percent *versus* 33.0 percent). The authors suggest that the low insured loan take-up could be due to the prior existence of limited liability; that is, the actual consequences of defaulting on a loan might not have been so severe in the first place, and thus the actual value of buying insurance would be limited. In the same line, Cole et al.'s (2008) randomized control trials in India aim to identify the barriers to a wider adoption of rainfall insurance. They find that subjects' purchase rates are very price elastic, and that cash constraints seem to play a role in insurance adoption. More interestingly, they find that third party endorsement (such as that of a local authority) of insurance can affect its take-up, thus suggesting a potentially strong correlation between choices across subjects from the same village.

Our behavioral experiment shares some features in common with the previously discussed works, but it arguably offers a more complete depiction of how rural producers make production decisions. In particular, our experiment focuses on examining the interrelationship among three themes: agricultural yields, loan, and insurance. In our experiment, loans yield higher expected yields (i.e., a more profitable production) and insurance eliminates the possibility of defaulting on a loan, thus securing the farm production and ensuring farmers to keep access to loans in the future. Written on valley-wide yields, this insurance protects producers from catastrophic events that dramatically reduce average yields at the valley level. Subjects' farming profits depend on two random variables:

[7] Once farmers bid a price, a random seed price was drawn from a uniform distribution with mean of 50 Rupees (Rs.). Thus, if farmers bid at least the amount of the randomly drawn price, they could get the seed and "plant it", and get the corresponding payoff. After this, farmers draw a chip from a bag to determine the season's harvest payoff. Thus, for a farmer who planted the seed, his net earnings would be the harvest payoff, minus the price paid for the seed, plus 50 Rs. (off-farm earnings), while for one who did not plant the seed, it would be only the 50 Rs. corresponding to the off-farm earnings.

a covariate shock—represented by the valley-wide average yield—that affects equally all subjects in the same valley, and an idiosyncratic shock, uncorrelated with the covariate shock.

Moreover, while our farming experiments are close in spirit to the randomized control trials conducted by Giné and Yang (2010), we used actual payoffs to incentivize players to elicit their preferences for distinct production projects. Moreover, our farming experiments have greater complexity than the experiments of Lybbert (2006) in that our farmers' payoffs for each project choice depend on two sources of randomness, while in Lybbert's experiments there is only a random "yield risk" that subjects should consider before deciding their choice (a seed). Likewise, our farming experiments introduce additional complexity to the typical individual loan experiments, in which players have to choose whether to request a loan with a risky result, or to invest in a safe project (e.g., Giné et al., 2009), by providing subjects a more complete set of financial instruments to finance their production. Obviously, the greater complexity in the design of our experiments increases the challenges for ensuring experimental control. In the next section, we discuss our experimental design.

2.2 Our Farming Experiments

The experiment script for our farming experiments was written following standard experimental procedures as close as possible (Davis and Holt, 1993). Experiment trials were conducted in Madison and Davis in the U.S. (with graduate students), and Lima (with social scientists and cotton farmers), and the valley of Pisco and its neighbor Ica (with cotton farmers), in Peru. The final version of the script was reviewed by a journalist who works closely with farmers, in order to ensure that the language used in the instructions would be understandable to a typical farmer.

The farming experiments were designed to examine the potential demand for index-based crop insurance and analyze the effects of buying insurance on the demand for loans. In these experiments, we simulated farming decisions where subjects, endowed with a "hectare of land", had to choose among alternative cotton production projects—fallback (safe project), take an uninsured loan (risky project), and take a loan bundled with index yield insurance (insured loan, less risky project)[8]—in a series of repeated rounds.

Each project yields a related profit, which is known to subjects before they make their decisions. In the cases of the uninsured loan and the insured loan projects, profits depend additively on the realization of two random variables: a covariate shock (represented by the valley-wide average yield), and an idiosyncratic shock. The probability distributions of both shocks were estimated using information from the Pisco valley. In particular, detrended 1986-2006 time series data of valley yields (y_t), expressed in Kilograms per hectare, were fitted to a *Weibull* density function. The parameters of the *Weibull* function were estimated using maximum likelihood in `Gauss`:[9]

$$y_t \sim \textit{Weibull}\ (6.00,\ 1806.08), \tag{1}$$

[8]Throughout the paper we use interchangeably the terms *fallback*, and *safe* project; the terms *unisured loan* and *risky* project, and the terms *insured loan* and *loan bundled with yield insurance* project.

[9]We used the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm. The parameters' standard deviations are 1.03 and 70.17.

which has mean of 1,674 Kilograms per hectare.

Moreover, four-year (2002-2005) panel data were used to estimate the distribution of the idiosyncratic shocks (ϵ_{it}),[10] using the following fixed effects model:

$$y_{it} - \mu_i = \beta_i(\overline{y}_t - \mu) + \epsilon_{it}, \tag{2}$$

which regresses the farmer i's yields (y_i) deviation from its mean, μ_i, on the deviation of the *sample*'s average yields ($\overline{y}_t$) from its mean (μ).

We then discretized the densities of valley yields, y_t[11] (*Weibull*), and idiosyncratic shocks, ϵ_{it} (*Normal* distribution, centered on zero), in order to simulate the effects of distinct realizations of those shocks on profits. In particular, we divided the density of y_t into five sections—labeled as *very low*, *low*, *normal*, *high*, *very high*—having the following probabilities (in percent): 10, 20, 40, 20, and 10. Analogously, the density of ϵ_{it} was divided into three sections—labeled as *bad*, *normal*,[12] and *good*—with the following probabilities: 25, 50, and 25.

Once we performed the estimations above, all yield figures were converted to *quintals* (QQ)[13] (1 quintal = 46 Kilograms), a denomination familiar to our subjects. Thus, the valley average yield values, y_t, corresponding to the mid-point of those sections are (in rounded figures): 23, 30, 37, 43, and 48 quintals per hectare, respectively. In the case of the idiosyncratic shocks, we consider the deviations from the "normal" category, expressed as $\Delta\epsilon_{it}$, in the computation of the profits. In particular, the mid-point of the "bad" luck category lies –12.12 percent (below) the center of the distribution of ϵ, while the mid-point of the "good" luck category lies 11.63 percent above the center of the distribution.

The farmer i's per hectare profits in Soles from the insured and uninsured loan projects at each section of the valley yield and idiosyncratic shock densities, was computed using the following formula:

$$\Pi_{it}^{project} = (p \cdot y_{it}) * (1 + \Delta\epsilon_{it}) - (1 + r)Loan + p * Indemnity - premium, \tag{3}$$

where the price (p) of a *quintal* of cotton is set at 124.2 Soles, the loan size (*Loan*) used is 2,464 Soles (equivalent to US$800 at the time of conducting the experiment), and the interest rate (r) was set at 30 percent (the going rate at that time). Insurance contract is written on 85 percent of the average valley yields, equivalent to 31 quintals per hectare (=1,674/46 = 36.4 x 0.85)[14] and the *premium* was set at 150 Soles per insured hectare.[15] Thus, the *Indemnity* (expressed in quintals per hectare) in period t is defined as $\mathbf{I}\ (y_t < 31) * (31 - y_t)$, where $\mathbf{I}(\cdot)$ is the indicator function. This indexed insurance thus covers any shortfall in valley average yields below the 31 quintals per

[10] This is also a measure of the uninsured or basis risk uncovered.by insurance.

[11] Note that y represents the *valley* average yield, while $\overline{y}$ refers to the *sample* average used to estimate the idiosyncratic shocks.

[12] The "Normal" categories of those shocks lie roughly at the center of their respective densities.

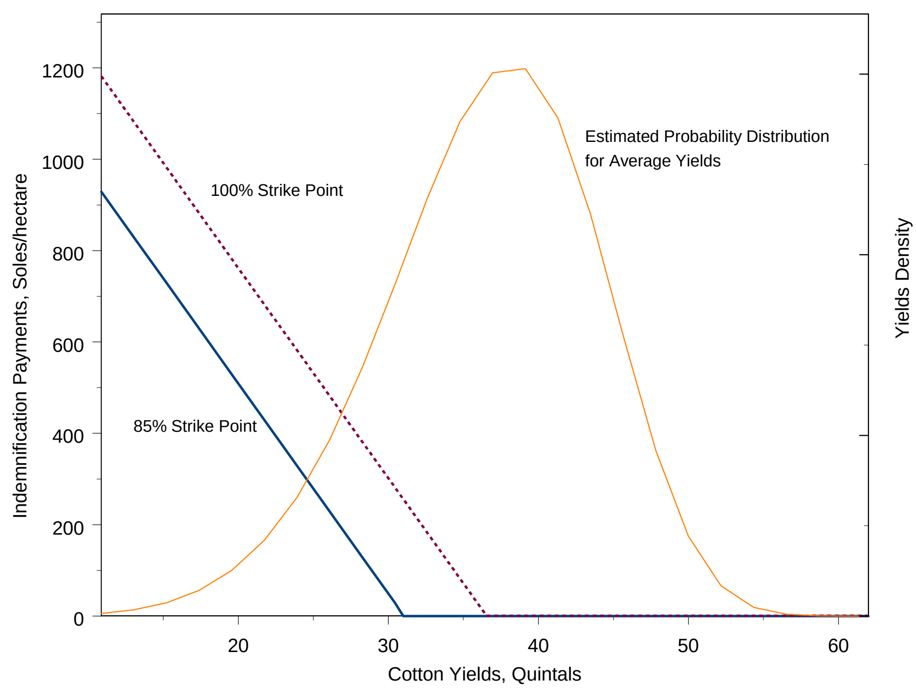
[13] A *Quintal* is equivalent to 100 pounds, which is in turn roughly equivalent to 46 Kilograms.

[14] This strike yield was set after game trials in Pisco, where most subjects preferred the 85 percent strike yield over the 65 percent and 90 percent strike yields.

[15] This premium includes a mark-up or load of 40 percent over the actuarially fair price (107 Soles per hectare).

hectare, as depicted by the solid line in Figure 1, where we also plot the estimated *Weibull* density of the average valley yields. The indemnity function for the 100 percent contract (dotted line), with a strike yield of 36.4 quintals per hectare, is also pictured for comparison.

