The Impact of Contract Design on Insurance Take-up*

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Abstract

This paper uses data from a randomized experiment with around 1700 households in rural China to study the effect on insurance take-up of offering a menu of insurance contracts rather than a single one. Surprisingly, I find that offering more choices increases the take-up rate of the basic contract (lowest premium and payout) by 30%, while only a small proportion of farmers choose contracts with higher premiums and payouts. Information inference explanation is ruled out by the fact that the effect holds even when all farmers are aware of the existence of all contracts. To explain the result, I estimate a model of insurance demand that allows preferences to be reference dependent and those reference points to be endogenous to the choice set. A policy implication is that strategically offering a menu of contracts can be an easy and cheap way to improve insurance take-up.

Keywords: Insurance, Take-up, Contract, Context Effect, Information
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1 Introduction

Poor households in rural areas are exposed to substantial weather disasters, which can generate large fluctuations in income and consumption if insurance markets are incomplete. To protect themselves from this risk, rural households undertake risk management strategies such as adopting informal insurance, avoiding high risk-high return agricultural activities, holding precautionary savings, and reducing their investment in production (Morduch (1995), Rosenzweig and Stark (1989)). However, informal insurance mechanisms cannot effectively reduce the negative impact of regional weather shocks (Townsend (1994)). In the absence of formal insurance markets, the negative shocks and forgone profitable opportunities can lead to highly variable household income and persistent poverty (Dercon and Christiaensen (2011), Jensen (2000), Rosenzweig and Wolpin (1993)).

To shield farmers from weather-related risk, a number of developing countries have started to develop and market formal insurance products. However, the take-up rate for formal weather insurance is usually surprisingly low, even with heavy government subsidies. The disappointed development of rural insurance markets can be caused by reasons from both the supply side and the demand side, and this paper focuses on the supply side story. Farmers have different demand for insurance depending on their production size, risk altitude, etc. Optimal product-line design emphasizes the strategic use of a menu of products as a discrimination tool in a market with consumers with heterogeneous demand. This paper uses a novel experimental design to study the effect of offering a menu of insurance contracts, rather than a single one, on insurance take-up rate.

I designed a two-year randomized experiment based on the introduction of a new weather insurance policy for rice farmers offered by the People's Insurance Company of China (PICC), China's largest insurance provider. Implemented jointly with PICC, the experiment involved around 1700 households across 38 villages of rural China. The experimental design allows me to not only identify the causal effect of contract design on product adoption, but also test for the role of various channels through which the contract effect operate.

To estimate the value of contract choices for insurance take-up, during the first year of the experiment I randomly offer contract menues with one, two, or three contracts to different households. The additional two contracts have higher premiums and payout than the first one, and the premium-payout ratio is higher. Surprisingly, I find that offering more choices increases the take-up rate of the basic contract (lowest premium and payout) by 30%, while only a small proportion of farmers choose contracts with higher premiums and payouts.

There are two possible reasons of why insurance take-up is influenced by the contract design. The first explanation is that this is a context effect: a consumer's choice between two alternatives depends on the presence of the other options. In my context, the additional two contracts are more expensive than the basic contract, so they may make the basic contract more attractive and as a result increase the take-up of the basic contract. The other channel is information inference. In this case, there are two types of information that the contract set may contain: probability of disasters (premium payout ratio is different across contracts), and product quality (When the insurance company offers more choices, farmers may think the insurance company designed the program more carefully and thus improved their trust on the program).

To separate between the two channels, I implement a 4 by 2 household level randomization in the second year. First, there are four types of contract menus offered to different households: Group T1 - only offer the basic contract; Group T2-T4: offer three contracts. For Group T2, the additional two contracts have the same per unit price as the basic contract, while for Groups T3 and T4, the additional two contracts are more expensive than the basic contract. The second randomization is an information treatment implemented across different contract groups. Within each of these four groups (T1- T4), half of the households were provided with an additional set of information, which includes the existence of other contracts and the real probability of disasters.

By comparing the basic contract take-up rates across contract groups and information groups, I show that the contract effect cannot be explained by information inference. First, take-up of the basic contract decreases if the two additional contracts are equally expensive as the basic one; the more expensive the additional two contracts, the higher the take-up of the basic contract. Second, the contract effect is not affected by the information treatment. This means context effect is the main explanation: the preference between buy and not-buy is influenced by the menu of choices offered.

This paper contributes to the existing literature in the following ways. First, the paper is among the first that uses field experiment to test context effects. While there's an extensive literature demonstrates context effects in laboratory settings, there's limited experimental evidence in the field. Second, the paper sheds light on the challenge of how to improve weather insurance take-up. Existing research has tested possible explanations for low take-up such as lack of trust, financial illiteracy, credit constraints, or ambiguity aversion (Bryan 2010, Cai et al 2014, Cole et al 2011, Gaurav et al 2011, Gine et al 2008), but insurance demand remains low even after some of these barriers were removed in experimental treatments. I provide evidence that strategically offering a menu of contracts can be an easy and cheap way to improve insurance take-up.

The rest of the paper is organized as follows. In Section 2, I provide background information on rice insurance in China. In Section 3, I describe the experimental design and survey data. The main empirical results are discussed in Section 4, where I present the main treatment effect of contract design on actual insurance take-up and analyze the possible mechanism driving this effect. In Section 5, I present and estimate a choice-set dependent reference model to do policy simulation. Section 6 concludes.

