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Willingness-to-pay for microinsurance and flexibility: Evidence from an agricultural investment lab-in-the-field experiment in Senegal

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Preliminary and incomplete - please do not cite, comments welcome

Abstract

Agricultural insurance does not only affect investment decisions in agriculture but also in a secondary, unrelated income earning activity that can serve as a risk mitigation and risk coping strategy, such as livestock farming. The value of insurance may depend on the market environment in the investment market for livestock: with complete livestock markets, agricultural insurance may be less valuable; with seasonal livestock markets and non-flexible decision making environments, agricultural insurance becomes more valuable. Using data from a lab-in-the-field experiment with agricultural decision makers in rural Senegal we study the effects of agricultural insurance on investments in livestock with complete and seasonal livestock markets. In general, insurance increases investment in livestock farming. There is a widespread willingness to pay for insurance but it does not react to the size of the insurance coverage. The value of insurance is higher in inflexible investment decisions indicating that insurance is more valuable in non-flexible decision making environments, such as incomplete and seasonal markets.

Keywords: Microinsurance, risk, flexible decision making, willingness to pay, lab-in-the-field experiment
JEL categories: C91, C93, O16, Q12

1 Introduction

Poor households depending on agro-pastoral livelihoods have seasonal income and are therefore particularly vulnerable to idiosyncratic income shocks. Additionally, weather-related aggregate shocks such as droughts or floods pose huge threats to vulnerable households who have little

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means of diversifying their income sources or investing in risk-reduction technologies. Failed risk management and shock coping gives rise to a set of concerns such as too conservative production choices and underinvestment in productive assets (Simtowe (2006); Dercon and Christiaensen (2011); Karlan *et al.* (2014)).

While insurance may alleviate these consequences and relax binding risk coping constraints, it remains unknown how it influences other income earning activities. This is particularly important for households that engage in a set of ex-ante risk mitigation activities, such as income smoothing attempts by income diversification, risk coping strategies, such as consumption smoothing activities via self-insurance through savings or building up a buffer stock, informal insurance, credit, attempts to earn more, and finally consequences when income and consumption smoothing are not sufficient to reduce the impact of shocks, such as reduction of consumption, health problems, reduces children education, increased child labor, etc. (Dercon (2002))

Recent research increasingly recognizes the importance of interacting savings, credit and insurance as risk coping tools for agricultural smallholders and their financial activities in developing countries (Karlan and Morduch (2009)). New proposals consider the concept of risk layering in which each different type of risk or different extent of loss is addressed with a different financial instrument. Smaller losses are covered by self-insurance, e.g. savings, buffer stocks, etc. or credit, bigger losses are covered by private insurance (e.g. crop loss), and catastrophic losses are covered by the international community (Carter *et al.* (2011)).

Agricultural insurance helps households to better cope with shocks to investments in agriculture and thus leads to higher investments in productive assets. In a framed field experiment with farmers in Ethiopia, Hill and Viceisza (2012) find that agricultural insurance increases the risky investment in fertilizer. Karlan *et al.* (2014) confirm this in a randomized field experiment where they find that insuring investment risk for farmers in Ghana leads to significantly larger agricultural investment and riskier production choices in agriculture.

While much of the focus of the effects of insurance so far has been on income skewing and in particular underinvestment in profitable investments many households engage in a variety of income earning activities aside from agriculture to diversify their income and to earn income also in the agricultural lean season. Some income earning activities not only diversify household income, such as livestock rearing, but also double as buffer stocks and allow households to better self-insure against small income fluctuations.

However, households' investment decisions may be complicated when markets for these investment are seasonal or incomplete which is associated with reduced flexibility in investment decision making. In the Koussanar region in Senegal, for example, almost all households are

primarily engaged in agricultural activities. Livestock rearing is an important additional income earning activity, but cattle and livestock markets are highly seasonal. Throughout the year, households keep their cattle to build up buffer stocks resulting in a small and inactive cattle market. Especially after the harvest when income is high, demand for cattle is high. Supply, however, is highest right before the rainy season, that is in the lean season, when normadic tribes migrate south and flood the market with cattle and other livestock. The lean season, however, is characterized by low income and limited knowledge about the success of the soon-to-start agricultural season creating a mismatch between market seasonality and income flows. This incomplete and seasonal market implies a reduced decision making flexibility, especially in the absence of credit markets or savings. Households cannot invest when their income is high since the market is not in season and when the market is in season their income from their primary income generating activity is not yet realized.

Offering agricultural insurance will not only affect investment decisions in agricultural activities, as previous studies have shown (Hill and Viceisza (2012); Karlan *et al.* (2014)), but has possibly also an effect on the decisions to invest in a different, unrelated income earning activity that can serve as a risk mitigation and risk coping strategy, such as livestock rearing for income generation and buffer stock building. Insurance for the primary income earning activity renders investments in the secondary income earning activity less dependent on fluctuations in the first activity. These effects are likely to be affected by the market environment in this secondary investment market. With complete markets, income fluctuations in agriculture will affect livestock investments to a lesser extent and hence insurance is less valuable. With seasonal markets and non-flexible decision making environments, insurance becomes more valuable since income fluctuations have a higher effect on investment decisions.

To analyze the effect of insurance of the primary income generating activity, i.e. agriculture, on investment decisions in a secondary income generating activity, i.e. livestock, in flexible and non-flexible decision making environments and to assess the valuation of insurance in both these environments, we conduct lab-in-the-field experiments with agricultural decision makers in rural Senegal. We randomly selected 400 agricultural households in rural Senegal around Koussanar in Tambacounda region for participation in the experimental sessions that consisted of 20 participants each. In the experimental sessions, the participants played an investment decision game in which they made investment decision in a risky and a safe investment alternative from a fluctuating underlying income in both flexible and inflexible decision making scenarios. We add two insurance treatments to the standard investment decision in which the variability of the underlying income is reduced. After the investment decisions have been made, we elicit the

valuation of both insurance and flexibility by determining the willingness to pay for both using a Becker-DeGroot-Marschak (BDM) mechanism (Becker *et al.* (1964)).