Figure 1: Indemnity and Valley Yield Density Functions for Pisco



Furthermore, in order to simplify the implementation of the experiment, we considered the case of the typical farmer (i.e., $\beta_i = 1$), which basically implies a one-to-one relationship between individual farmer's yields (y_{it}) and actual average valley yields (y_t), using the expression indicated in eqn.[2]. The figures of individual yields used in the profit function shown in eqn.[3] then correspond to the mid-point value of the valley yields at every section of its density (23, 30, 37, 43, and 48 quintals per hectare, going from "very low" to "very high" yields): $y_{it} = y_t$. The resulting profit figures were rounded to the nearest 50. For the fallback project, profits were adjusted accordingly to get lower but more stable profits than in the uninsured loan case.[16] We will discuss the characteristics of the resulting profits for each project in the next section.

As mentioned earlier, our behavioral experiments consisted of a sequence of two sets of experiments. We started with a *baseline experiment*, where farmers had to opt for either the fallback or the uninsured loan project. And then, we continued with an *insurance experiment*, where a third alternative project (insured loan) was included in the set of choices. This sequential structure of the experiments allows us to examine any changes in farmers' choices between the first two projects after the introduction of insurance.

An important characteristic of the uninsured loan project is that when the valley average yield

[16] We further assumed a symmetric distribution for the idiosyncratic shock around the mean of zero.

is *very low*, the farming income is not sufficient to repay the loan, regardless of the idiosyncratic shock. Defaulting on a loan involves two negative consequences in the experiment: no future access to credit (i.e., subjects must do the fallback project) and a 50 percent decrease in the value of the "endowed" land. The value of a hectare of land was set at 2,400 Soles; the reduction of this value to 1,200 Soles is meant to simulate the penalty that would occur after defaulting on a collateralized loan. On the other hand, buying the (85 percent) insurance contract guarantees the *full* repayment of loans at every realization of the valley average yield and the idiosyncratic shock, thus allowing farmers to keep the option of choosing the uninsured loan project in the future and to preserve their land value.

In the next section, we describe in detail the procedures followed in the implementation of these farming experiments.

3 Experimental Procedures and Data

Our experimental design faced two major challenges: to explain clearly the notion of probabilities associated with the different sections of the probability distributions for the covariate and idiosyncratic shocks, and to ensure a minimum level of comprehension of the insured and uninsured loan projects, so that choices would be "informed." We responded to the first challenge by using transparent randomizing devices to simulate the realizations of the covariate shocks (colored chips) and idiosyncratic shocks (colored ping-pong balls), which were referred to as "individual luck," in order to convey the idea that their individual characteristics are uncorrelated among peers within a given valley. These shocks were drawn from sacks containing 10 chips (1 black, 2 red, 4 white, 2 blue, and 1 green)—the "valley sack"—and 4 balls (1 purple, 2 white, and 1 yellow)—the "luck sack"—which reproduce the probabilities structure mentioned earlier, going from the worst to the best outcome. The design of the experiment worksheets reinforced the information about the probabilities under each scenario of the covariate shock and idiosyncratic shock, by (i) spacing columns and rows, respectively, in a roughly proportional manner; and (ii) by including pictures in color of the actual colored chips and balls associated with each scenario. Table 1 shows a sample worksheet used for the insured loan project, labeled as project C, in the actual experiments. A similar design, also printed in color, was used for the other projects' worksheets. We will discuss the profits' figures later.

Secondly, in order to enhance subjects' comprehension of the procedures, field assistants explained them how the combination of a covariate shock and an idiosyncratic shock drawn determined the profits of the project chosen in every decision round, where each round represented a single farming season. The monitor, in charge of giving the instructions to all participants as a group, illustrated the rules and procedures with interactive examples. We also allowed participants to ask questions during the course of the presentation of the instructions.[17] We were aware of the risks of doing this, but we actually did not receive questions that may have induced players to play

[17] Key moments at which we specifically asked if they had any questions were: at the end of the project description, and before the low- and high-stake rounds.

Table 1: Sample Game Worksheet used for Project C

PROYECTO C: ALGODÓN CON PRÉSTAMO Y SEGURO					
	Rendimiento promedio en el valle				
	Muy bajo (23 QQ)	Bajo (30 QQ)	Normal (37 QQ)	Alto (43 QQ)	Muy alto (48 QQ)
Suerte	150	150	650	1200	1850
Suerte	500	500	1250	1950	2550
Suerte	850	850	1750	2650	3250

in a certain way.[18]

The experiment instructions were read aloud in Spanish by the same monitor in every session. The monitor used a projector to present the information about the types of shocks, the projects' characteristics and the sequence of the actions subjects should follow in each decision round. The contents of those slides are provided in Appendix A.[19] At the beginning of every session, all participants received a binder containing the worksheets with the information of the projects' profits related to each type of covariate and idiosyncratic shocks, as well as a pencil to record their choices, the type of shocks realized, and the resulting profits in each simulated farming season. Helping subjects to see the connection between their choices, types of shocks drawn, and resulting profits, was also intended to enhance trust in our calculations of their experiment winnings.

The farming experiment lasted three hours on average. Total experiment winnings in cash from participating in this particular experiment ranged from 11 to 26 Soles, with average winnings of 17 Soles (equivalent to $6). Experiment winnings and attendance fees were paid at the end of the entire session—which also included the conduct of the risk experiment (results are reported in Galarza [2009]), and pre-experiment and post-experiment surveys—that lasted on average five hours.[20]

Recall that in all of our 24 sessions, participants were assigned to numbered seats at random upon arrival, and we divided the participants into at most four "valleys" with a minimum of 3 members in subjects' each one. Splitting subjects this way allowed us to get more variability in the realizations of the covariate shocks, to have a closer monitoring, and to accelerate the tasks. Two persons from our field team were in charge of each valley. A senior assistant, well versed in the

[18] Most of the questions asked concerned the reasons for the differences in payoffs from particular projects under certain realizations of shocks; whether yield insurance covered losses due to hazards at the irrigation sector level; the source of the (agricultural production, cost, and valley yield) figures used for our analysis; whether the indemnity payments could be sufficient to repay the loan; or the timing of the insurance payouts; and the like.

[19] Out of the 24 sessions held, only in three of them we used posters containing the same information as in the slides for a short time. The monitor used sixteen slides to explain the farming and risk games.

[20] After finishing the farming experiments and having a short break, a risk experiment—which lasted about 30 minutes on average—was ran. The rest of the time—one hour and a half—was spent conducting the entry and exit surveys.

experiment rules and procedures, recorded the players' choices and profits, and did the entry and exit surveys, while a helper assisted with the drawing of the covariate and idiosyncratic shocks.

Let us consider now the structure of profits associated with each type of covariate and idiosyncratic shock that was shown to our subjects. Table 2 reports the profits calculated without considering the probability of losing land. As seen in the table, the uninsured loan project (labeled as project A) has higher, but more volatile, expected profits than the other two projects; with the fallback project (project B) being the least profitable project in expectation and the one with the lowest standard deviation (the safest). More specifically, the mean profits of the projects are: 1,355 (project A), 735 (project B), and 1,283 (project C), while their standard deviations—reported in Table 3, columns 2 to 4—are 859, 331, and 767, respectively.

Table 2: Farming Game Profits
(Expressed in Soles per hectare)

			Valley-Wide Average Yield					
			Very Low (23 QQ) *[0.10]*	Low (30 QQ) *[0.20]*	Normal (37 QQ) *[0.40]*	High (43 QQ) *[0.20]*	Very High (48 QQ) *[0.10]*	*Mean*
	Project A: Produce cotton with loan (uninsured loan)							
L	Bad	*[0.25]*	0 [1]	250	800	1,350	2,000	*840*
u	Normal	*[0.50]*	0 [1]	600	1,400	2,100	2,700	*1,370*
c	Good	*[0.25]*	0 [1]	900	1,900	2,800	3,400	*1,840*
k	*Mean*		*0*	*588*	*1,375*	*2,088*	*2,700*	*1,355*
	Project B: Produce cotton without a loan (fallback)							
L	Bad	*[0.25]*	300	400	600	900	1,350	*665*
u	Normal	*[0.50]*	350	450	650	1,000	1,500	*735*
c	Good	*[0.25]*	400	500	700	1,100	1,650	*805*
k	*Mean*		*350*	*450*	*650*	*1,000*	*1,500*	*735*
	Project C: Produce cotton with a loan & insurance (insured loan)							
L	Bad	*[0.25]*	150	150	650	1,200	1,850	*730*
u	Normal	*[0.50]*	500	500	1,250	1,950	2,550	*1,295*
c	Good	*[0.25]*	850	850	1,750	2,650	3,250	*1,810*
k	*Mean*		*500*	*500*	*1,225*	*1,938*	*2,550*	*1,283*

Note: Subjects were shown this table, *except* for the averages and probabilities.
[1] The values of unpaid debts were 700 (Bad luck), 350 (normal luck), and 50 (good luck).

On the other hand, considering the probability of losing land (i.e., of losing 1,200 Soles when project A is chosen and a very low valley yield is realized) in the profits' calculation, the mean profit of the insured loan project becomes now the largest. Although it is likely that subjects may not have appreciated this effect to its full extent during the course of the experiments, the fact that we reviewed with them whether their land depreciated or not when making their profit's calculations, could have encouraged them to consider their land value in their calculations of profits for the different projects.