2 Background

Rice is the most important food crop in China, with nearly half of the country's farmers engaged in its production. In order to maintain food security and shield farmers from negative weather shocks, in 2009 the Chinese government requested PICC to design and offer the first rice production insurance policy in 31 selected pilot counties.[1] The program was extended to 62 counties in 2010 and 99 counties in 2011.

To study the effect of contract design on the adoption of rice insurance, I conduct the experiment across 38 natural villages within two of the rice production counties included in the government's first round pilot of the insurance program. The sample counties are located in Jiangxi province, which is one of China's major rice bowls[2]. All households in these villages were offered the formal rice insurance product. Since the product was new at that time, no household had previously heard of such insurance.

The insurance contract is as follows. The actuarially fair price is 12 RMB per mu per season.[3] The government gives a 70 percent subsidy on the premium, so farmers only pay the remaining 3.6 RMB per mu. Such governmental subsidies to agricultural insurance are common in China and in other countries. If a farmer decides to buy the insurance, the premium is deducted from the rice production subsidy deposited annually in each farmer's bank account, with no cash payment needed.[4] The insurance covers natural disasters, including heavy rain, flood, windstorm, extremely high or low temperatures, and drought. If any of these disasters occurs and leads to a 30 percent or more loss in yield, farmers are eligible to receive payouts from the insurance company. The amount of the payout increases linearly with the loss rate in yield, from 60 RMB per mu for a 30 percent loss to a maximum payout of 200 RMB per mu for a total loss. The average loss rate in yield is assessed by a

[1]Although there was no insurance before 2009, there were other mechanisms by which the consequences of weather shocks on farmers and their crop yields were mitigated. For example, if major natural disasters occurred, the government made payments to households whose production had been seriously hurt. However, the level of transfer in these cases was usually very limited and far from sufficient to help farmers resume production. In addition, households within villages would sometimes participate in informal risk-sharing in the case of non-aggregate weather shocks.

[2]Note that "natural village" refers to the actual village, whereas "administrative village" refers to a bureaucratic entity that contains several natural villages.

[3]1 RMB = 0.15 USD; 1 mu = 0.067 hectare. In the experimental sites, farmers produce two or three seasons of rice each year.

[4]Starting in 2004, the Chinese government has given production subsidies to rice farmers in order to increase production incentives.

committee composed of insurance agents and agricultural experts.[5] Since the average gross income from cultivating rice in the experimental sites is around 800 RMB per mu, and the production cost is around 400 RMB per mu, this insurance policy covers 25 percent of gross income or 50 percent of production costs.[6]

The insurance product considered here differs from index-based weather insurance offered in other countries in several aspects. The product is actually a great deal for farmers, as the post-subsidy price is only around 1 percent of the production cost. Moreover, this product is more vulnerable to moral hazard as the payout is determined by loss in yield. However, the moral hazard problem should not be large here as the maximum payout (200 RMB) is much lower than the profit (800 RMB), and the product does require natural disasters to happen in order to trigger payouts.

3 Experimental Design and Data

I use a two-year randomized experiment to identify the role of contract design in influencing insurance demand. The first year experiment was carried out in spring 2010, and includes 13 villages with around 560 households. The first year data is used to test how do different combinations of contracts affect insurance take-up. The second year experiment was implemented in spring 2011, with another 25 villages (around 1200 households), in order to identify different mechanisms of the contract effect.

3.1 Experimental Design: Year One

During the first year of the experiment, the insurance company offer three contracts, with different premium, maximum payout, and government subsidy.

[5]To illustrate this policy, let us consider the case of a farmer growing rice within a two mu area. The normal yield per mu is 500kg; however, a wind disaster has reduced this year's yield to 300kg per mu. Since this represents a 40% yield loss, the farmer will receive 200*40% = 80 RMB per mu from the insurance company.

[6]In addition, the daily wage in rural China is around 20 RMB per day, the maximum amount of payout per mu is equivalent to 10 days' earnings.

The liability and criteria of payout are the same across different contracts. The first contract is the basic one: for each unit of rice production (mu), to buy the insurance, farmers pay 3.6 RMB to get a maximum of 200 RMB payout (government subsidy = 70%). For the second contract, farmers pay 12 RMB and the maximum payout is 400 RMB (government subsidy = 50%). For the third contract, the maximum payout is 600 RMB while the price that farmers need to pay equals 21.6 RMB (government subsidy = 40%). As a result, although the amount of government subsidy is higher for the second and third contracts compared with the first one, the rate of subsidy is lower. So the second two contracts are more expensive than the first one.

As shown in Figure 1, within each village, I randomly assign different combinations of the above three contracts to each household. Specifically, for group A (133 households), I only offer the basic contract (3.6, 200); for group B (280 households), I offer two contracts (3.6, 200) and (12, 400); for group C (142 households), all of the three contracts are offered. Farmers in groups B and C can pick any contract in the choice set if they decide to buy the insurance. However, they have to choose the same contract for all rice production area. For contract randomization on the household level, the sample within each village was stratified according to rice production area.