We find that insurance can successfully increase investment in livestock farming, the risky asset, but there is no over-proportional impact on investment aside from the effect induced by the reduced variability in income. The majority of participants has a positive willingness to pay for flexibility, meaning that a flexible decision making scenario is clearly preferred. There is also a widespread willingness to pay for insurance but in general it does not depend much on the insurance coverage. The value of insurance is higher in inflexible investment decisions indicating that insurance is more valuable in non-flexible decision making environments, possibly also driven by other financial instruments.

Our study contributes to the literature on microinsurance, in particular agricultural insurance in low income countries. Most studies focus on the effects of reducing income risk by insurance on investment decisions in this insured income generating activity (Karlan *et al.* (2014)). While they find that demand for the offered index-insurance is strong, many other index-based agricultural insurance programs suffer from low take-up (Cole *et al.* (2013)). In particular the interaction of formal insurance, such as index-based agricultural insurance, with other forms of risk coping and insurance is increasingly being studied.

Landmann *et al.* (2012) use lab-in-the-field experiments in the Philippines to study insurance, risk sharing and savings. They observe a crowding-out effect of informal risk sharing by formally offered insurance and that insurance is an important complement to risk sharing when secret savings obscure the observation of financial resources. Chandrasekhar *et al.* (2013) study informal risk sharing and savings and they find that savings crowd out informal insurance when risk sharing partners differ in their valuation of the risk sharing relation.

While the latter two studies rather look at informal risk sharing and savings, other studies confirmed that the interaction between informal risk sharing groups and formal insurance seems to play an essential role in households' demand for and use of insurance. Mobarak and Rosenzweig (2012) and (2013) study interactions of informal risk sharing and formal insurance using both randomized offers of rainfall insurance contracts and rich survey census data on informal risk sharing within sub castes in India. They find that informal risk sharing for idiosyncratic losses enhances the benefits of index insurance for aggregate shocks. De Janvry *et al.* (2014) study theoretically that insurance demand may be low when potential insurance clients are members of risk sharing groups due to free-riding and coordination problems. They propose that group insurance can increase the demand for index insurance. Using lab-in-the-field experiments on health insurance in Tanzania, Janssens and Kramer (2012) find substantial support

free-riding but only limited coordination failures in their study on demand for group and individual insurance. However, little is known on the interactions between insurance and other financial products such as credit and savings, and empirical evidence remains limited.

In contrasts to the other studies, we study the interactions of insurance and self-insurance possibilities by investment in a secondary income generating activity under consideration of different market environments. We abstract from other identified possible explanations of low demand for index-based insurance such as trust in the insurance provider, basis risk of index-insurance schemes, etc. and look at the pure mechanism of insurance. In our lab-experimental setting we disentangle the effects of insurance on investment decisions and the demand for insurance by first analyzing the investment decisions with and without obligatory insurance and then eliciting the valuation of insurance.

The remainder of this paper is organized as follows. Section 2 presents the theoretic foundations and the implementation of the experimental design. Section 3 presents the experimental results and Section 5 concludes.

2 Experimental design

2.1 Subject pool

We randomly selected 400 agricultural households in 28 villages in Koussanar district in Tambacounda province in Senegal to participate in a household survey. A month later we invited the agricultural decision makers of the interviewed households to participate in a full day experimental session of which 398 participated. All households are agro-pastoral households, with over 90 percent engaged in own agricultural activities and over 56 percent in animal husbandry (Table 1, Panel B). In addition, most households run a household business (49 percent) that is either based on trading forest products (36 percent) or food items (19 percent), or any other kind of informal business (27 percent).

In Senegal, the extended family usually lives together in one compound household under the leadership of one household head (compare DeVreyer *et al.* (2008) for this new household definition). Several subgroups exist within a household, such as the first and second wife of the household head with their dependable children, or the brother of the household head with his wife and family. In our sample, households consist on average of 12.76 household members that are organized in around three subgroups per household with around four members each (Table 1, Panel A).[1] The average household head is male (96 percent), 47 years old and married (96

[1] Each adult person living in the household that is responsable for other dependable persons is considered

percent). 44 percent of household heads are polygamous and a married household head has on average 1.5 wives. The household head is also mostly responsible for agricultural decisions on the family plots. Only if a subgroup is wealthy enough and has enough time after fulfilling the required work on the family plots it may engage in farming of an individual plot. However, the family plots remain the most important farming activity of the household.

Although the household size allows most households to diversify their income sources, many households are affected severely and regularly by adverse income shocks to their agricultural production. In the last six agricultural seasons, 12 to 33 percent of households stated that they suffered from a bad harvest (Table 1, Panel C). Insufficient rain or a bad partition of rain were stated as the most frequent reasons for a bad harvest. Also, within the general shock exposure of households, lack of water is the most common shock (22 percent), as well as animal epidemics (16 percent) and diseases of household members (13 percent) (Table 1, Panel B).

In face of this shock environment, an insurance against rainfall may be beneficial for the agricultural households in this area. To test, how a rainfall insurance would affect their decision making and how much farmers value such an insurance, we conduct the following experiment that mimics important characteristics of their decision making environment.

2.2 Agricultural investment game

Experimental investment decision

The experimental design is built around a basic investment decision. Participants face an investment opportunity with risky prospects. From their initial endowment y, they can invest an amount x in a risky asset. This amount is lost with probability one-half or multiplied by three with probability one-half. In addition to the return on investment, there is a second stochastic element in the experimental setting. The participants' initial wealth can be high ($\overline{y}$) or low ($\underline{y}$) with equal probability. This reflects the fact that investment decisions depend on income, consequently on the annual harvest of agricultural production which can be good or bad depending on the weather conditions.