To make the figures comparable with those shown in the previous table, we only changed the profits for project A under the very low average yield (reported a net loss of –1,200 instead of 0), while in the other two projects, no land losses are realized. As a result, while yield insurance only decreases from 859 to 767 the standard deviation of profits[21] when no land losses are considered (see columns 2 and 4 of Table 3), we can see a much greater reduction in volatility when land losses are included in the profits calculation (from 1,099 to 767 in their standard deviations[22]). While we can easily notice that the expected benefits from buying insurance would be even greater in an intertemporal context, in which the land not lost would yield potentially greater profits, we believe that this effect was poorly perceived by our subjects.[23]

Thus, we will argue that risk aversion considerations could better guide an ordering in preferences. One could then state that as risk aversion goes up, subjects would tend to switch from the uninsured loan (A) to the insured loan project (C), and then to the fallback project (B). This ordering, which also corresponds to the ranking according to the standard deviation of the three projects' profits shown in Table 3, will be used as the base ordering in the econometric analysis performed in Section 4. And we could use the ordering according to the total expected profits in further analysis.

Table 3: Farming Game Payoffs: Mean and Standard Deviation
(Expressed in Soles per hectare)

	Excluding Land Loss			Including Land Loss[1]		
	Unins.Loan (Project A)	Fallback (Project B)	Ins. Loan (Project C)	Unins.Loan (Project A)	Fallback (Project B)	Ins. Loan (Project C)
Mean	1,355	735	1,283	1,235	735	1,283
Stand.Dev.	859	331	767	1,099	331	767
Ordering considering:						
Mean	1st	3rd	2nd	2nd	3rd	1st
Std. Dev.	3rd	1st	2nd	3rd	1st	2nd

[1] Only the profits from project A under the very low valley yield changed (from 0 to -1,200).

Turning now to the procedures followed during the course of our farming experiments, we started with the *baseline experiment*, and continued with the *insurance experiment*. As is customary in experimental economics, each of those experiments started with a set of six "low stakes" rounds, intended to get subjects familiar with the experiment rules and procedures, which were followed by a set of six "high stakes" rounds. Subjects knew that all sets of rounds would end with the sixth one.[24]

[21] To see more clearly the magnitude in the reduction of profits' risk, this implies a reduction from 0.63 to 0.60 in the coefficient of variation of profits.

[22] Which implies a substantial reduction in the coefficient of variation from 0.89 to 0.60 due to insurance.

[23] One interesting extension, which is beyond the scope of this paper, would be to consider that farmers use decision weights instead of objective probabilities in their expected calculations and to examine the ranking of mean and standard deviation of those projects.

[24] After several experiment trials, we chose six rounds because it showed to have sufficient variability in the covariate shocks. In particular, we were interested in getting a very bad valley-wide averge yield in each six-round campaign, so that farmers would *learn* first hand the consequences of choosing the loan project.

In the baseline experiment, subjects chose between the fallback (project B: *cotton without a loan*) and the uninsured loan (project A: *cotton with a loan*) projects. The sequence of events in each round of play, t, was as follows:

(i) All players selected their favorite projects;

(ii) (starting clockwise in each valley, v) one player drew a covariate shock (represented by a colored chip) from the valley sack. Players rotated this picking-the-chip role;

(iii) then each player i drew his or her own idiosyncratic shock or "luck" (colored ball) from the luck sack;

(iv) our assistants explained the profit corresponding to the triplet {`project chosen`$_{ivt}$`, covariate shock`$_{vt}$`, idiosyncratic shock`$_{ivt}$} to each subject.

Once the six rounds were played, one of them was randomly chosen for play by having a participant in each valley roll a six-sided die. We used this random incentive design in order to preserve the proper incentives to carefully select *every* choice. This selection criterion of the round for play was reminded to all subjects at the beginning of each set of six rounds.

Furthermore, in order to include the effects of losing collateral into the decision-making, the total experiment *payoffs* included the value of the endowed land at the end of the every set of six rounds, in addition to the experiment profits obtained from the project chosen. In order to determine the final land value, we used the following rule: regardless of which round was chosen for play, as long as in *any* of them the following combination {`uninsured loan; black chip, any colored ball`} resulted, farmers were paid half of the original land price. Subjects' winnings were as follows: for every 1,200 Soles of payoffs (profit *plus* land value), participants would receive 1 Sol in cash. Subjects learned their winnings in cash at the end of each set of six rounds.

The low-stake rounds were followed by a set of six "high-stake" rounds, where subjects started again with a clean slate: full access to loans, and a hectare of land with its original value. The procedures and rules were exactly the same as we described earlier, and the only change was the increase in 100 percent in the exchange rate to compute the winnings in cash, as a way to incentivize more careful decisions. Thus, now for every 600 Soles of payoffs, participants would receive 1 Sol in cash.

After running the baseline experiment, the insurance experiment was conducted; we had again a set of 12 rounds with the insured loan project (project C: *cotton with loan & insurance*) included in the set of choices. The rules and procedures followed in this new experiment, as well as the exchange rates used, were exactly the same as the ones described above. We emphasized with subjects that the results from the baseline experiment (i.e., whether subjects defaulted on a loan or not) did not carry over to the insurance experiment. Written on 85 percent of the long-run average valley yields, insurance pays out indemnities when valley yields fall below 31 quintals per hectare; i.e., when valley yields are "low" (30 quintals per hectare) or "very low" (23 quintals per hectare), which will happen when a black chip or a red chip are drawn in a valley. We should note in Table 2 that, since indemnity payouts cover exactly the shortfalls under those sections of the distribution, the amount of the profits are the same for every category of idiosyncratic shock (150, 500 and 850 Soles).

3.1 Participants Characteristics and Matrix of Choices

The main characteristics of our experimental subjects are as follows: Our typical experimental subject is older than 50, has spent half of her lifetime managing a farm, has only completed elementary education (six years of schooling), owns 6 hectares, sows 5 of them, and holds assets for twenty thousand Soles (about $7,000), as shown in Table C.1 in the Appendix. Moreover, 66 percent of our subjects have access to any type of credit, only 14 percent of them have life insurance; and 10 percent, have accident insurance. Furthermore, on average, subjects exhibit a moderate to high risk aversion. We will examine more closely these variables later on.

It should be mentioned that, since we are interested in capturing the choices that contain the most information possible, the following analysis will use the last high stakes round at which subjects stopped learning about the different projects, which is the last high stakes round (if subjects did not fall in default) or the round immediately prior to the one in which subjects fell in default (given that immediately after that round, subjects are only left with the fallback project). We call this round the *final unconstrained round*.[25]

Table 4 shows one of our main results, the matrix of project choices made by subjects in the baseline experiment (indicated in rows) and in the insurance experiment (in columns). We observe at the bottom of column 5 that a large proportion (57 percent) of the experimental subjects chose the insured loan project, a proportion that was similar in all of the high stakes rounds. (The average number of switches in project choices is 0.80, with a standard deviation of 1.31.) This result—that the subjects in our sample overinsured against low probability, high-loss events—was also found by Laury et al. (2008) in a lab experiment, given a constant expected loss and insurance loading factor.

Another interesting result is that purchasing insurance seems to have encouraged almost 14 percent (52 out of 378) of subjects to opt for a loan instead of producing using their own resources (see cell `{B,C}` in the matrix), thanks to the reduction in the likelihood of default implied by insurance. An alternative reading of the same figure indicates that about 60 percent (52 out of 91) of the risk rationed subjects (i.e., those who chose the fallback project in the baseline experiment[26]) switched to the insured loan project when it was available. This is an encouraging result that goes in line with an intended effect of insurance: to encourage farmers to undertake riskier but potentially more profitable projects.

We can further see in the table that a relatively small proportion of subjects made choices inconsistent with transitivity in preferences. In particular, 20 out of 91 subjects who selected the fallback project over the uninsured loan project in the baseline experiment (cell `{B,A}`) switched

[25] During the first high stake round of the insurance experiment, 2.6 percent of subjects fell into default.

[26] Obviously, we are assuming here that these subjects are risk rationed in real life, a result that may not necessarily hold.

to the uninsured loan project in the insurance experiment, and 14 out of 287 subjects who chose the uninsured loan in the baseline experiment (cell {A,B}) switched to the fallback project in the insurance experiment. Note that since we are working with the final unconstrained rounds, these choices were made *before* any bad year (i.e., a black chip drawn in a given round) happened when the uninsured loan was selected, and thereby they are likely to reflect their true preferences.[27]

Table 4: Choices in Baseline and Insurance Experiments

		Insurance Experiment				
		Uninsured loan (A)	Fallback (B)	Insured loan (C)	Total	%
Baseline Experiment	Uninsured loan (A)	109	14	164	287	*75.9*
	%	*38.0*	*4.9*	*57.0*	*100.0*	
	Fallback (B)	20	19	52	91	*24.1*
	%	*22.0*	*20.9*	*57.1*	*100.0*	
	Total	129	33	216	378	*100.0*
	%	**34.1**	**8.7**	**57.1**	**100.0**	

Before we discuss the main distinctive characteristics of subjects in the baseline and insurance experiments, we need to define two variables of interest that were constructed from within the experiments: financial literacy and risk aversion. In constructing this measure of the degree of comprehension of the main features of the insured and uninsured loans, we included four indicators: (i) self-reported comprehension of the farming experiment rules (variable *Self-report*), (ii) whether subjects knew (reminded) that insurance indemnity payouts depend on valley-wide average yields (*Learn_ins1*) and (iii) not on idiosyncratic shocks (*Learn_ins2*), and (iv) whether they knew the two consequences of defaulting on a loan (*Learn_loan*). We assigned the same weights to each of these variables:

$$Financial\ literacy = (Self\text{-}report + Learn\_Ins1 + Learn\_Ins2 + Learn\_Loan)/4;$$

where *Self-report* takes the values of 1, 0.75, 0.5, or 0.25 if subjects claimed that the instructions were “very easy", “easy", “hard", or “very hard", respectively. *Learn_Ins1* and *Learn_Ins2* are indicator variables that take the value of 1 if the answer was correct and 0, otherwise. *Learn_Loan* takes the value of 1 if the two consequences of defaulting an uninsured loan (i.e., no future access to loans and land depreciation) were indicated by subjects; 0.5 if only one of those were mentioned; and 0 otherwise. We then normalized this indicator to take values between 0 (which means that a subject does not know anything about the rules of the experiment) and 1 (which indicates that a subject knows very well the rules). The average value of this indicator across subjects is 0.54,

[27] Using the modal choice during the high-stake rounds would result in a take-up rate for the insured (uninsured) loan of 58.5 percent (24.3 percent), and 37.6 percent of risk rationed subjects, with 57 percent of them switching to the insured loan in the insurance experiment.

which indicates a moderate level of comprehension overall.[28]

In the case of elicited risk preferences, risk parameters were estimated using the results of a lottery experiment conducted with the same Pisco subjects. The data were fitted to Constant Relative Risk Aversion (CRRA) utility functions under Expected Utility Theory (EUT) and Cumulative Prospect Theory (CPT),[29] resulting in average estimated CRRA coefficients of 0.45 (EUT) and 0.74 (CPT), estimates that suggest the existence of a moderate to relatively high degree of risk aversion. The interested reader is referred to our companion paper (Galarza, 2009) for details.