The procedure of the experiment is as follows. In each village, I gather households assigned with the same contract set and hold meetings for different contract groups simultaneously. Households make purchase decisions individually right after the meeting.

3.2 Experimental Design: Year Two

During the second year, the procedure of the experiment is the same as that in year one. However, the design is a bit different from that in year one, in order to identify different mechanisms of the contract effect. In detail, the basic framework of the second-year experiment is a 4 by 2 household level randomization. First, there are four types of contract menus offered to different households. In those menus, contracts with different levels of premium and maximum payouts are included. The disasters covered and criteria of payout are the same across different contracts. Refer to Figure 2, within each village, households are randomized into four groups:

- Group T1: only offer the basic contract - farmers pay 3.6RMB to get a maximum payout of 200RMB;
- Group T2: offer three contracts - (3.6, 200), (7.2, 400), (10.8, 600): the additional two contracts have the same per unit price as the basic contract;
- Group T3: offer three contracts - (3.6, 200), (12, 400), (21.6, 600): this is the same contract menu offered to group C during year one, and the additional two contracts are more expensive than the basic contract;
- Group T4: offer three contracts - (3.6, 200), (15.6, 400), (27.6, 600): the amount of subsidies are the same across the three contracts. The additional two contracts are more expensive than the basic contract, and more expensive than that faced by group T3.

The second randomization is an information treatment, which was implemented across different contract groups. Within each of the four groups (T1-T4), half of the households were provided with an additional set of information. First, we indicate the existence of other contracts. Specifically, we tell farmers that the insurance company designed different contracts to satisfy farmers' heterogenous demand, and some farmers in the village are offered with a menu of contracts to choose from. The reason of why not all farmers receive the set of contracts is because of the budget constraint facing the government: since the subsidy that government need to provide is higher in additional contracts compared with the basic contract, they cannot offer it to everyone. For the same reason, rate of subsidies also varies across households and villages. Second, we show farmers the real probability of disasters, which is calculated based on the historical yield data.

3.3 Data and Summary Statistics

The empirical analysis is based on the administrative data of insurance purchase from PICC, and data collected from a household survey completed after households had made their insurance purchase decisions. All rice-producing households were invited to one of the meetings in which the insurance product was introduced, and almost 90 percent of them attended. In total, around 1750 households were surveyed in two years.

The household survey includes questions on demographics, rice production, income, natural disasters experienced and losses incurred, experience in purchasing any kind of insurance, risk attitudes, and perceptions about future disasters.[7] It also contains questions that test farmers' trust on the insurance company and evaluation of the insurance product. Summary statistics of selected household characteristics are presented in Table 1. Most household heads are male, with an average age of around 50. Approximately 70% household heads have at least primary school education. Moreover, rice production is the main source of household income, accounting on average for 60% of total income; 67% of households had experienced natural disasters in the most recent year, and the average yield loss rate was around 28%; sample households are risk loving, with an average risk aversion of 0.14 on a scale of zero (risk loving) to one (risk averse).

Randomization checks of the choice treatment and information treatment are presented in Table 1. There's no significant difference in household characteristics between the treatment and control groups.

[7]Risk attitudes were elicited by asking households to choose between a certain amount with increasing values of 50, 80, 100, 120, and 150 RMB (riskless option A), and risky gambles of (200RMB, 0) with probability (0.5, 0.5) (risky option B). The proportion of riskless options chosen was then used as a measure of risk aversion, which ranges from 0 to 1. The perceived probability of future disasters was elicited by asking, "What do you think is the probability of a disaster that leads to more than 30 percent loss in yield next year?"

4 Empirical Results

4.1 Effect of Contract Design on Insurance Adoption: Year One

To test the effect of contract design on insurance take-up, I use the first year sample and show the average take-up rates of the insurance by contract groups. According to Figure 1, the overall take-up of insurance (purchase of any contract) is significantly higher when more than one contracts are provided. Specifically, comparing Group A (single contract) and Group C (three contracts), the overall take-up rate can be increased by more than 50% (from 30% to 46%) by simply offering another two contracts. Interestingly, this incrase is mainly driven by an increase of the basic contract take-up rate (from 30% to 41%); only 6% household take contract (12, 400) and 5% take contract (21.6, 600).

To show whether the above results are statistically significant, I estimate the following equation:

$$Takeup_{ij} = \beta_0 + \beta_1 TwoChoices_{ij} + \beta_2 ThreeChoices_{ij} + \beta_3 X_{ij} + \eta_j + \epsilon_{ij}, \quad (1)$$

where $Takeup_{ij}$ a dummy variable indicating either the overall take-up or the basic contract take-up, $TwoChoices_{ij}$ is an indicator of whether a household is in Group B where two contracts, (3.6, 200) and (12, 400), are provided, $ThreeChoices_{ij}$ is an indicator of whether a household is in Group C where three contracts, (3.6, 200), (12, 400), and (21.6, 600) are provided, X_{ij} includes household characteristics, and η_j are village fixed effects.

As shown in Column (1) of Table 2, offering two choices increases the overall take-up by 11.8 percentage points, while including three contracts in the menu increases overall take-up by 17 percentage points. Adding village fixed effects and household characteristics does not change the effect much (Column (2), Table 2). However, offering two contracts does not have a significant impact on the basic contract take-up, but providing three contracts increases the basic contract take-up by 14 percentage points (Column (4), Table 2).