2-decisions and 1-decision scenarios

The participants must decide how much to invest in the risky asset according to two distinct scenarios. In the first scenario, the 2-decisions scenario, the participant knows the value of his initial wealth y before deciding how much to invest. He therefore takes two investment decisions,

as a separate subgroup. The household head always forms the first subgroup and all unaccompanied adults are counted in his subgroup.

one in the good harvest case $y = \overline{y}$, and one in the bad harvest case $y = \underline{y}$. In the second scenario, the 1-decision scenario, the participant must decide how much to invest in the risky asset before he knows the realized value of y. The participant therefore takes only one investment decision. The 2-decisions scenario is the flexible scenario, while the 1-decision scenario is the inflexible scenario resembling commitment.

Standard and insurance treatments

We then apply different treatments to these scenarios. Across treatments we vary the variability in y, the initial wealth, from a standard deviation of five in the standard treatment S, to three in the first insurance treatment I1 and to one in the second insurance treatment I2 while keeping the expected wealth level constant. Reducing the variability in y resembles the basic mechanism of insurance and aims at capturing the effect of insurance on investment decisions.

Figure 1 sets out the resulting combinations of flexibility and insurance. Each participant takes the investment decision in all four cases: 1) Flexibility - No insurance, 2) Flexibility - Insurance, 3) Non-flexibility - No insurance, and 4) Non-flexibility - Insurance.

FIGURE 1: Identification strategy

		Flexibility of decision making scenario	
		Flexible	Non-flexible
Insurance treatment	No insurance	Flexible - No insurance	Non-flexible - No insurance
	Insurance	Flexible - Insurance	Non-flexible - Insurance

Willingness to pay

A second phase of the experiment consists of eliciting the participants' willingness to pay using a standard Becker-DeGroot-Marschak procedure (Becker *et al.* (1964)). First, we elicit how much participants are willing to pay for flexibility, i.e. how much they are willing to pay to switch from a 1-decision inflexible scenario to the corresponding flexible 2-decisions scenario. We denote this as WTP for flexibility. Second, we elicit the willingness to pay for insurance. Participants are asked to reveal how much they are willing to pay to switch from a standard treatment in which the variability of initial wealth is high to an insurance treatment in which the variability

of initial wealth is low. We denote this as WTP for insurance.

For the WTP for insurance we have a valuation of the respective insurance, i.e. the moderate-coverage I1 and the high-coverage insurance I2, for the flexible and the non-flexible decision making scenario. This allows us to disentangle the effect of the insurance mechanism and flexibility on the valuation for insurance.

2.3 Procedural details

The agricultural decision makers of the 400 households were invited to participate in sessions with around 20 participants each. Transportation from their villages to the location of the experimental sessions was provided, as well as a breakfast, refreshments and a lunch. Participants played two different experiments, one in the morning and one in the afternoon. They received FCFA 500 as a show-up fee and could earn up to FCFA 4,000.[2] Average earnings for the full experimental sessions day and the two games were FCFA 1,984. Normally, participants in group discussions or workshops receive around FCFA 1,000 per day, so the decisions were well monetarily incentivized.

After participants arrived in the morning, they registered, received an anonymous participant's code, and completed a small survey. The first game was played in the morning session. This paper is based on the afternoon game.

The instructors gave a thorough explanations of the decision making scenario using flip charts. The following framing was used to explain the decision making scenario. The underlying wealth was presented as the harvest outcome, which could be a good harvest $y = \overline{y}$ represented by 15 bundles of grain or a bad harvest $y = \underline{y}$ represented by five bundles of grain. In the investment decision, participants had to divide their initial wealth from the harvest between investing a discrete amount x in cattle and saving $y - x$ in a lock box. The investment in cattle is prone to a cattle epidemic. In case there is no cattle epidemic, the value of the amount invested in cattle triples, otherwise it is lost completely. This was presented as purchasing a small goat whose value triples if it grows up, but it can catch a disease and die with equal probability.

The resulting four states of the world, e.g. good harvest - no cattle epidemic, good harvest - cattle epidemic, bad harvest - no cattle epidemic, and bad harvest - cattle epidemic were illustrated using the flip chart graphics. It was emphasized that all states have the same probability of occurrence.

The explanations were enriched by presenting two examples of investment choices, one in-

[2] Around FCFA 500 correspond to USD 1 during the time of the household surveys and experimental sessions from February to May 2013.

vestment choice for the bad harvest case, and another investment choice for the good harvest case. The payoffs of this investment choice in all four states of the world were calculated and shown.

After these extensive explanations and demonstrations, participants had to answer four basic test questions. Five instructors assisted the participants and noted their answers on the understanding of the setup. Nearly 75 percent answered at least three of four questions correctly. A training period followed in which participants made investment decisions and practiced the realization of the harvest and the cattle epidemic shock. To facilitate decision making, each participant had a decision making sheet for the good harvest and the bad harvest depicting both investment possibilities and their outcome per invested unit for the case with the individual shock to the risky investment, the cattle epidemic, and the case without. Each participant received tokens for the respective decision that they physically distributed on their decision sheet between both investment alternatives. This made calculations for them very easy since the could count the tokens instead of applying mental arithmetic. The instructors counted their tokens and noted their investment decisions. The determination of the harvest type and cattle epidemic were demonstrated using random draws from an opaque bag and symbols for the respective situations. The explanations correspond to the 2-decisions scenario.