3.2 Descriptive Analysis of Experiment Results

This section examines the main characteristics exhibited by our subjects in the Baseline Experiment and in the Insurance Experiment, as a means to provide insight about the variables correlated with the demand for the insured loan that will be analyzed in Section 4. Since we are interested in capturing the choices that contain the most information possible, the following analysis will use the last high stakes round at which subjects stopped learning about the different projects, which is the last high stakes round (if subjects did not fall in default) or the round immediately prior to the one in which subjects fell in default (given that immediately after that round, subjects are only left with the fallback project). We call this round the *final unconstrained round*.[30]

3.2.1 Baseline Experiment: Risk-Rationed Subjects *versus* Uninsured Borrowers

Table C.2 in the Appendix shows the means T-tests of selected variables for the two groups in the baseline experiment. We see that uninsured borrowers have a lower proportion of females and own and cultivate bigger parcel sizes (by one hectare) than risk-rationed subjects. The former group also appears to be more connected to agricultural information networks, as indicated by their bigger number of information partners; people within an information network exchange information about farming activities, such as pests control, new seeds, and the like. Uninsured borrowers also have a greater access to loans from any source in real life, especially from cotton mills. Furthermore, uninsured borrowers show a lower tendency to overweight small probabilities, meaning that when they are told an event has a small probability of happening (e.g., 1, 5, or 10 percent), they act *as if* such event were to happen with a *higher* probability.[31] We will discuss in more detail the effects of this type of psychological distortion of probability information in Section 4. For all of the above indicated variables, the differences in means between risk-rationed and uninsured borrowers

[28] If we excluded the self-reported comprehension variable (*self-report*), such an indicator would have an average value of 0.50, and the correlation coefficient with education would be 0.37.

[29] Under EUT, risk preferences are entirely defined by the curvature parameter, while in CPT, a probability weighting function parameter also affects risk preferences. This function captures the subjective distortions made to actual probabilities. More details of the estimation process are provided in Section 4.1.

[30] During the first high stake round of the insurance game, 2.6 percent of subjects went into default.

[31] To illustrate the notion of overweighting of small probabilities, let us take the case of a lottery, whose chances of winning its biggest prize is say 0.001. Now, let us consider that subjects transform such 0.001 into a subjective probability of 0.01; that is, they behave *as if* they could get the highest prize with a bigger probability than it actually is. The consequence of this overweighting is that, for a given curvature of the utility function, they would behave in a more risk seeking manner than such curvature would suggest. Levy and Levy (2002) analyze the effects of probability weighting on the lotteries' risk premium.

are significant at either 1 or 5 percent. Our indicator of financial literacy is marginally greater for uninsured borrowers. The formal education levels and risk aversion estimates shown by those two groups are statistically similar.

In the econometric analysis about the choices made in the insurance experiment performed in Section 4, we will control for choices made in the baseline experiment by including the predicted probability of choosing the fallback project in this experiment as a control variable, which will in turn be estimated as a linear function of gender, age, education, and owned land size variables.

3.2.2 Insurance Experiment: Insured Borrowers *versus* the Others

Comparing insured borrowers to uninsured borrowers and risk-rationed producers, Table C.3 in the Appendix shows that insured borrowers are markedly different from the other two groups in several important respects: demographics, literacy, productivity, assets, risk preferences, as well as market and social connections.

First, insured borrowers are significantly younger (by two years) and have higher education (by one year) than uninsured borrowers; and this gap is even bigger when we compare insureds to risk-rationed subjects. Second, insured borrowers are also more likely to have better understood the properties of insurance than the other two groups of subjects, a result reflected by their higher values of the variable *Financial Literacy*. Third, insureds also report higher cotton yields in the last farming season (2007-2008), though this difference is statistically significant (at 5 percent level) only when insureds are compared to risk-rationed subjects (the gap is 6 quintals, or 276 Kilograms per hectare). Fourth, insureds own more valuable assets, denoted by the variable *Wealth* (that includes the values of land and house), a result that is mainly explained by their more valuable houses. In fact, insureds' house values are 50 percent higher than those of uninsured borrowers, and this gap is even larger when we compare insured to risk-rationed subjects. Furthermore, while insureds do have significantly bigger parcels than risk-rationed subjects (by one hectare), such gap vanishes when we compare insureds to uninsured borrowers.

Fifth, surprisingly, risk-rationed subjects are more risk averse than uninsured borrowers, who are in turn more risk averse than insured borrowers; and such differences in risk aversion are statistically significant (at 10 percent) under the EUT and the CPT specifications. How can we explain this seemingly counterintuitive result? In particular, why should higher risk averse subjects choose the uninsured loan instead of the insured loan?: The fact that (higher) risk aversion under EUT and CPT is highly correlated with a lower education attainment and a lower financial literacy suggests that higher risk averse subjects are less likely to have understood the true dynamic benefits from buying crop insurance. Having a relatively poor understanding of this insurance, risk averse subjects would thus have opted for either the safest (fallback) project or a project they know relatively well in real life—the uninsured loan.

Sixth, insured borrowers are also more likely to have obtained a loan to finance their agricultural activities than risk-rationed subjects, but less likely so than uninsured borrowers (significance at 5 percent level). Seventh, considering the number of experimentally-constructed valley members with whom an individual shares information about farming activities as an indicator of social connection, we find that insured and uninsured borrowers are similarly connected with other farmers—the agricultural 'networks' have on average 1.7 members—while groups belong to a slightly bigger agricultural network than risk-rationed farmers. Eighth, the winnings from the low stakes insurance experiment are (expectedly) higher for subjects choosing the insured loan than those obtained by subjects who chose the fallback project. Ninth, overweighting is the greatest for those who chose the fallback project, and lowest for those choosing the insured loan. Lastly, we do not observe statistically significant differences in terms of gender, farming experience, or belonging to a farmer association amongst these three groups.

To sum up then, we saw that financial literacy, wealth, risk preferences, and social network variables are likely to be correlated with the project choices made in the insurance experiment, and we will include those variables in the regression analysis. We discuss in the next section the econometric methods used in the estimation of those project choice decisions and the main estimation results.

4 Econometric Specification

We estimate ordered probit models, using the choices made in the *final unconstrained round*. The base ordering is given by risk considerations: as risk aversion increases, one should expect to see subjects switching from the uninsured loan (riskiest) to the insured loan, and then to the fallback project (safest): A→C→B. Thus, in our base econometric specification, the dependent variable, y_i, which denotes the project choice by individual i, will take the value of 1, if the uninsured loan project was chosen; 2, if it was the insured loan project; and 3, if it was the fallback project.

Using the latent utility framework, we define y_i^* as an unobserved measure of utility for individual i:[32]

$$y_i^* = X_i'\beta + \epsilon_i, \tag{4}$$

where ϵ_i will be assumed to follow a logistic distribution, and X is the vector of regressors. Thus, for our three-category ordered model we have that,

$$y_i = j \qquad \text{if } \alpha_{j-1} < y_i^* \leq \alpha_j, \quad j = 1, 2, 3, \tag{5}$$

with $\alpha_0 = -\infty$ and $\alpha_3 = \infty$, where the $\alpha's$ indicate the cut points or thresholds that define the project choice. Using the previous two equations, the probability of choosing project j can be expressed as follows:

$$\begin{aligned} \Pr(y_i &= j) = \Pr(\alpha_{j-1} < y_i^* \leq \alpha_j) \\ &= \Pr(\alpha_{j-1} - X_i'\beta < \epsilon_i \leq \alpha_j - X_i'\beta) \\ &= F(\alpha_j - X_i'\beta) - F(\alpha_{j-1} - X_i'\beta), \end{aligned} \tag{6}$$

where $F(\cdot)$ is the (normal) cumulative probability distribution of ϵ_i. The parameter vector β and

[32] I am drawing on Cameron and Trivedi (2009) for this part.

the cutpoint parameters α result from maximizing the following log-likelihood function:

$$\ln L(\alpha, \beta \mid X) = \sum_{i=1}^{N} \sum_{j=1}^{3} \ln \left[F(\alpha_j - X_i'\beta) - F(\alpha_{j-1} - X_i'\beta) \right]^{y_{i,j}}, \tag{7}$$

where $y_{i,1}, y_{i,2}, y_{i,3}$ are three indicator variables with $y_{i,j} = 1$ if $y_i = j$; and $y_{i,j} = 0$, otherwise. The interpretation of the regression coefficients is as follows: Since the project choices used as dependent variable are ordered from high relative risk (uninsured loan project) to low relative risk (fallback project), a positive coefficient β_i indicates a higher probability of choosing a safer project (hence a lower probability of choosing a riskier project).

We run these ordered probit regressions with standard errors clustered by the experimentally-constructed-valleys, in order to correct for a possible intra-cluster correlation. We also include session fixed effects in the regressions, in order to control for intra-session correlated decisions. The next section discusses the estimation results, which were ran in `Stata` 10.

4.1 Empirical Analysis

In this section we examine the main determinants of project choice in the high stakes insurance experiment. In particular, we analyze the main predictors of choosing the riskiest project (uninsured loan) instead of any of the other two safer projects (insured loan or fallback project). We will discuss the effects of wealth, financial literacy, social connections, and variables constructed from within the experiments (choices in the baseline experiment, winnings in the low stakes rounds, experiment effects, risk aversion, and nonlinear probability weighting).