Since the main reason of why the insurance company is not offering contracts with higher payouts to more farmers is that the government cannot afford the additional subsidies, my results eliminates this concern, as even when additional contracts are provided, only a few people purchase them. However, at the same time, simply adding some additional contracts does increase the basic contract take-up significantly.

There are two possible reasons of why insurance take-up, especially the basic contract take-up, is influenced by the contract design. The first explanation is that this is a context effect: a consumer's choice between two alternatives depends on the presence of the other options. In my context, the additional two contracts are more expensive than the basic contract, so they may make the basic contract more attractive and as a result increase the take-up of the basic contract. An extensive literature demonstrates context effects in laboratory settings, but there's no experimental evidence in the field. The other channel is information inference, which suggests that people inferred some information from the contract set, and that changed their behavior. For example, in this case, there are two types of information that the contract set may contain. The first one is the probability of disasters. Because the premium payout ratio is different across contracts, people may infer different probability of disasters when they face different contract menu. The other type of information that farmers can possibly infer is the product quality. When the insurance company offers more choices, farmers may think the insurance company designed the program more carefully and thus improved their trust on the program. In other words, it can be a signal of better product quality. It's important to separate between these two channels because they suggest completly different policy implications. However, it's difficult to differentiate between them using the current design because introducing additional contracts brings in context effect and information inference at the same time.

4.2 Channles of The Contract Effect on Insurance Adoption: Year Two

I use two strategies To separate between the two channels of the contract effect, based on the second-year experimental design. First, refer to Figure 2, during the second year, four types of contract menues were provided. In Group T2, the two additional contracts have the same price as the basic contract offered to Group T1. However, for Groups T3, the two additional contracts are more expensive than the basic contract, and the contracts that Group T4 face are even more expensive. If the main channel of the contract effect on insurance take-up is through context effect: the existence of the two additional contracts makes the basic contract more attractive, then we should observe a smaller effect on basic contract take-up if the two additional contracts are of a similar price as the basic contract, and the effect should be bigger if the gap between the price of the two additional contracts and that of the basic contract is larger.

I plot the average take-up rates of different contracts across the four groups in Figure 4. Comparing Group T1 and Group T2, we can see that when the two additional contracts have the same price as the basic contract, the take-up of the basic contract decreases. The more expensive the two additional contracts (T3 and T4), the higher the take-up of the basic contract. To show whether these effects are statistically significant, I estimate the following equation:

$$Takeup_{ij} = \gamma_0 + \gamma_1 T2_{ij} + \gamma_2 T3_{ij} + \gamma_3 T4_{ij} + \gamma_4 X_{ij} + \eta_j + \epsilon_{ij} \tag{2}$$

where $Takeup_{ij}$ a dummy variable indicating either the overall take-up or the basic contract take-up, and $T2_{ij}$, $T3_{ij}$, and $T4_{ij}$ are indicators of whether a household is in Groups T2, T3, and T4, respectively. According to results in Table 3, all results observed in Figure 2 are statistically significant. This is consistent with the context effect explanation of the contract effect.

The second strategy I use to estimate channels of the contract effect is by exploiting the information treatment. The main information that farmers can infer from the contract set includes probability of disasters and quality of the insurance program. In the information treatment, the true probability of disasters is revealed, and the fact that the insurance company designed other contracts is annouced. If information inference is the main explanation of the contract effect, we should not observe any contract effect in the information treatment group. I test this hypothesis in Table 4. Results show that the contract effect is not affected by the information treatment. As a result, information inference is not the main mechanism driving the contract effect.

5 A Choice-set Dependent Preference Model (IMCOMPLETE)

In order to do a policy simulation and show what's the optimal combination of contracts to maximize insurance take-up and household welfare, I estimate a choice-set dependent preference model. The policy simulation part is not completed yet, and here I only present the model estimation.

Consumers' choice decisions depend on comparisons among available contracts within a given context. There are two main attributes of the insurance contract, price c, and coverage π. The individual's valuation of an insurance contract is composed of the baseline absolute valuation $\nu(.,.)$ and the comparative valuation $f(.)$:

$$u(c,\pi) = \nu(c,\pi) + f(\nu(c,\pi) - \nu(c_r,\pi_r)). \tag{3}$$

where c_r, π_r is the reference point.

Comparative valuations $f(\nu(c,\pi) - \nu(c_r,\pi_r))$ depend on departures from a choice set-specific reference point (c_r, π_r). This component incorporates reference dependency and allows for loss aversion. One example is:

$$f(\nu(c,\pi) - \nu(c_r,\pi_r)) = \begin{cases} exp(\lambda)\left[\nu(c,\pi) - \nu(c_r,\pi_r)\right] & \text{if } \nu(c,\pi) < \nu(c_r,\pi_r) \\ exp(\gamma)\left[\nu(c,\pi) - \nu(c_r,\pi_r)\right] & \text{if } \nu(c,\pi) \geq \nu(c_r,\pi_r) \end{cases}$$

where $\lambda > \gamma$ to capture the loss aversion. Note that I take exponential of both λ and γ in the function. This monotonic transformation ensures the multipliers in the reference dependency component are positive, which makes the estimation in the later stage easier. I also assume that the reference point is in the convex hull of the offered contracts' attributes. Given a set of contracts $\{(c, \pi)\}$, individual chooses (c^*, π^*) to maximize equation (3).