It was then explained to the participants that now they should imagine that a pastoral tribe migrates to this area to sell livestock and that they have to make their investment decision in livestock now even before knowing their harvest outcome. This is a very typical situation in Senegal where big cattle herders migrate through this area right before the agricultural season starts to sell cattle. This setup represents the 1-decision scenario. It was explained using flip chart graphics, followed by an investment decision in livestock demonstrated in an example and a training round. A sample decision sheet for the 1-decision scenario in the standard treatment is shown in the appendix.

At the end of the demonstration the willingness to pay exercise was explained and demonstrated. The participants were offered to play the 1-decision scenario with their investment decision visualized by the divided tokens. Then they were offered to switch to the 2-decision scenario for a price. They had to state how much they were willing to pay for switching from the 1-decision to the 2-decisions scenario. The actual price would be determined by a random draw from a bag after making ones bid. If their willingness to pay exceeds the price, they may switch for paying the chosen price, otherwise not. This Becker-DeGroot-Marschak mechanism (compare Becker *et al.* (1964)) was very well understood by participants since it is similar to normal bargaining on markets. This technique is a widely used way to elicit true willingness to

pay (compare Cole *et al.* (2011) and Berry *et al.* (2012) for an application).

After the extensive explanations and the training sessions, one instructor presented the treatments one after another and the participants took their decisions for the three scenarios in the standard game, and both insurance treatments. The sequence within each treatment was always the 2-decisions-scenario, the 1-decision-scenario and the willingness to pay for flexibility. The order of treatments was randomized across session. For each decision made, one token stating the respective treatment and scenario was placed in a bag. At the end of the session one token is drawn randomly to determine the payoff-relevant decision.

After the decisions, the decisions in the standard and insurance treatment were compared and participants were asked for the willingness to pay for switching from the standard game to the insurance game. This was done for both the 2-decisions-scenarios and the 1-decision-scenario. For this, the decision sheets with the noted decisions were presented the participants again to facilitate decision making.

After the payoff relevant scenario was determined, a random draw decided whether participants could switch to an insurance treatment or a flexible decision making scenario. The price for switching was drawn and all participants with a higher willingness to pay than the determined price switched decision scenarios. Each participant received their decision sheet with the respective investment decisions made. The harvest type was drawn randomly for a group of four participants and the cattle epidemic shock was drawn individually to calculate final payoff. By this procedure, all decisions were payoff-relevant and monetarily incentivized.

3 Experimental analysis

3.1 Theoretical framework

In order to gain better intuition on the role of insurance in environments that are more or less flexible, let us consider an individual that maximizes his expected wealth, i.e. a rational and risk-neutral individual. Because the risky asset, as designed in the experiment, yields a fifty percents rate of return, this individual will optimally decide to invest all his available wealth in the risky asset. In the 2-decision scenario described above, we will have $\bar{x} = \bar{y}$ if harvest is good and $\underline{x} = \underline{y}$ if harvest is bad. Under our distributional assumptions, the expected final wealth of the individual will therefore be given by

$$\frac{3}{2}E[y].$$

When the environment is flexible, i.e. when we consider the 2-decision scenario, the payoff of the individual only takes into account the expected value of his initial wealth ; this essential property of risk neutral preferences carries over once investment decision his taken into account. In this setting, it is clear that a mean-preserving contraction of initial wealth as proposed in our different insurance treatments, has no value for the individual. It has also no effect on the expected amount that is invested in the risky asset.

Consider now the 1-decision scenario described above. The individual will still want to invest all his available wealth in the risky asset but he will now be constrained by his level of wealth in the bad harvest case. He will only invest $x = \underline{y}$. Under our distributional assumptions, his expected final wealth will be

$$E[y] + \frac{1}{2}\underline{y}.$$

It is immediate to see that flexibility is valuable but also to see that, in the 1-decision scenario, payoff takes into account not only the expected initial wealth but also the level of wealth in the bad harvest case. As a consequence, insurance, by increasing $\underline{y}$ and relaxing the constraint on investment, modifies behavior and becomes valuable. With insurance, investment increases in the 1-decision scenario and the individual's expected payoff is higher.

Beyond this simple case of a risk neutral individual, it is possible to provide a straightforward analysis of the interactions between insurance and flexibility in the case of a risk averse individual envisioning full insurance, i.e. envisioning the possibility to smooth his wealth entirely. With full insurance, initial wealth is equalized among states of nature and flexibility, i.e. the ability to adapt the investment decision to the realized state, has no particular value. On the other hand, without insurance, flexibility is valuable and the individual can reach a higher payoff with the 2-decision scenario than with the 1-decision scenario and because he is risk averse, those two payoffs will be lower than his payoff with full insurance.

We therefore get the following ordering : full insurance with flexibility $\cong$ full insurance without flexibility $\succ$ no insurance with flexibility $\succ$ no insurance without flexibility.

In this setting, it is clear that the utility gain coming from insurance is higher in the non-flexible environment while the utility gain from flexibility is higher without insurance : a form of substitutability between insurance and flexibility.

Following these theoretical insights, we will be particularly interested in looking at the effect of insurance on the investment decisions of individuals. We will also investigate the issue of substitutability between insurance and flexibility by looking at whether the willingness-to-pay for insurance is higher in 1-decision scenarios compared to 2-decision scenarios and by looking at

whether the willingness-to-pay for flexibility decreases in treatments with insurance compared to treatments without insurance.

3.2 Experimental results

Agricultural insurance may affect investment in a second income earning activity, i.e. livestock rearing, since it smooths the primary income source and renders investment decisions less susceptible to income fluctuations. Insurance on the primary income source will therefore increase investment in a secondary income generating activity. The effects of insurance, however, are likely to interact with the investment decision environment in the investment market. A flexible decision making environment may be less valuable to a decision maker with insurance, i.e. when the underlying income stream is smooth. Likewise, insurance of the underlying income may be less valuable to an agricultural decision maker when the investment decision making is completely flexible.