The base specification includes the following independent variables: the level of assets, a variable measuring the degree of social connection existing in the experimentally-constructed valleys, the predicted choices made in the Baseline Experiment, low-stakes winnings in the Insurance Experiment, and a variable that controls for the potential existence of a source of judgment bias called "hot-hand" effect, which may arise from an attempt to discover trends in past information, and results in an overestimation of the autocorrelation in the series of good or bad events.[33]

Our variable *Wealth* includes the value of land and house, while our social connection variable—*Agricultural Network*—indicates the number of subjects in a given randomly-formed valley with whom a person shares information about farming activities.[34] This variable also controls for potentially correlated decisions within each experimental valley.[35] On the other hand, the variable that predicts choices made in the baseline experiment—*Risk Rationed*—indicates the probability of choosing the fallback project in that experiment,[36] and intends to account for the potential

[33] Offerman and Sonnemans (2004) report some evidence of the overrreaction resulting from hot-hand effects in sports and financial markets. They further desing an experiment to distinguigh between hot-hand and recency effects, the latter being the bias towards overweighting recent information and underweighting prior beliefs.

[34] Including demographic indicators would not change the results significantly.

[35] While it could have been interesting to capture the way information is aggregated within different valleys and how it is then translated into decisions under risk, by simply including the size of the agricultural network, we expect to control for the influence that the members within a valley may have had on individual's project choices.

[36] We estimated a *Probit* regression of the unconstrained final high stakes round in the baseline game on age (in years), education (years), gender, and owned land size (hectares).

correlation between choices in the insurance experiment and those in the baseline experiment. The variable *Prior Rounds Earnings*, which measures the winnings in Soles from the low stakes rounds in the insurance experiment, controls for "wealth" effects that could have arisen if project choices depended on how much winnings they earned in the prior rounds of the insurance experiment. Finally, we control for the potential existence of a source of judgment bias called "hot-hand" effect, which may arise from an attempt to discover trends in past information and results in an overestimation of the autocorrelation in the series of good or bad events.[37] Focusing solely on negative events, this bias would imply that, for instance, drawing two consecutive black chips (which means that a very low average yield was drawn in a particular farming season) may lead subjects to erroneously think that those events are autocorrelated and would then drive them to rely on a safe project (i.e., either the fallback or the insured loan projects). This overreaction notion is closely related to the overweighting of probabilities information, in the sense that the probability of a bad *recent* event is overvalued, thus resulting in a too optimistic or too pessimistic behavior. To control for this "hot-hand" effect, we use a dummy variable for drawing two consecutive black chips in the last two low stakes rounds of the Insurance Experiment, and we expect a positive (negative) correlation with the safer projects (insured loan or fallback project) take-up *if* there is an overestimation (underestimation) of the autocorrelation in the series of black chips: once two black chips are drawn, those subjects overestimating (underestimating) such autocorrelation would (not) expect another black chip to be drawn in the next rounds, thus judging the insured loan or the fallback project—choices which eliminate the chances of a loan default if a black chip is drawn—more (less) attractive than the uninsured loan.

In addition to those controls, we are particularly interested in examining the effects that risk preferences, education, and financial literacy can have over the project selection in the Insurance Experiment. Our risk variable was estimated from a Holt-Laury (2002) type of binary lottery experiment in which the same sample of subjects chose between a relatively safe lottery and a relatively risky lottery along ten decision rows. Prizes are held constant in each row, while the probability of the higher prize in each lottery decreases as the experiment progresses. The idea of this design is that, unless subjects are extremely risk loving, they should start choosing the safe lottery and switch to the risky lottery before or in the 10th row, where the prize from the risky lottery is *for sure* greater than that from the safe lottery. Lottery choices were used to estimate risk preferences by maximum likelihood. Results from that experiment, reported in Galarza (2009), show evidence of risk aversion and subjective probability distortions that characterize Tversky and Kanheman's(1992) Cumulative Prospect Theory (CPT).[38] In the risk regression, higher education appears significantly correlated with lower risk aversion. On the other hand, our *Financial Literacy* indicator intends to capture the level of subjects' comprehension about the main features of the

[37] Offerman and Sonnemans (2004) report some evidence of the overrreaction resulting from hot-hand effects in sports and financial markets. They further desing an experiment to distinguigh between hot-hand and recency effects, the latter being the bias towards overweighting recent information and underweighting prior beliefs.

[38] In addition to the curvature of the utility function, a probability weighting function parameter that captures the subjective probability distortions, is also estimated under CPT. Defined over lottery gains, a nice feature of CPT is that if no such probability distortions are found, the model collapses to EUT. For a discussion of the main features of CPT, see Tversky and Kahneman (1992).

insured and uninsured loan projects, and takes values between 0 (meaning that subjects do not know anything about the insured and uninsured loan projects) and 1 (meaning that subjects know very well those projects).

Turning to the regression results shown in Table 5, in all four specifications considered, the variables that enter with significant signs are the probability of being risk rationed, our indicator of 'hot-hand' effect, and risk aversion. First, being risk rationed in the baseline experiment makes subjects to be more likely to choose the safer projects in the insurance experiment as well. This result should not be surprising and simply points to the consistency in choices across these two types of experiments. Moreover, if one suspects that there is some endogeneity issues with the inclusion of this variable, given that, after all, choices made by subjects in the baseline game may be correlated with some other observable characteristics that also explain choices in the insurance experiment, it should be mentioned that excluding this variable does not affect the qualitative results under the four specifications considered.

Second, we find that subjects appear to underestimate the autocorrelation of very bad covariate shocks, since once they face two consecutive black chips in their valleys they tend to choose the risky project instead of the safer ones (presumably because they do not expect the next season to face another black chip). This effect is significant (*p-values* < 0.06 in specifications [1], [2], & [3], and *p-value* < 0.05 in specification [4])

Third, our risk estimate appears to have a quadratic, concave relationship with project choices: higher risk aversion is positively correlated with a higher demand for safer projects, but such relationship is decreasing. This non-linear relationship hints that the highest risk averse subjects would prefer switching to the riskier project, a result that is rather puzzling. Taking specification [1] alone (column 2), we could explain this result noting that highly risk averse subjects are more likely to have lower financial literacy (Spearman's correlation coefficient of -0.26, significant at 1 percent), and we could thus think that higher risk averse subjects, being less likely to have understood the intertemporal and dynamic benefits of insurance, will have a lower demand for it. However, when we control for financial literacy (specification [2] in column 2), the relationship between risk aversion and project choice remains basically the same, meaning that financial literacy does not explain project choices. It is rather surprising not to find that financial literacy affects project choice (though its coefficient has a positive sign, meaning that higher financially literate subjects are more prone to select the safer projects (in particular, the insured loan project), its magnitude is negligible and it is not statistically significant. We also tried to see if there was a non-linear relationship, or if the individual components of this indicator were significant, but did not find any evidence of it.

We further examined whether the interaction between financial literacy and risk aversion could predict project choice (for some moderate degrees of risk aversion and financial literacy), but while neither financial literacy nor its interaction term with risk aversion resulted statistically significant (see specification [3] in column 4), and the standard errors of those variables become large. In this case, risk aversion enters with a significant sign (at 10 percent), and its quadratic term continues to be significant at 5 percent (*p-value* is 0.015). In all specifications where risk aversion is included, its linear term and its quadratic expression are jointly statistically significant at either the 10 percent (specification [3]) or 1 percent (specifications [1] & [2]).

Table 5: Ordered Probit Results for Project Choice
Regressions weighted by the inverse of the risk estimate's variance

Variable	(1)	(2)	(3)	(4)
Wealth (10,000 Soles)	0.022	0.022	0.017	0.022
	(0.027)	(0.027)	(0.028)	(0.027)
Financial Literacy Indicator		0.008	1.065	
		(0.408)	(0.812)	
Education (years)				0.039
				(0.015)**
Number of Peers in Agr Network	-0.078	-0.078	-0.082	-0.073
	(0.053)	(0.052)	(0.053)	(0.052)
Est.Prob.Being Risk Rationed[3]	0.738	0.739	0.760	0.746
	(0.209)***	(0.208)***	(0.207)***	(0.210)***
Prior Rounds Earnings–Soles[4]	-0.092	-0.092	-0.075	-0.089
	(0.102)	(0.103)	(0.102)	(0.104)
Two Black Chips, Insurance Exp[5]	-0.613	-0.613	-0.585	-0.641
	(0.316)*	(0.316)*	(0.307)*	(0.318)**
CRRA Estimate under EUT	0.747	0.749	2.589	
	(0.680)	(0.721)	(1.474)*	
CRRA Estimate Squared	-1.922	-1.922	-2.405	
	(0.944)**	(0.951)**	(0.986)**	
CRRA Estimate * Financial Literacy			-2.570	
			(1.678)†	
Mean of dependent variable			0.57	
Number of Observations			350	
Pseudo R-squared	0.126	0.126	0.131	0.124

n.a.: not applicable. *(**)[***] denotes significance at 10%(5%)[1%] level. † *P-value* of 0.126.
Robust standard errors clustered by the experimentally-constructed-valleys reported in parenthesis.
All regressions include session fixed effects.
[1] CRRA estimated assuming Expected Utility Theory-EUT with Fechner errors.
[2] CRRA estimated assuming cumulative prospect theory-CPT with Fechner errors. [3] Estimated using a *Probit* model with age, education, gender and land size as independent variables. [4] In low stakes Insurance Experiment. [5] Indicator variable for drawing 2 black chips in the last 2 low stakes rounds.

Things are different when we include education (expressed in years) instead of financial literacy in the regression, and we exclude the risk estimates (we did so because the estimation of the risk preferences included dummy variables of education—illiterate, some primary, and some post-secondary education—and including both education and risk would confound the effects of education on project choice). Results in this case, reported in column (5), indicate that higher levels of education are strongly correlated with a higher propensity to stay away from the risky, uninsured loan project. The qualitative results in terms of the other regressors remain unchanged with respect to specifications [1] & [2].