I simply function $\nu(.,.)$ as:

$$\nu(c, \pi) = \theta c - \alpha\pi \tag{4}$$

and $f(.)$ becomes

$$f(\nu((c, \pi), \nu(c_r, \pi_r))) = f_c(\nu_c(c) - \nu_c(c_r)) + f_\pi(\nu_\pi(\pi) - \nu_\pi(\pi_r)) \tag{5}$$

where

$$f_c(\nu_c(c) - \nu_c(c_r)) = \begin{cases} exp(\lambda_c)\theta(c - c_r) & if c \leq c_r \\ exp(\gamma_c)\theta(c - c_r) & if c \geq c_r \end{cases} \tag{6}$$

$$f_\pi(\nu_\pi(\pi) - \nu_\pi(\pi_r)) = \begin{cases} -exp(\lambda_\pi)\alpha(\pi - \pi_r) & if \pi \geq \pi_r \\ -exp(\gamma_\pi)\alpha(\pi - \pi_r) & if \pi \leq \pi_r \end{cases} \tag{7}$$

and

$$u(c, \pi) = \theta c - \alpha\pi + exp(\gamma_c)\theta(c - c_r) - exp(\lambda_\pi)\alpha(\pi - \pi_r) \tag{8}$$

$$u(0, 0) = -exp(\lambda_c)\theta c_r + exp(\gamma_\pi)\alpha\pi_r \tag{9}$$

There are three contracts and an outside option:

$$\{(c_0, \pi_0), (c_1, \pi_1), (c_2, \pi_2), (c_3, \pi_3)\}$$

where $(c_0, \pi_0) = (0, 0)$ is the outside option. And (c_r, π_r) is the reference level. Each individual will face possibly different subset of the list. Let J_i denotes the subset for individual i. Then the utility for individual i from choosing contract $j \in J_i$ is

$$u_{ij} = \theta_i c_j - \alpha_i \pi_j + [\mathbb{I}(c_j < c_r) exp(\lambda_c) + (1 - \mathbb{I}(c_j < c_r)) exp(\gamma_c)] \, \theta_i (c_j - c_r) \\ - [\mathbb{I}(\pi_j < \pi_r) exp(\gamma_\pi) + (1 - \mathbb{I}(\pi_j < \pi_r)) exp(\lambda_\pi)] \, \alpha_i (\pi_j - \pi_r)$$

where $\mathbb{I}(.)$ is the indicator function. For the moment, assume that $\lambda_c = \lambda_\pi = \lambda$ and $\gamma_c = \gamma_\pi = \gamma$. Now the individual will choose contract j over k if

$$\begin{aligned} u_{ij} &\geq u_{ik} \\ \alpha_i[-(\pi_j - \pi_k) + (\mathbb{I}\{\pi_k < \pi_r\} exp(\gamma) + \mathbb{I}\{\pi_k \geq \pi_r\} exp(\lambda))(\pi_k - \pi_r) \\ -(\mathbb{I}\{\pi_j < \pi_r\} exp(\gamma) + \mathbb{I}\{\pi_j \geq \pi_r\} exp(\lambda))(\pi_j - \pi_r)] \geq \\ \theta_i[(c_k - c_j) - (\mathbb{I}\{c_j < c_r\} exp(\lambda) + \mathbb{I}\{c_j \geq c_r\} exp(\gamma))(c_j - c_r) \\ +(\mathbb{I}\{c_k < c_r\} exp(\lambda) + \mathbb{I}\{c_k \geq c_r\} exp(\gamma))(c_k - c_r)] \end{aligned} \tag{10}$$

We now order the contracts based on π so that $\forall k < j$, $\pi_k < \pi_j$. Now $\forall k < j$, the LHS of inequality (10) becomes

if $\pi_k < \pi_j < \pi_r$

$$\text{LHS} = \alpha_i(-(1 + exp(\gamma))(\pi_j - \pi_k)) \equiv \alpha_i \eta_{1,jk}$$

if $\pi_r < \pi_k < \pi_j$

$$\text{LHS} = \alpha_i(-(1 + exp(\lambda))(\pi_j - \pi_k)) \equiv \alpha_i \eta_{2,jk}$$

if $\pi_k < \pi_r < \pi_j$

$$\text{LHS} = \alpha_i(-(1 + exp(\gamma))(\pi_j - \pi_k) - (exp(\lambda) - exp(\gamma))(\pi_j - \pi_r)) \equiv \alpha_i \eta_{3,jk},$$

in all three cases above, $\eta_{1,jk}, \eta_{2,jk}, \eta_{3,jk}$ are all negative. Then, $\forall k > j$, the