We first look at the descriptive statistics before analyzing the effect of the insurance treatments on investment decisions and the valuation for insurance and flexibility in a regression framework. For this, we estimate the following equation using the OLS estimation technique:

$$Y_{it} = \alpha + \beta_t X_t + u_{it} \tag{1}$$

where the dependent variable Y_{it} is the investment decision, or the valuation of insurance or flexibility of household i in treatment t. The three treatments or the two decision making scenarios are captured in X_t. We cluster the standard errors at the individual level and include participant fixed effects δ_i as a robustness check.

Investment decisions

First, we study how investment behavior changes with insurance in both flexible and inflexible decision making scenarios. Then we study how decision makers value flexibility and insurance by eliciting their willingness to pay for flexibility and insurance.

Table 2 sets out the descriptive statistics and the OLS estimation of the investment share of total wealth invested in the risky asset. On average, participants invest around 46 percent of their initial wealth in the risky asset in all investment decisions. The mean investment shares for the good harvest (46 percent) and bad harvest decisions (45 percent) in the 2-decisions scenario and the 1-decision scenario (47 percent).

Within one decision making scenario, the share of wealth invested does not change signifi-

cantly across the three treatments (Table 2, odd columns for pooled insurance treatments, even columns for both insurance treatments separately). While insurance increases investment in the low income state proportionally to the income increase by insurance in this state, it also decreases investment in the high income state proportionally to the income decrease in this state. This implies that the provision of insurance as modeled by the reduction in variability of the initial wealth has no significant over- proportional impact on investment decisions which may indicate the limited suitability of insurance as an investment promotion tool.

The share of wealth invested is similar across the three treatments which implies that insurance increases investment in the low income state, but not over-proportionally. We can conclude that insurance for the underlying income in agriculture has a positive effect on investment in livestock rearing, a second income activity.

When comparing investment decisions in the 2-decisions scenario for the good and the bad harvest case, 97% of participants are constrained by a non-flexible decision making environment since they choose different investment shares depending on the harvest outcome.

Willingness to pay for flexibility

Table 3 sets out the willingness to pay for flexibility that was elicited by the Becker-DeGroot-Marschak mechanism. On average, 65 percent of participants have a positive willingness to pay for flexibility as measured by a binary variable (Table 3, columns 1 and 2). The average willingness to pay for flexibility in the standard treatment is 1.8 on a discrete scale from zero to five (Table 3, columns 3 and 4). There is no significant difference in the willingness to pay for flexibility neither for the pooled or the separated insurance treatments (Table 3, columns 1 and 3 for the pooled insurance treatments, columns 2 and 4 for the separate insurance treatments). The WTP for flexibility does not change with insurance and there are no significant differences across treatments although the vast majority of decision makers are constrained by non-flexible decision making environments. Although decision makers value flexibility, this valuation does not depend on the availability of insurance.

Willingness to pay for insurance

We elicit the WTP for insurance both for the flexible and the non-flexible decision making environment. First, we pool both the moderate-coverage I1 and the high-coverage insurance I2 as set out in Table 4. For the flexible decision making scenario, on average 45 percent have a positive willingness to pay of on average 1.2 units. For the non-flexible decision making scenario 50 percent have a positive WTP for insurance with on average 1.3 units.

The binary variable *flexibility* equals 1 if the decision-making scenario is flexible and 0 otherwise. It indicates the difference in the valuation of insurance that is driven by the decision making flexibility. For the binary WTP for insurance pooled for I1 and I2, flexibility significantly reduces the WTP for insurance by 4.9 percentage points (Table 4, column 1). Evaluated at the sample mean of 47 percent this corresponds to a reduction by around 10 percent. The coefficient is robust to the inclusion of participant fixed effects. For the discrete WTP for insurance pooled for I1 and I2, decision making flexibility reduces the WTP by 0.11 units. Evaluated at the sample mean of 1.27 units, this corresponds to a reduction by 8.5 percent (Table 4, column 2). This effect, however, is not robust to the inclusion of participant fixed effects.

Table 4 column 3 to 6 disentangles the effect for the moderate-coverage I1 and the high-coverage insurance I2. The effect of a lower valuation of insurance is driven by the moderate-coverage insurance I1.

Overall, we find that insurance is increasing investment in the bad harvest state, that the WTP for flexibility is high but not responsive to the provision of insurance and that the WTP for insurance decreases in flexible decision-making environments. The observed behavior is broadly in line with our hypotheses indicating that decision makers broadly respond to the insurance mechanism as expected.

This bears the question of why only around 45 percent of the participants in our experiment have a positive valuation of insurance. By our experimental design, we have excluded explanations for low insurance demand that are related to trust in the insurance provider or the unknown and complex concept of insurance contracts.

FIGURE 2: Willingness to pay for insurance

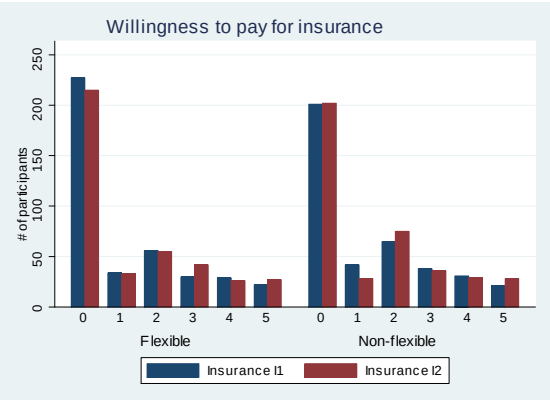

Figure 2 shows the distribution of the WTP for both I1 and I2 for the flexible and non-flexible decision making environment. The actuary fair insurance premium for I1 is 2 units and for I2 is 4 units. For the moderate-coverage insurance I1, 35 percent of participants have a higher WTP for insurance than the actuary fair premium. For the high-coverage insurance I2

only 14 percent of participants have a higher WTP for insurance than the actuary fair premium Comparing the WTP for insurance to both actuary fair insurance premiums reveals that the valuation of insurance does not match the costs of providing insurance for most farmers.