We should mention that the aforementioned qualitative results hold even when we consider that the errors follow a logistic distribution (see Table E.1 in Appendix E).

Regression results considering the risk and overweighting parameters estimated under CPT as independent variables turned out to be less clear.[39] In particular, both variables enter the regression with statistically insignificant coefficients. Moreover, the estimation of a quadratic shape of the relationship between risk aversion and project choice gets complicated by the fact that the standard errors become large...

4.1.1 Robustness Checks

In progress...

- We could consider an alternative ordering in choices, this time corresponding to the mean *total* projects' profits (which coincides with the projects' complexity).
- Non-linear relationship with the financial literacy variable (get 3 quantiles of the density, and include dummy variables for the lowest two)
  - Financial literacy is still insignificant, and results are basically the same
- Non-linear relationship with the risk preferences estimate (get 3 quantiles of the density, and include dummy variables for the lowest two)
  - Same thing as using quadratic shape
- Only including those who did not switched back and forth in the risk experiment (no MSB)...
  - Quadratic shape is not significant, financial literacy becomes significant (5%), wealth (1%), still significant hot-hand effect
- Excluding those who mistakenly chose the safe lottery in the 10^{th} row of the risk experiment
  - Quadratic shape is not significant, hot hand effect is significant and prob. being risk rationed becomes significant (5%)
- Excluding those who did AB & BA (switching from safe/loan [baseline experiment] to loan/safe [in insurance experiment])
  - It only makes risk estimates more significant (and wealth becomes significant)

[39] Given the Tversky and Kahneman (1992) one-parameter weighting function used in the estimation performed in Galarza (2009), a value of 0.7 or less of such a parameter implies such *overweighting* pattern. We used this dummy variable to ease interpretation.

5 (Preliminary) Conclusion

In a context of collateral-constrained formal credit markets, the introduction of insurance is expected to help enhance the demand for credit by reducing the fear of losing collateral that prevents potential borrowers from taking loans. This paper provides experimental evidence of such desired credit crowding-in effect of insurance from Peru. Framing our experiments to recreate a similar environment to the choices and outcomes that farmers have in real life, we started with a Baseline Experiment where subjects had to choose between a fallback (safe) production project or produce using an uninsured working capital loan (risky project). We then introduced a third project—producing cotton with an insured loan—which allows us to measure the effect of insurance on the demand for loans (Insurance Experiment). Our results show that while about a quarter of our subjects are risk rationed, meaning that they chose to do the fallback project in the baseline experiment, about 60 percent of those subjects switched to the insured loan project when it was available.

Overall, in the Insurance Experiment, more than 50 percent of the subjects chose the insured loan during the high stakes rounds. Given that this insurance contract eliminates by construction the chance of loan default, this demand is likely to reflect the fear of losing collateral when one is unable to repay a loan. While one could suspect that this very high insurance take-up rate may simply reflect subjects' desire to “try that new product" out of curiosity, there are two reasons to believe that this was not the case. First, the insured loan take-up does not vary much even during the low stakes rounds. Second, and more interestingly, using contingent valuation questions in the post-experiment survey, we verify that indeed about 55 percent of farmers indicated that they would be willing to buy the insured loan contract with the premium of 150 Soles per hectare.

The econometric results of the main predictors of project choice show that, controlling for wealth and choices in the baseline experiment, project choice is affected by the hot-hand effects that stem from an underestimation in the autocorrelation in the sequence of very bad years (or black chips), while the relationship with risk aversion appears to have a quadratic shape. That is, only low and moderately risk averse subjects will choose the safest projects (i.e., fallback or insured loan), while highly risk averse farmers will more likely choose the risky, uninsured loan project. Although there is certainly more work to do in order to fully understand this result, this preliminary evidence should be taken as suggestive of the usefulness of exploring some departures from the standard microeconomic theory.

This paper contributes to the existing literature about the use of behavioral field experiments to predict financial decisions made in a risky environment. A novel feature of our experimental design is that it involves choices over alternative projects related to agricultural production decisions, whose profits depend on the realizations of two random shocks: one intended to reflect the effects of covariate, systemic variables, and the other, the effects of idiosyncratic factors. Another possible use of our experimental design is in the education of potential beneficiaries of virtually any new financial product.

References

[1] Banerjee, Abhijit and Esther Duflo (2008). "The Experimental Approach to Development Economics," Working Paper, Massachusetts Institute of technology, Department of Economics and Abdul Latif Jameel Poverty Action Lab.

[2] Becker, Gordon M., Morris H. DeGroot and Jacob Marschak (1964). "Measuring Utility by a Single-Response Sequential Method," *Behavioral Science*, 9: 226-232.

[3] Boucher, Steve, Michael R. Carter and Catherine Guirkinger (2008). "Risk Rationing and Wealth Effects in Credit Markets," *American Journal of Agricultural Economics,* 90(2): 409-423.

[4] Cameron, Colin and Pravin Trivedi (2009). *Microeconometrics using Stata*. Texas: Stata Press.

[5] Cardenas, Juan Camilo and Jeffrey Carpenter (2005). "Experiments and Economic Development: Lessons from field labs in the developing world," Working Paper.

[6] Carter, Michael R. and Christopher Barrett (2006). "The Economics of Poverty Traps and Persistent Poverty: An Asset-based Approach," *Journal of Development Studies*, 42(2): 178-199.

[7] Cole, Shawn, Xavier Giné, Jeremy Tobacman, Petra Topalova, Robert Townsend, and James Vickery (2008). "Barries to Household Risk Management: Evidence from India," Working Paper.

[8] Davis, Douglas and Charles Holt (1993). *Experimental Economics*. Princeton, NJ: Princeton University Press.

[9] Dercon, Stefan (2005). "Risk, Insurance, and Poverty: A Review." In: Dercon, Stefan (ed.), *Insurance Against Poverty*. Oxford, New York: Oxford University Press.

[10] Feder, Gershon (1980). "Farm Size, Risk Aversion and the Adoption of New Technologies under Uncertainty," *Oxford Economic Papers*, 32(2): 263-283.

[11] Fox, Craig R. and Russel A. Poldrack (2009). "Prospect Theory and the Brain," In: Glimcher, Paul W., Colin F. Camerer, Ernst Fehr and Russell A. Poldrack (eds.), *Neuroeconomics. Decision Making and the Brain* (pp.145-173). London; San Diego, CA: Academic Press.

[12] Galarza, Francisco (2009). "Choices under Risk in Rural Peru," *AAE Staff Paper # 542*, University of Wisconsin-Madison, Department of Agricultural and Applied Economics (AAE).

[13] Giné, Xavier, Pamela Jakiela, Dean Karlan and Jonathan Morduch (2009). "Microfinance games," Working Paper.

[14] Giné, Xavier, Robert Townsend and James Vickery (2008). "Patterns of Rainfall Insurance Participation in Rural India," *World Bank Economic Review*, forthcoming.

[15] Giné, Xavier and Dean Yang (2010). "Insurance, Credit, and Technology Adoption: Field Experimental Evidence from Malawi," *Journal of Development Economics*, 89(1): 1-11.

[16] Harrison, Glenn and John List (2004). "Field Experiments," *Journal of Economic Literature*, 42(4): 1013-1059.

[17] Laury, Susan, Melayne Morgan McInnes, and J. Todd Swarthout (2008). "Insurance Purchase for Low-Probability Losses," Working paper.

[18] Levy, Haim and Moshe Levy (2002). "Arrow-Pratt Risk Aversion, Risk Premium and Decision Weights," *Journal of Risk and Uncertainty*, 25(3): 265-290.

[19] Lybbert, Travis J. (2006). "Indian Farmer's Valuation of Yield Distributions: Will Poor Farmers Value 'Pro-Poor' Seeds?," *Food Policy*, 31(5): 415-441.

[20] Miranda, Mario (1991). "Area Crop Yield Insurance Reconsidered," *American Journal of Agricultural Economics*, 83(3): 650-665.

[21] Morduch, Jonathan (1995). "Income Smoothing and Consumption Smoothing," *Journal of Economic Perspectives*, 9(3): 103-114.

[22] Offerman, Theo and Joep Sonnemans (2004). "What's Causing Overreaction? An Experimental Investigation of Recency and the Hot-hand Effect," *Scandinavian Journal of Economics*, 106(3): 533-553.

[23] Tversky, Amos and Daniel Kahneman (1992). "Advances in Prospect Theory: Cumulative Representations of Uncertainty," *Journal of Risk and Uncertainty*, 5(4): 297-323.

Appendix A. Information Shared with Subjects

1. Number and color of chips by type of valley-wide average yields (VAYs): black, red, white, blue, green
2. Historical valley-wide average cotton yields: 1986-2006 (bar graph)
3. Project A (cotton with loan) payoffs for the normal individual luck (luck dimension not shown) by type of VAY
4. Example of calculating the payoffs for the normal individual luck (luck dimension not shown) with normal VAY
5. Number and color of balls by type of individual luck: purple, white, yellow
6. Project A's payoffs (by type of luck and category of VAY)
7. Project B's payoffs (by type of luck and category of VAY)
8. Project A's and B's payoffs (by type of luck and category of VAY) on the same page
9. Project C's payoffs (by type of luck and category of VAY)
10. Project A's, B's & C's payoffs (by type of luck and category of VAY) on the same page

    {End of Farming experiments}
11. Maximum and minimum prizes of lotteries
12. Lotteries' payoffs for decision row 2
13. Lotteries' payoffs for decision row 8 (symmetric to 2)
14. Lotteries' payoffs for decision rows 2 and 8 (together)
15. Practice experiment sheet for binary lottery experiment (ten decision rows)
16. Experiment sheet for high-stake binary lottery experiment (ten decision rows)

    {End of Lottery Experiment}

Appendix B. Summary of Experimental Procedures

The following is the structure of the farming experiments conducted in Pisco.