LHS of inequality (10) becomes

if $\pi_j < \pi_k < \pi_r$

$$\text{LHS} = \alpha_i(-(1+exp(\gamma))(\pi_j - \pi_k)) \equiv \alpha_i \eta_{1,jk}$$

if $\pi_r < \pi_j < \pi_k$

$$\text{LHS} = \alpha_i(-(1+exp(\lambda))(\pi_j - \pi_k)) \equiv \alpha_i \eta_{2,jk}$$

if $\pi_j < \pi_r < \pi_k$

$$\text{LHS} = \alpha_i(-(1+exp(\gamma))(\pi_j - \pi_k) + (exp(\lambda) - exp(\gamma))(\pi_k - \pi_r)) \equiv \alpha_i \eta_{4,jk},$$

in all three cases above, $\eta_{1,jk}, \eta_{2,jk}, \eta_{4,jk}$ are all positive. Let RHS be the right hand side of inequality becomes (10), then the individual chooses contract j if

$$\begin{aligned} \forall k < j, \alpha_i &< \frac{RHS}{\eta_{1,jk}^{\mathbb{I}\{\pi_k<\pi_j<\pi_r\}} \eta_{2,jk}^{\mathbb{I}\{\pi_r<\pi_k<\pi_j\}} \eta_{3,jk}^{\mathbb{I}\{\pi_k<\pi_r<\pi_j\}}} \\ \Leftrightarrow \alpha_i &< \min_{k<j} \left\{ \frac{RHS}{\eta_{1,jk}^{\mathbb{I}\{\pi_k<\pi_j<\pi_r\}} \eta_{2,jk}^{\mathbb{I}\{\pi_r<\pi_k<\pi_j\}} \eta_{3,jk}^{\mathbb{I}\{\pi_k<\pi_r<\pi_j\}}} \right\} \equiv \bar{\Delta}_{ij} \end{aligned} \tag{11}$$

By a similar argument, we have

$$\alpha_i > \max_{k>j} \left\{ \frac{RHS}{\eta_{1,jk}^{\mathbb{I}\{\pi_j<\pi_k<\pi_r\}} \eta_{2,jk}^{\mathbb{I}\{\pi_r<\pi_j<\pi_k\}} \eta_{4,jk}^{\mathbb{I}\{\pi_j<\pi_r<\pi_k\}}} \right\} \equiv \underline{\Delta}_{ij} \tag{12}$$

Assume α_i has CDF $F(.)$, then

$$\begin{aligned} P_{ij} &= Pr(\text{choosing contract j}) \\ &= Pr\left(\underline{\Delta}_{ij} < \alpha_i < \bar{\Delta}_{ij}\right) \\ &= \left[F(\bar{\Delta}_{ij}) - F(\underline{\Delta}_{ij})\right] \mathbb{I}\{\underline{\Delta}_{ij} < \bar{\Delta}_{ij}\} \end{aligned} \tag{13}$$

Let D_{ij} be the observed decision of household i on contract j, then the log likelihood function is

$$\begin{aligned}\mathcal{L} &= \sum_i \log \left(\sum_{j \in J_i} \mathbb{I}(D_{ij} = 1) P_{ij} \right) \\ &= \sum_i \log \left(\sum_{j \in J_i} \mathbb{I}(D_{ij} = 1) \left[F(\bar{\Delta}_{ij}) - F(\underline{\Delta}_{ij}) \right] \mathbb{I}\{\underline{\Delta}_{ij} < \bar{\Delta}_{ij}\} \right) \end{aligned} \tag{14}$$

Assume that $\theta_i = X_i \beta$ where X_i is a set of observable characteristics, then the parameters of interest: β, λ, γ.

The estimation result of the model is in Table 5. Estimates of λ and γ captures the choice set dependent figure and loss-aversion. Results show that estimates of λ is much larger than that of γ, which is consistent with the loss-aversion theory.

6 Conclusions

This paper uses a randomized field experiment conducted in China's main rice producing region to analyze the role of contract design in the adoption of a new weather insurance product and the mechanisms through which contract effect operate. I find that providing a menu of contracts for farmers to choose from has a large effect on insurance take-up. This contract effect is driven by a context effect, intead of information inference. The policy implication is that strategically offering a menu of contracts can be an easy and cheap way to improve insurance take-up.

FIGURE 1. EXPERIMENTAL DESIGN, YEAR 1

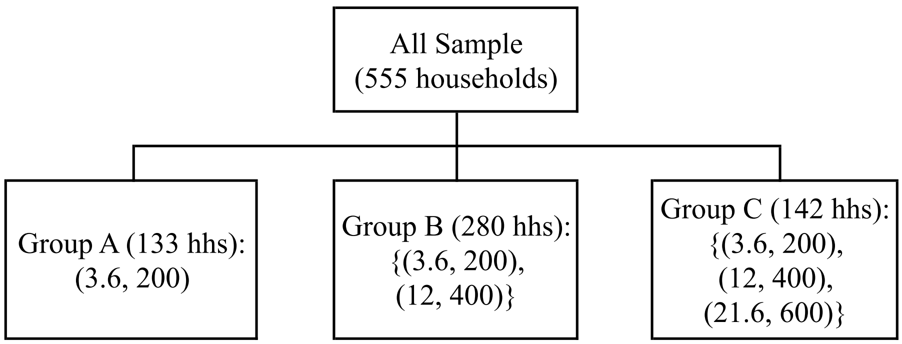
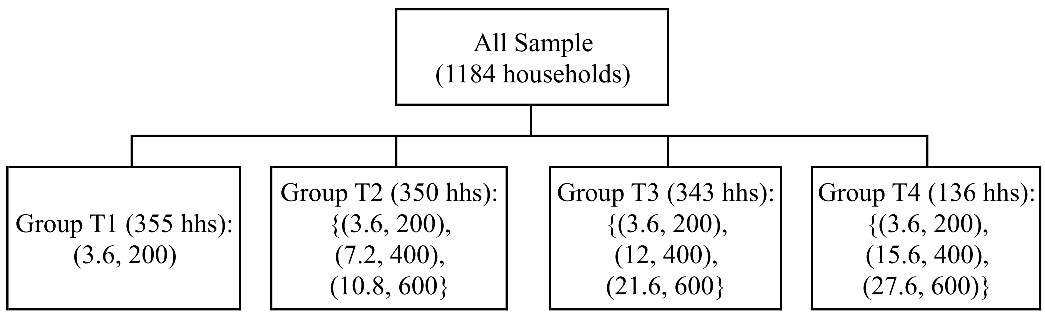