4 Robustness checks

Understanding of decision making scenario

The low literacy level of participants brings up the question of whether participants have fully understood the decision making problem. As elaborated in section 2.3, the decision making scenario was explained extensively using flip charts and examples for illustration. After the explanations, four test questions were asked to check whether participants had understood the explanations and the decision making scenarios. Of all participants, 75% answered at least three our of the four test questions correctly.

After the test questions, the practice period followed in which participants made their investment choices and drew the realization of the harvest and the cattle epidemic to better understand the involved probabilities. We believe that this practice period in particular increased the understanding of participants significantly. The answered test questions therefore indicate a lower bound of participants' understanding.

As a robustness check, we conducted all analyses only on the subsample of the participants who answered at least three out of four test questions correctly. The results are robust to this sample restriction. The tables are delegated to the appendix A.

Serial correlation and order effects

Our experimental design relies on a within-subject comparison. Since individuals take similar decisions repeatedly we are worried about possible effects of serial correlation over the different decisions as well as order effects by the order in which the three treatments were played.

To account for serial correlation, we cluster the standard errors at the session level. This leaves us with a lower number of clusters since we only have 20 sessions. But results are mainly robust to this check.[3]

To prevent possible order effects, the treatment order was randomly assigned at the session level. This leaves us with different orders of treatments across sessions. Therefore, we can rely on a between-subject comparison using only the first investment decisions. Of course this comparison is not possible for the WTP for insurance since these were elicited at the end. For the investment

[3] Results are available upon request.

decisions and the WTP for flexibility, the result is similar and coefficients are of the same order in the between-subject analysis compared to the within-subject analysis. This gives confidence, that serial correlation and order effects do not play an important role. The tables are delegated to the appendix A.

5 Concluding remarks

While in our lab-in-the-field experiments insurance has been successful in increasing investment in the low income state, no over-proportional impact on investment aside from the effect induced by the reduced variability in income has been found. This may indicate the limited suitability of insurance as an investment promotion tool and may lead to further research on the two different roles of insurance of investment promotion and safety net provision. Willingness to pay for insurance in general seems not to depend much on insurance coverage, although the value of insurance is higher in inflexible investment decisions.

The results suggest that participants behave broadly as expected: a smoother underlying income by consumption increases investment in a secondary income earning activity and insurance is valued more in an inflexible decision making environment. Although we can rule out many of the previously suggested reasons for low demand of microinsurance by the design of our experiment, we still find that only half of the participants do have a positive demand for insurance and maximum around a third would actually purchase insurance at an actuary fair premium. In a next step we will combine the experimental results with data from household surveys on household and participant characteristics to get a deeper understanding of who these households are that demand insurance.

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6 Tables

TABLE 1: Household characteristics

Panel A: Household characteristics		**Panel B: Income sources and shock exposure**	
Household head		*Income activities of households (in %)*	
Age	47.75	Agriculture	90.73
	(13.01)	Animal husbandry	56.39
Sex (% male)	0.96	Employment	7.52
	(0.19)	Household business	49.37
Married (in %)	0.96	Remittances	21.55
	(0.20)	Pensions, government transfers	3.01
Polygamous (in %)	0.44	Other	5.01
	(0.50)		
No. of wives	1.51		
	(0.70)	*Affected by shock in the last 5 years (in %)*	
Literate (in %)	0.42	Animal epidemic	15.79
	(0.49)	Loss of traction animal	12.31
Economically active (in %)	0.94	Crop damage (disease)	10.8
	(0.23)	Crop damage (insectes)	6.53
Household		Crop damage (other animals)	1.01
Household size	12.77	Stock damage	3.02
	(7.69)	Lack of water	22.11
No. of subgroups	3.22	Excess water	4.77
	(1.40)	Fire	9.55
No. of persons per subgroup	4.16	Death of bread earning family member	3.02
	(1.96)	Disease	12.81
Observations	399	Loss of employment	1.01

Panel C: Agricultural seasons and harvest

	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
Harvest quality (in %)						
Good harvest	12.44	15.6	15.86	13.08	11.6	25.91
Normal harvest	56.35	68.8	69.05	65.64	54.38	58.03
Bad harvest	25.89	12.02	12.28	19.49	32.73	15.28
Reasons for bad harvest (in %)						
Lack of rain	58.82	34.04	26.53	35.53	43.75	11.67
Bad partition of rain	8.82	19.15	30.61	28.95	25.78	21.67
Lack of agricultural tools	9.8	14.89	10.2	11.84	10.94	15
Seeds not usuable	2.94	4.26	6.12	0	1.56	6.67
Insufficient seeds	3.92	2.13	6.12	6.58	4.69	6.67
Fertilizer not available	3.92	6.38	6.12	2.63	1.56	6.67
Increase input prices	0	2.13	2.04	1.32	0	0
Disease/ death	0.98	4.26	4.08	1.32	0.78	3.33
Lack of family labor	0.98	2.13	0	2.63	0.78	8.33

Notes: Table includes means of means of household characteristics, standard deviations in parentheses.