- Entry survey
- Introduction of the experimental session
- Presentation of the experiment: goals
- Description of project A: cotton with loan
  - Description of Covariate shock: valley-wide average yield (VAY), *slide*
    - Examples of how different colored chips represent distinct types of VAY
    - Example of how different colored chips imply different profits, *slide*
    - Example of how the payoff for the normal VAY was calculated, *slide*
  - Description of Idiosyncratic shock: individual luck, *slide*
    - Example of how different colored balls (and different colored chips) imply different profits for project A (uninsured loan)
  - Example of drawing a valley chip and an individual luck (see profits), *slide*
- Description of project B: cotton without loan (fallback), *slide*
  - Example of drawing a valley chip and an individual luck (see profits)
- Comparison of outcomes in projects A and B, *slide*
  - Example of drawing a valley chip and an individual luck (compare profits *if* project were chosen A versus profits *if* project B were chosen)
- Play six rounds of low stakes, baseline experiment (A versus B)
  - Payments are calculated and shown to subjects
- Play six rounds of high stakes, baseline experiment (A versus B)
  - Payments are calculated and shown to subjects
- Description of project C: cotton with loan and index insurance, *slide*
  - A salient feature: no default loans under *any* covariate shock or idiosyncratic shock
  - Example of drawing a valley chip and an individual luck (see profits)
- Comparison of outcomes in projects A, B, and C, *slide*
  - Example of drawing a valley chip and an individual luck (compare profits *if* project were chosen A versus profits *if* projects B or C were chosen)
- Play six rounds of low stakes, insurance experiment (A versus B versus C)

  - Payments are calculated and shown to subjects

- Play six rounds of high stakes, insurance experiment (A versus B versus C)

  - Payments are calculated and shown to subjects

- End of Farming Experiments

Appendix C. Tables

Table C.1 Summary Statistics

Variable	Mean	Std. Dev.	N
Dependent variable			
Insured loan take-up rate (high stakes)	0.57	0.49	378
Demographics and Education			
Age (years)	54.9	13.3	367
Aged less than 40	0.14	0.35	367
Aged between than 40 and 50	0.19	0.39	367
Aged between than 50 and 60	0.33	0.47	367
Aged over 60	0.33	0.47	367
Female (Yes=1)	0.27	0.44	367
Education (years)	6.33	4.11	365
Illiterate	0.05	0.23	365
Some primary school	0.51	0.50	365
Some secondary school	0.34	0.47	365
Completed higher than secondary school	0.09	0.29	365
Financial literacy indicator[1]	0.54	0.20	378
Agriculture and Assets			
Farming experience (years)	23.9	12.7	368
Size of owned agricultural plot (hectares)	6.03	5.57	367
Size of sown land (hectares)[2]	5.01	4.13	365
Cotton yields (quintals per hectare)[2]	46.8	14.8	293
Self-reported value of owned ag plot (000 Soles)	7.43	8.78	307
Self-reported value of house (000 Soles)	15.92	21.0	321
Self-reported value of assets (000 Soles)[3]	20.42	21.8	362
Networks, Credit, and Insurance			
Talked to somebody in her “valley" about farming(Yes=1)	0.67	0.47	378
Number of “valley" members in her agricultural network	1.73	1.61	378
Has ever been a local authority (Yes=1)	0.39	0.49	365
Belongs to a farmer association (Yes=1)	0.29	0.46	364
Got credit for farming activities (Yes=1)[2]	0.61	0.49	378
Got formal credit (Yes=1)	0.38	0.49	232
Got credit from cotton mills (Yes=1)	0.28	0.45	232
Has life insurance (Yes=1)	0.14	0.37	367
Has Accident insurance (Yes=1)	0.10	0.30	367
Experimental Variables			
Risk rationed (Baseline Experiment) (Yes=1)	0.24	0.43	378
Risk parameter estimate, EUT[4]	0.45	0.29	365
Risk parameter estimate, CPT[4]	0.74	0.32	365
Probability weighting parameter estimate, CPT[5]	0.54	0.21	365
Overweighting small probabilities (Yes=1), CPT[5]	0.80	0.40	365
Drew two black chips,last low-stake rounds Insurance Experiment	0.02	0.13	378
Winnings from low stakes Insurance Experiment (Soles)	3.04	0.85	378

[1] Indicator calculated using knowledge of insurance and loan project, as well as a self-reported degree of comprehension. [2] It refers to the 2007-2008 farming season. [3] *Wealth* includes the values of land & house.
[4] EUT (CPT): Risk estimate assuming Expected Utility Theory (Cumulative Prospect Theory).
[5] Overweighting means that the probability weighting parameter is less than or equal to 0.7.

Table C.2: Summary Statistics by Project Choice in Final Unconstrained Round
Baseline Experiment

Name	Uninsured Loan (A)			Fallback (B)			*T-Test*
	Mean	S.D.	N	Mean	S.D.	N	(A)=(B)
Demographics and Education							
Age (years)	54.6	0.80	278	55.9	1.39	89	-0.80
Young (age < 40)	0.14	0.02	279	0.12	0.04	89	0.48
Middle (age: [50-60])	0.34	0.03	279	0.33	0.05	89	0.19
Old (age > 60)	0.33	0.03	279	0.36	0.05	89	-0.57
Female	0.24	0.03	279	0.36	0.05	89	-2.15**
Education (years)	6.35	0.25	279	6.27	0.45	86	0.17
Illiterate	0.05	0.21	279	0.09	0.29	86	-1.37*
Some primary school	0.51	0.50	279	0.50	0.50	86	0.20
Some secondary school	0.35	0.48	279	0.30	0.46	86	0.85
Higher than second. school	0.09	0.29	279	0.10	0.31	86	-0.40
Financial literacy indicator	0.55	0.20	286	0.51	0.20	92	1.49*
Agriculture and Assets							
Farm experience (years)	23.4	12.6	279	25.4	13.1	89	-1.27
Size of owned land (Has)	6.28	0.36	278	5.24	4.17	89	1.85**
Size of sown land (Has)[1]	5.23	4.15	277	4.32	4.02	88	1.83**
Cotton yields (QQ/ Ha.)[1]	47.4	14.4	230	44.8	16.2	63	1.12
Land value (000 Soles)	7.64	9.39	235	6.76	6.42	72	0.91
House value (000 Soles)	15.44	19.65	241	17.35	24.32	80	-0.63
Wealth (000 Soles)	20.14	20.84	274	21.30	24.83	88	-0.40
Networks and Credit							
Belongs to ag network	0.71	0.45	287	0.56	0.50	91	2.56***
# members in ag network	1.82	1.60	287	1.44	1.62	91	1.97**
Has been local authority	0.40	0.49	277	0.35	0.48	88	0.88
Belongs to farm association	0.27	0.45	277	0.36	0.48	87	-1.47*
Got credit for farming activities	0.66	0.48	286	0.48	0.50	92	3.01***
Got formal credit	0.36	0.48	188	0.50	0.51	44	-1.71**
Got credit from a cotton mill	0.31	0.46	188	0.14	0.35	44	2.76***
Experimental Outcomes							
Risk estimate under EUT[2]	0.44	0.30	280	0.46	0.29	85	0.48
Risk estimate under CPT[2]	0.73	0.33	280	0.77	0.31	85	0.92
Prob. weighting parameter est., CPT	0.54	0.21	280	0.52	0.20	85	0.81
Overweighting small probabilities, CPT[3]	0.78	0.42	280	0.87	0.34	85	-1.86**
Drew two black chips, low-stake rounds[4]	0.02	0.13	287	0.01	0.10	91	0.43
Winnings, low stakes Insur. Experiment[5]	3.07	0.88	287	2.96	0.73	91	1.07

* (**) [***]: Significant at 10% (5%) [1%] level. *T-test* assumes unequal variances.
[1] It refers to the 2007-2008 farming season.
[2] EUT (CPT): Risk estimate assuming Expected Utility Theory (Cumulative Prospect Theory).
[3] Overweighting means that the probability weighting parameter under CPT is less than or equal to 0.7.
[4] In last two low-stake rounds of Insurance Experiment. [5] Expressed in Soles.

Table C.3: Summary Statistics by Project Choice in Final Unconstrained Round
Insurance Experiment