FIGURE 2. EXPERIMENTAL DESIGN, YEAR 2



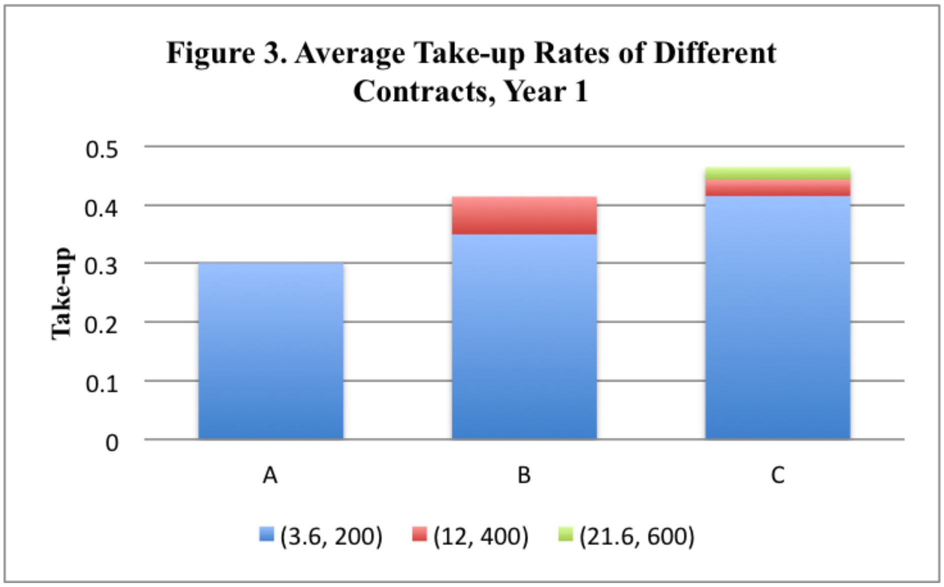


Figure 3. Average Take-up Rates of Different Contracts, Year 1
0.5
0.4
0.3
0.2
0.1
0
Take-up
A
B
C
(3.6, 200)
(12, 400)
(21.6, 600)