TABLE 2: Investment shares in risky asset with insurance provision

	2-decisions scenario				1-decision scenario	
	Good harvest		Bad harvest			
	(1)	(2)	(3)	(4)	(5)	(6)
Insurance	-0.002		0.002		-0.009	
	(0.005)		(0.005)		(0.006)	
Insurance I1		-0.007		-0.002		-0.011
		(0.006)		(0.006)		(0.007)
Insurance I2		0.002		0.006		-0.007
		(0.006)		(0.006)		(0.007)
Standard (constant)	0.461***	0.461***	0.450***	0.450***	0.474***	0.474***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
Participant fixed effects (FE)	No	No	No	No	No	No
Robust to inclusion of particpant FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent variable	0.460	0.460	0.451	0.451	0.467	0.467
R-squared	0.000	0.001	0.000	0.001	0.001	0.001
Observations	1192	1192	1190	1190	1192	1192
P-value t-test I1 vs. I2		0.159		0.163		0.532

Notes: Dependent variable: Share of fluctuating wealth invested. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 3: Willingness to pay for flexibility

	WTP 0-1 dummy		WTP 0-5 scale	
	(1)	(2)	(3)	(4)
Insurance	0.018		0.092	
	(0.021)		(0.076)	
Insurance I1		0.020		0.128
		(0.024)		(0.087)
Insurance I2		0.015		0.055
		(0.024)		(0.086)
Standard (constant)	0.638***	0.638***	1.804***	1.804***
	(0.024)	(0.024)	(0.084)	(0.084)
Participant fixed effects (FE)	No	No	No	No
Robust to inclusion of particpant FE	Yes	Yes	Yes	Yes
Mean of dependent variable	0.650	0.650	1.865	1.865
R-squared	0.000	0.000	0.001	0.001
Observations	1194	1194	1194	1194

Notes: Dependent variable: Willingness-to-pay for flexibility, elicited by a Becker-deGroot-Marschak mechanism. WTP 0-1 dummy equal 1 if WTP>0, 0 otherwise. WTP 0-5 scale is elicited on a discrete scale from 0 to 5. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE 4: Willingness to pay for insurance and flexibility - Pooled insurance

	WTP for insurance		WTP for insurance I1		WTP for insurance I2	
	0-1 dummy	0-5 scale	0-1 dummy	0-5 scale	0-1 dummy	0-5 scale
	(1)	(2)	(3)	(4)	(5)	(6)
Flexibility	-0.049**	-0.109*	-0.065**	-0.133	-0.033	-0.085
	(0.019)	(0.062)	(0.026)	(0.082)	(0.027)	(0.081)
Standard (constant)	0.494***	1.328***	0.495***	1.294***	0.492***	1.362***
	(0.022)	(0.073)	(0.025)	(0.080)	(0.025)	(0.083)
Participant fixed effects (FE)	No	No	No	No	No	No
Robust to inclusion of particpant FE	Yes	No	Yes	Yes	Yes	Yes
Mean of dependent variable	0.469	1.273	0.462	1.227	0.476	1.319
R-squared	0.002	0.001	0.004	0.002	0.001	0.001
Observations	1592	1592	796	796	796	796

Notes: Dependent variable: Willingness to pay for insurance, elicited by a Becker-DeGroot-Marschak mechanism. WTP 0-1 dummy equal 1 if WTP>0, 0 otherwise. WTP 0-5 scale is elicited on a discrete scale from 0 to 5. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix A Robustness checks

Understanding of decision making

TABLE A.1: Robustness check: Sample restriction to clients who answer test questions correctly - Investment shares in risky asset with insurance provision

	2-decisions scenario				1-decision scenario	
	Good harvest		Bad harvest			
	(1)	(2)	(3)	(4)	(5)	(6)
Insurance	-0.004		-0.001		-0.005	
	(0.006)		(0.005)		(0.007)	
Insurance I1		-0.008		-0.005		-0.006
		(0.007)		(0.006)		(0.008)
Insurance I2		0.000		0.003		-0.003
		(0.007)		(0.006)		(0.008)
Standard (constant)	0.459***	0.459***	0.452***	0.452***	0.471***	0.471***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)
Participant fixed effects (FE)	No	No	No	No	No	No
Robust to inclusion of particpant FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.000	0.001	0.000	0.001	0.000	0.000
Observations	880	880	878	878	880	880
P-value t-test I1 vs. I2		0.248		0.265		0.725

Notes: Sample restricted to participants who answered at least three out of four test questions correctly before the practice period. Dependent variable: Share of fluctuating wealth invested. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE A.2: Robustness check: Sample restriction to clients who answer test questions correctly - Willingness to pay for flexibility

	WTP 0-1 dummy		WTP 0-5 scale	
	(1)	(2)	(3)	(4)
Insurance	0.009		0.056	
	(0.024)		(0.088)	
Insurance I1		0.007		0.088
		(0.027)		(0.105)
Insurance I2		0.010		0.024
		(0.027)		(0.096)
Standard (constant)	0.650***	0.650***	1.854***	1.854***
	(0.028)	(0.028)	(0.099)	(0.099)
Participant fixed effects (FE)	No	No	No	No
Robust to inclusion of particpant FE	Yes	Yes	Yes	Yes
R-squared	0.000	0.000	0.000	0.000
Observations	882	882	882	882

Notes: Sample restricted to participants who answered at least three out of four test questions correctly before the practice period. Dependent variable: Willingness-to-pay for flexibility, elicited by a Becker-deGroot-Marschak mechanism. WTP 0-1 dummy equal 1 if WTP>0, 0 otherwise. WTP 0-5 scale is elicited on a discrete scale from 0 to 5. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A.3: Robustness check: Sample restriction to clients who answer test questions correctly - Willingness to pay for insurance and flexibility - Pooled insurance