Name	Insured Loan (C)			Uninsured Loan(A)			*T-Test*	Fallback (B)			*T-Test*
	Mean	S.D.	N	Mean	S.D.	N	(C)=(A)	Mean	S.D.	N	(C)=(B)
Demographics and Education											
Age (years)	53.8	13.2	210	56.0	56.5	124	-1.51*	57.9	14.6	33	-1.53*
Young	0.15	0.36	211	0.13	0.34	124	0.56	0.09	0.29	33	1.07
Middle	0.35	0.48	211	0.31	0.46	124	0.83	0.33	0.48	33	0.19
Old	0.29	0.45	211	0.37	0.49	124	-1.44*	0.45	0.51	33	-1.72*
Female	0.26	0.44	211	0.26	0.44	124	0.05	0.33	0.48	33	-0.82
Education (years)	6.8	4.1	210	5.8	4.1	122	2.08**	5.6	3.9	33	1.61*
Illiterate	0.04	0.20	210	0.07	0.25	122	-0.87	0.12	0.33	33	-1.32*
Some primary school	0.47	0.50	210	0.58	0.50	122	-2.03**	0.52	0.50	33	-0.51
Some second.school	0.39	0.49	210	0.27	0.45	122	2.19**	0.30	0.47	33	0.94
> second.school	0.10	0.31	210	0.08	0.28	122	0.70	0.06	0.24	33	0.94
Financial literacy	0.56	0.19	216	0.51	0.21	129	2.09**	0.50	0.22	33	1.46*
Agriculture and Assets											
Farm experience[1]	23.4	12.7	211	24.2	12.1	124	-0.53	26.0	14.9	33	-0.93
Size, owned land[2,3]	6.1	6.3	210	6.3	4.8	124	-0.35	4.9	3.1	33	1.69**
Size of sown land[2,3]	5.05	4.2	210	5.2	4.0	123	-0.41	3.8	4.2	32	1.53*
Cotton yields-QQ/Ha[2]	47.9	15.2	163	46.3	14.7	106	0.89	41.9	11.5	24	2.31**
Land value[4]	7.73	10.90	173	7.30	5.01	107	0.44	6.08	4.07	27	1.44*
House value[4]	18.65	25.76	185	12.37	16.48	108	2.93***	11.48	9.52	28	2.75***
Wealth[4]	23.13	26.66	207	17.08	12.34	124	2.80***	15.67	10.86	31	2.78***
Networks and Credit											
Belongs to agricult. network	0.69	0.46	216	0.70	0.46	129	-0.15	0.48	0.51	33	2.18**
# members netwk	1.75	1.58	216	1.82	1.65	129	-0.42	1.27	1.63	33	1.56*
Has ever been a local authority	0.39	0.49	209	0.36	0.48	124	0.53	0.50	0.51	32	-1.12
Belongs to a farm association	0.30	0.46	208	0.27	0.45	124	0.56	0.28	0.46	32	0.25
Got credit	0.59	0.49	216	0.70	0.46	129	-2.00**	0.42	0.50	33	1.88**
Formal credit	0.41	0.49	128	0.38	0.49	90	0.42	0.21	0.43	14	1.58*
From cotton mill	0.27	0.44	128	0.27	0.44	90	-0.02	0.43	0.51	14	-1.14
Experimental Outcomes											
Risk rationed[5]	0.24	0.43	216	0.16	0.36	129	1.98**	0.58	0.50	33	-3.64***
Risk estimate EUT	0.42	0.29	210	0.47	0.29	122	-1.59*	0.51	0.30	33	-1.53*
Risk estimate CPT	0.71	0.33	210	0.78	0.32	122	-1.85**	0.79	0.28	33	-1.56*
Prob.weighting param.	0.55	0.21	210	0.52	0.21	122	1.43*	0.51	0.18	33	1.38*
Overweight low prob.[6]	0.78	0.41	210	0.81	0.39	122	-0.67	0.88	0.33	33	-1.52*
Drew two black chips[7]	0.005	0.07	216	0.03	0.17	129	-1.65*	0.03	0.17	33	0.84
Winnings, low stakes[8]	3.11	0.79	216	3.06	0.95	129	0.48	2.58	0.63	33	4.31***

* (**) [***] Significant at 10% (5%) [1%] level. *T-tests* assume unequal variances.
[1] Units are years. [2] For farming season 2007-2008. [3] In hectares. [4] Units are thousand Soles. [5] In the Baseline Experiment.[6] Overweighting means that the probability weighting parameter is less than 0.7.
[7] In last two low-stake rounds Insurance Experiment. [8] In low stakes Insurance Experiment(expressed in Soles).

Appendix D. Surveys Conducted

D.1 Entry Survey

I. General Information

1. Name
2. Gender
3. What is your age?
4. How many children younger than 15 years of age currently live in your household?
5. How many completed years of education do you have?
6. The person with the most education in your household, how many completed years of education does he or she have?
7. How many years have you dedicated to agricultural activities?
8. How many hectares does your household own?
9. How many hectares did you work in the past year?
10. How much do you think you would have to pay to rent a hectare of land with similar characteristics to those of your principal cotton parcel?

Row by row, mark with an X the space that corresponds to the subject's answer.	11.1 Did you plant cotton in the years (…)?		11.2 What were your cotton yields in the years ()? (QQ x Ha)	11.3 Do you believe that your cotton yields in the years () were () than those of other farmers in your neighborhood?			11.4. In the years (…), did you…									
							A. Become sick or injured?		B. Suffer any kind of theft? (Seeds, cotton, pesticides, etc.)		C. Suffer a problem with the climate?		D. Suffer an infestation or blight in your cotton crop?		E. Have problems with the irrigation infrastructure in your area?	
	yes	No		Higher	Equal	Less	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
2007-2008																
2006-2007																
2005-2006																

12. During the past 5 years, did you receive any type of technical assistance (TA) or training (T) related to the production of cotton?

If no, continue to question 14. If yes, continue to 13.

13. Describe the last two TA or T that you received?

	From whom did you receive the TA or T? >> Table 1	The TA or T was? >> Table 2
TA 1		
TA 2		
T 1		
T 2		

Table 1
1. Cotton gin
2. Other private business
3. NGO
4. Ministry of Agriculture
5. Other? Who?_________
____
____

Table 2
1.Very beneficial
2. beneficial
3. Somewhat beneficial
4. Not beneficial

II. Social Capital

14. Are you or have you ever been any kind of authority of some association, in your community, or irrigation commission?

15. Do you currently belong to any association of farmers?

III. Insurance

Row by row, mark with an X the space that corresponds to the subject's answer.	16.1 Do you know what () insurance is? *yes, quest.* ***16.2*** *No, quest.* ***16.3***		16.2 Do you have to pay for (…) insurance?			16.3 Do you or does anyone in your household have (…) insurance? *yes, Q.* ***16.4*** *No, Q.* ***16.5***		16.4 If so, does this person pay for the (…) insurance?		16.5 Do you know who delivers the services of () insurance?				16.6 Only if they respond YES to question **16.1** Do you know what benefits you receive from (…) insurance? *(Table 3)*
	Yes	No	Yes	No	Doesn't know	Yes	No	Yes	No	The public sector	The Caja rural or a bank	Insurance company	Do not know	
Health														
Accidents														
Life/burial/ funeral														
Debt														
Other? Which?														

Table 3
1. Free or less expensive medical attention in case of an accident
2. Gives my family money should I pass away.
3. Medical attention in a hospital
4. Pays my debts if I pass them to my next of kin
5. Pays for my burial and/or funeral,

17. Would you be interested in paying a monthly premium to an institution in exchange for receiving a payment ONLY in the case that you:

__ Are ill or injured
__ Suffer an infestation or blight in your crops
__ Suffer a problem with the climate (e.g., drought)
__ Suffer problems with the irrigation infrastructure

D.2 Exit Survey

I. Networks

1. How many people in the group in which you are seated do you know? ___

2. How many people in the group have you spoken with about farming activities (e.g., what to plant, input use, etc.)? ___

II. Assets

3. The house in which you live is
___ Owned by you ___Owned by your parents/in-laws ___Owned by others ___Rented (if rented, continue to question 5)

4. How much do you think you would have to pay to buy a house similar to yours?
Amount ______Soles

5. Do you possess one of the following consumer goods?

___Car or light truck ___Motorcycle ___Heavy truck ___Tractor

III. Credit

6. If you applied for a loan at the local urban or rural Caja or a bank, do you think they would give it to you?
7. If you applied for a loan at a cotton gin, do you think they would give it to you?
8. If you applied for a loan from an informal moneylender, do you think they would give it to you?
9. In the years 2007-2008, did you obtain a loan in order to pay for your costs of production? ___
   (If no, continue to question 11)
10. From whom did you obtain this loan?
    ___Bank or Caja ___Cotton gin ___Informal lender

IV. Agricultural Insurance

11. Do you think that the instructions we gave you today prior to today's activities were:
    __Very difficult __Difficult __Easy __Very easy
12. Do you remember what happened if you obtained a loan without insurance and could not repay the loan? ____
    What happened?______
13. The indemnification that the insurance paid you depended on the average yields in the valley? ____
14. Did it depend on individual luck? ____
15. If someone were to offer you insurance similar to what we saw in activity 1 for the next agricultural year, would you be interested in buying it? ____
16. Would you be interested in paying XX Soles per hectare for insurance similar to what we saw in activity 1 (i.e., farming experiments)?

( ) YES >> *Mark with an X the maximum he/she would be willing to pay*		**( ) NO** >> *Mark with an X the maximum he/she would be willing to pay*	
S/. XX+25		S/. XX-25	
S/. XX+50		S/. XX-50	
S/. XX+75		S/. XX-75	
S/. XX+100		S/. XX-100	
More		less	

XX was set at 100, and 150, and 200 Soles.

Appendix E. Additional Regression Results

Table E.1: Ordered Logit Results for Project Choice
Regressions weighted by the inverse of the risk estimate's variance

Variable	(1)	(2)	(3)	(4)
Wealth (10,000 Soles)	0.040	0.039	0.041	0.032
	(0.048)	(0.048)	(0.047)	(0.049)
Financial Literacy Indicator		0.127		1.878
		(0.754)		(1.446)
Education (years)			0.071	
			(0.026)***	
Number of Peers in Agr Network	-0.151	-0.152	-0.140	-0.159
	(0.094)†	(0.095)†	(0.092)	(0.096)*
Est.Prob.Being Risk Rationed[3]	1.350	1.352	1.359	1.391
	(0.406)***	(0.406)***	(0.413)***	(0.408)***
Prior Rounds Earnings–Soles[4]	-0.103	-0.102	-0.117	-0.070
	(0.191)	(0.191)	(0.193)	(0.188)
Two Black Chips, Insurance Exp[5]	-1.665	-1.668	-1.600	-1.682
	(0.559)***	(0.562)***	(0.586)***	(0.542)***
CRRA Estimate	1.221	1.255		4.353
	(1.238)	(1.306)		(2.689)†
CRRA Estimate squared	-3.389	-3.398		-4.297
	(1.739)*	(1.750)*		(1.855)**
CRRA Estimate * Financial Literacy				-4.242
				(2.975)
Mean of dependent variable			0.57	
Number of Observations			350	
Pseudo R-squared	0.130	0.130	0.129	0.134

n.a.: not applicable. *(**)[***] denotes significance at 10%(5%)[1%] level. † *P-value* less than 0.11.
Robust standard errors clustered by the experimentally-constructed-valleys reported in parenthesis.
All regressions include session fixed effects.

[1] CRRA estimated assuming Expected Utility Theory-EUT with Fechner errors.

[2] CRRA estimated assuming cumulative prospect theory-CPT with Fechner errors. [3] Estimated using a *Probit* model with age, education, gender and land size as independent variables. [4] In low stakes Insurance Experiment. [5] Indicator variable for drawing 2 black chips in the last 2 low stakes rounds.