Figure 4. Average Take-up Rates of Different Contracts, Year 2

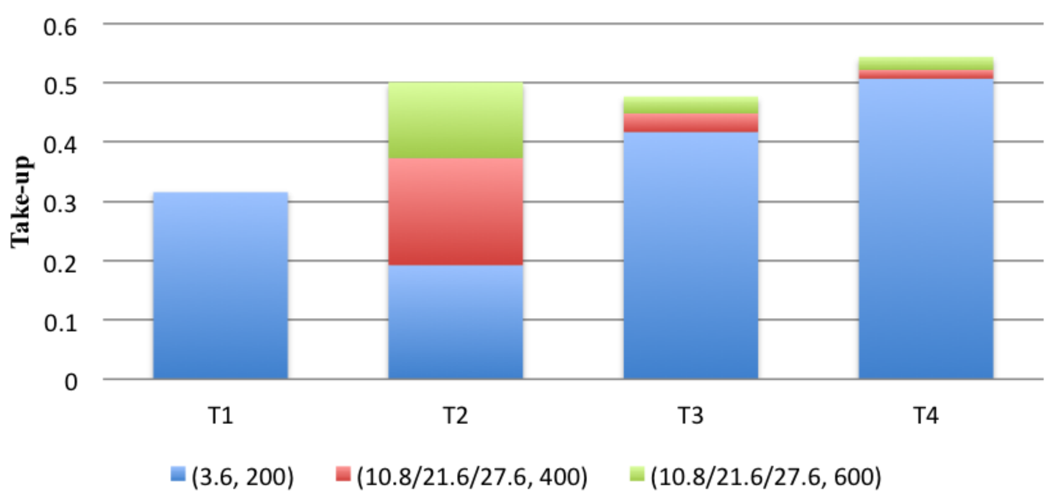


TABLE 1. SUMMARY STATISTICS

	Choice Treatment			Information Treatment		
	Yes	No	Dif	Yes	No	Dif
Gender of Household Head (1 = Male, 0 = Female)	0.64	0.67	-0.03	0.63	0.67	-0.04
	(0.48)	(0.47)		(0.48)	(0.47)	
Age	51.04	51.06	-0.02	51.32	50.85	0.48
	(12.37)	(12.42)		(12.69)	(12.16)	
Household Size	5.03	5.00	0.03	4.94	5.08	-0.14
	(2.08)	(2.09)		(1.96)	(2.16)	
Education (0 = Literate, 1 = Illiterate)	0.31	0.34	-0.03	0.33	0.31	0.02
	(0.46)	(0.48)		(0.47)	(0.46)	
Area of Rice Production (mu, 1 mu = 1/15 hectare)	11.85	12.91	-1.06	11.71	12.52	-0.81
	(20.39)	(20.54)		(6.3)	(6.52)	
Share of Rice Income in Total Income (percent)	60.91	60.34	0.57	59.73	61.52	-1.78
	(30.59)	(29.81)		(28.36)	(31.75)	
Any Disaster Happened Last Year (1 = Yes, 0 = No)	0.68	0.66	0.02	0.66	0.69	-0.03
	(0.47)	(0.47)		(0.47)	(0.46)	
Loss in Yield Due to Disasters Last Year (percent)	27.22	28.42	-1.19	26.59	28.30	-1.71
	(19.74)	(23.06)		(20.19)	(20.8)	
Risk Aversion (0-1, 0 as risk loving and 1 as risk avers	0.14	0.14	0.01	0.15	0.14	0.00
	(0.29)	(0.29)		(0.3)	(0.29)	
No. of Households: 1,739						
No. of Villages: 38						

Notes: This table checks the validity of the choice availability and information treatment randomization. Standard deviations are in parentheses. For the two columns reporting the difference between treatment and control groups, *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level. Risk attitudes were elicited by asking sample households to choose between a certain amount with increasing values of 50, 80, 100, 120, and 150 RMB (riskless option A), and risky gambles of (200RMB, 0) with probability (0.5, 0.5) (risky option B). The proportion of riskless options chosen by a household was then used as a measure of risk aversion, which ranges from 0 to 1.

TABLE 2. EFFECT OF INSURANCE CONTRACT ON INSURANCE TAKE-UP, YEAR 1

VARIABLES	Overall Take-up		Basic Contract (3.6, 200) Take-up	
	(1)	(2)	(3)	(4)
Two Choices	0.118*	0.131**	0.0509	0.0580
(Group B, =1 if Yes, =0 if No)	(0.0655)	(0.0666)	(0.0722)	(0.0720)
Three Choices	0.170***	0.202***	0.117*	0.139**
(Group C, =1 if Yes, =0 if No)	(0.0543)	(0.0520)	(0.0668)	(0.0672)
Observations	555	555	555	555
Village Dummies	No	Yes	No	Yes
Household Characteristics	No	Yes	No	Yes
R-Square	0.0112	0.0744	0.0055	0.0636

Notes: Robust clustered standard errors are in brackets. In columns (1) and (2), dependent variable is individual take-up of any contract; in columns (3) and (4), dependent variable is individual take-up of the basic contract (3.6, 200). *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level.

TABLE 3. EFFECT OF INSURANCE CONTRACT ON INSURANCE TAKE-UP, YEAR 2

VARIABLES	Overall Take-up	Basic Contract Take-up
	(1)	(2)
Group T2	0.189***	-0.136***
	(0.0407)	(0.0361)
Group T3	0.187***	0.112**
	(0.0432)	(0.0469)
Group T4	0.259***	0.204***
	(0.0467)	(0.0438)
Observations	1,184	1,184
Village Dummies	Yes	Yes
Household Characteristics	Yes	Yes
R-Squared	0.0627	0.0683

Notes: Robust clustered standard errors are in brackets. In column (1), dependent variable is individual take-up of any contract; in columns (2), dependent variable is individual take-up of the basic contract (3.6, 200). *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level.

TABLE 4. TEST CHANNELS OF THE CHOICE EFFECT: INFORMATION

VARIABLES	Overall Take-up	Basic Contract Take-up
	(1)	(2)
Group T2	0.164*	-0.130**
	(0.0888)	(0.0591)
Group T3	0.209***	0.135**
	(0.0519)	(0.0619)
Group T4	0.224***	0.202***
	(0.0561)	(0.0570)
Information	-0.0156	0.0153
(= 1 if Yes, = 0 if No)	(0.0735)	(0.0610)
Group T2 * Information	-0.0432	-0.0427
	(0.0819)	(0.0819)
Group T3 * Information	0.0260	-0.0165
	(0.0894)	(0.0839)
Group T4 * Information	0.0505	-0.000444
	(0.0988)	(0.0862)
Observations	1,184	1,184
Village Dummies	Yes	Yes
R-Squared	0.0632	0.0686

Notes: Robust clustered standard errors are in brackets. In column (1), dependent variable is individual take-up of any contract; in columns (2), dependent variable is individual take-up of the basic contract (3.6, 200). *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level.

TABLE 5. ESTIMATION OF THE CHOICE SET DEPENDENT PREFERENCE MODEL

Lamda	0.0693***
	(0.0269)
Gamma	-4.0552***
	(0.5423)
Gender of Household Head (1 = Male, 0 = Female)	0.0007
	(0.0006)
Age	0.0001
	(0.0000)
Household Size	0.0002
	(0.0001)
Education (0 = Literate, 1 = Illiterate)	0.0049***
	(0.0011)
Area of Rice Production (mu, 1 mu = 1/15 hectare)	0.0102***
	(0.0045)