	WTP for insurance		WTP for insurance I1		WTP for insurance I2	
	0-1 dummy	0-5 scale	0-1 dummy	0-5 scale	0-1 dummy	0-5 scale
	(1)	(2)	(3)	(4)	(5)	(6)
Flexibility	-0.039*	-0.087	-0.058*	-0.122	-0.020	-0.051
	(0.023)	(0.073)	(0.031)	(0.100)	(0.032)	(0.094)
Standard (constant)	0.478***	1.282***	0.483***	1.262***	0.473***	1.303***
	(0.026)	(0.083)	(0.029)	(0.092)	(0.029)	(0.095)
Participant fixed effects (FE)	No	No	No	No	No	No
Robust to inclusion of particpant FE	No	Yes	No	Yes	Yes	Yes
R-squared	0.002	0.001	0.003	0.002	0.000	0.000
Observations	1176	1176	588	588	588	588

Notes: Sample restricted to participants who answered at least three out of four test questions correctly before the practice period. Dependent variable: Willingness to pay for insurance, elicited by a Becker-DeGroot-Marschak mechanism. WTP 0-1 dummy equal 1 if WTP>0, 0 otherwise. WTP 0-5 scale is elicited on a discrete scale from 0 to 5. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Serial correlation and order effects

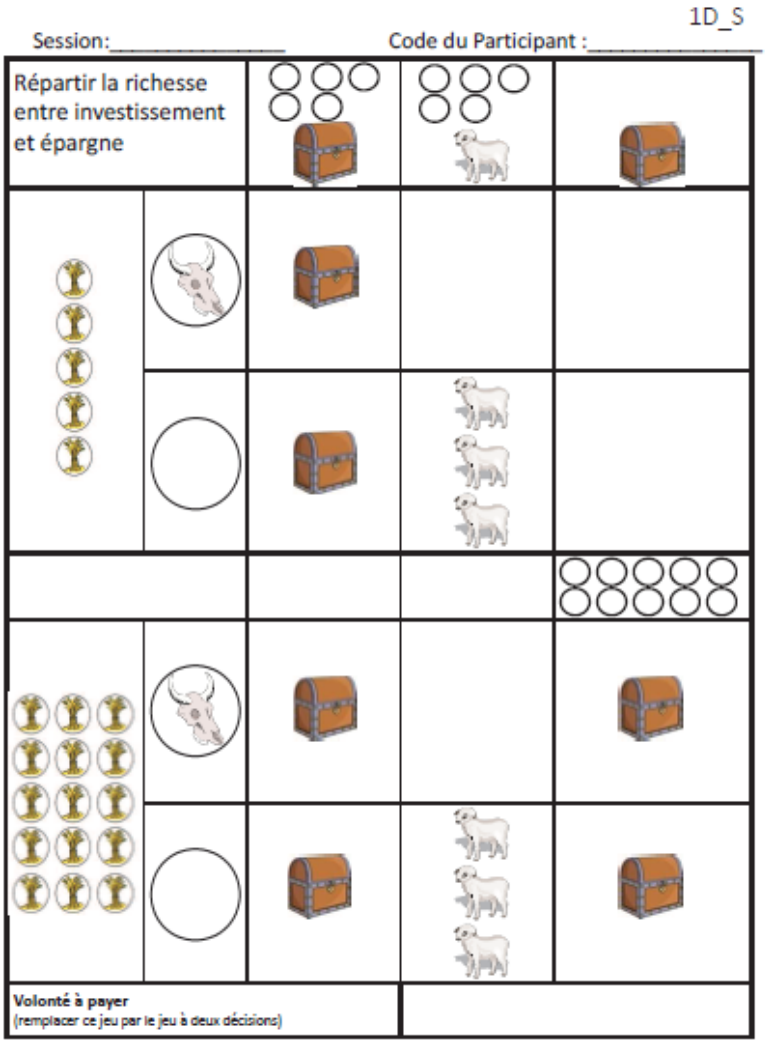
TABLE A.4: Robustness check: Serial correlation and order effects - Investment shares in risky asset with insurance provision

	2-decisions scenario				1-decision scenario	
	Good harvest		Bad harvest			
	(1)	(2)	(3)	(4)	(5)	(6)
Insurance	-0.017		-0.023*		-0.025	
	(0.011)		(0.012)		(0.014)	
Insurance I1		-0.001		-0.003		-0.019
		(0.016)		(0.013)		(0.016)
Insurance I2		-0.033***		-0.044***		-0.030
		(0.010)		(0.014)		(0.020)
Standard (constant)	0.475***	0.475***	0.469***	0.469***	0.480***	0.480***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.009)	(0.009)
R-squared	0.004	0.014	0.008	0.022	0.008	0.009
Observations	397	397	396	396	398	398
P-value t-test I1 vs. I2		0.075		0.040		0.619

Notes: Sample restricted to first round decision to compare effects between subjects. Dependent variable: Share of fluctuating wealth invested. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE A.5: Robustness check: Serial correlation and order effects - Willingness to pay for flexibility

	WTP 0-1 dummy		WTP 0-5 scale	
	(1)	(2)	(3)	(4)
Insurance	0.066		0.051	
	(0.042)		(0.197)	
Insurance I1		0.139**		0.293
		(0.057)		(0.275)
Insurance I2		-0.006		-0.190
		(0.041)		(0.159)
Standard (constant)	0.599***	0.599***	1.877***	1.877***
	(0.018)	(0.018)	(0.137)	(0.137)
R-squared	0.005	0.018	0.000	0.012
Observations	398	398	398	398

Notes: Sample restricted to first round decision to compare effects between subjects. Dependent variable: Willingness-to-pay for flexibility, elicited by a Becker-deGroot-Marschak mechanism. WTP 0-1 dummy equal 1 if WTP>0, 0 otherwise. WTP 0-5 scale is elicited on a discrete scale from 0 to 5. Robustness to participant fixed effects as indicated. Standard errors are clustered at the individual participant level and in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix B Decision sheet