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Borrowing from the Insurer

An Empirical Analysis of Demand and Impact of Insurance in China

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ABSTRACT

Farmers in developing countries face relatively large income risk and have limited access to formal financial products that can help them manage their risk. We present results from a randomized controlled trial in rural China designed to understand whether a small change in the timing of a premium payment for a swine insurance contract helps to overcome an important barrier to insurance demand and, if so, whether the resulting increase in insurance would allow farmers to increase investment in activities that expose them to the risk being insured against. We find that insurance take-up is three times higher among those who were given the option to pay at the end of the insured period. We use the random variation in insurance take-up thus induced to estimate the impact of insurance on investment. We find a positive impact on investment, which suggests that without insurance, farmers were not able to fully insure; that the new payment plan helped farmers to overcome an important barrier to insurance purchases; and that encouraging insurance purchases in this way can have a positive long-term effect on the income and welfare of rural households in China.

Keywords: microinsurance, delayed premium payment, liquidity constraint

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1. INTRODUCTION

Farmers in developing countries face relatively large income risk and have limited access to formal financial products that can help them manage risk. In the presence of risk that cannot be fully insured, farmers engage in risk-avoiding behavior at a cost to future expected income (Sandmo 1971; Kurosaki and Fafchamps 2002; Walker and Ryan 1990; Morduch 1991; Dercon and Christiaensen 2011; Hill and Viceisza 2012). This literature suggests that if farmers are offered insurance, they will purchase it, which will in turn allow them to invest in high-return activities that carry risk. However, a literature has emerged in recent years to try to understand why risk-averse farmers who are exposed to uninsured risk do not purchase well-priced insurance instruments (Cai et al. 2009; Cole et al. 2013a; Dercon et al. 2012; Hill, Robles, and Ceballos 2013). When insurance is provided for free, it has a positive impact on investment behavior (Karlan et al. 2013; Cole et al. 2013b), suggesting that low insurance demand is not the result of a limited need for insurance and that overcoming the constraints that farmers face in purchasing insurance could have substantial welfare effects.

In this paper we present results from a randomized controlled trial in rural China designed to understand whether a small change in the timing of a premium payment for a swine insurance contract would encourage higher demand and, if so, whether the resulting increase in insurance would allow farmers to increase investment in activities that expose them to the risk being insured against. Just prior to the purchasing window for the next insurance policy period, we randomly selected half of the farmers in our study and provided them with the option of purchasing an insurance contract but delaying payment of the premium until the end of the insured period. If no loss was suffered, the premium was to be paid with interest; but if a loss was incurred, the premium and interest payment would be deducted from the indemnity paid by the insurers. We find that insurance take-up is three times higher among those who were given the option to pay at the end of the insured period. The fact that more than 95 percent of insured households who did not suffer a loss repaid the premium on time suggests that the higher demand is not driven by the illusion of free insurance. We use the random variation in insurance take-up induced by the voucher to estimate the impact of insurance on investment. We find that insurance increases the total investment made by households, particularly higher-risk investments.

In many ways the literature explaining low insurance take-up among smallholder farmers is similar to the literature on technology adoption (Feder, Just, and Zilberman 1985; Munshi 2004; Jack 2011). Insurance, even if subsidized, is a new financial technology for many farmers, and as such, demand for insurance will likely face the same constraints as demand for new seeds or other agricultural inputs. Farmers who believe it to be unprofitable will eschew it (Clarke 2011); farmers who are uncertain about the new technology may be less likely to invest in it (Bryan 2010); and those who lack liquidity will find it more difficult to make the up-front payments required for purchase (Cole et al. 2013a).

However, purchasing an insurance contract is different from purchasing agricultural inputs in the level of trust required of the purchaser. When insurance is purchased by a farmer, the farmer is putting trust in the insurance company to provide support when it is most needed. Yet often the perceived probability of insurer default is quite high in rural areas of developing countries due to low levels of trust and unfamiliarity with formal financial institutions. In Madhya Pradesh, India, 50 percent of households surveyed reported that they thought private insurance companies were unlikely to honor an insurance contract (Hill, Robles, and Ceballos 2013), and 15 percent of households surveyed reported this to be the case in Ethiopia (Berhane et al. 2012). Such high perceived insurer default is often not well grounded in reality. For example, in our survey in China, about one-quarter of respondents thought that the probability of the insurer default was higher than 50 percent. However, the incidence of insurer default in the data is quite low: Among those who bought insurance and lost their pigs, only 4 percent complained that the insurance company refused to repay.

A number of studies have shown that demand for insurance is higher when trust in the provider of the product is high. In an experimental setting, insurance demand in India was found to be 36 percent higher when insurance was offered by someone known and trusted by the household (Cole et al. 2013).

Similarly, changing the background of the insurance flyer to match the religious affiliation of the potential buyer (from a mosque to a Hindu temple) raises insurance take-up. Cai et. Al. (2009), in the same context as our study, that of pig insurance in China (Cai et al. 2009), provides some suggestive evidence that trust in the insurer is an important determinant of demand.

The role of perceived default risk was also highlighted in Doherty and Schlesinger (1990), who showed that in the presence of default risk, many of the standard predictions of demand for insurance do not hold: Households may not purchase full insurance, and in the presence of contractual nonperformance, demand does not always increase in risk aversion.

The high perceived risk of insurer default can pose a significant constraint to demand for insurance offered by new financial intermediaries. To minimize these concerns, the delivery of insurance is often conducted by local organizations with a long history of dealing with farmers. In this paper we test whether delaying the payment of the premium to the end of the insurance period, when it is clear whether or not the insurer will default, may be an alternative way to overcome a trust deficit that may exist.

The delayed payment mechanism that we test in this paper may also increase insurance demand by relaxing liquidity constraints that may make it difficult for farmers to pay the insurance premium at the beginning of the season. Liquidity concerns affect demand for all insurance products, but this can be even more of a problem in agriculture if premiums are due when farmers must also buy other inputs, a number of months after the last harvest. Many agricultural insurance products in the United States are sold with payment due at the end of the insured period. Cole et al. (2013) use a field experiment in India to show that providing farmers with a cash transfer at the same time insurance is offered greatly increases take-up, which is suggestive that liquidity constraints may play a role in insurance demand. Duflo, Kremer, and Robinson (2010) show that asking for payments for agricultural inputs at a time when households are less likely to be liquidity constrained increases the number of household purchasing inputs. Providing farmers with the ability to pay later may provide them with the flexibility they need in timing the payment for their insurance premium.

Using a simple theoretical model, we show that the type of payment scheme offered to farmers in our study ameliorates constraints to demand caused by liquidity constraints and insurer default risk and thus has the potential to effectively increase insurance demand. In this paper we present results from the first experimental study to analyze the effects of this innovative insurance design on insurance take-up. The context we consider is one marked by high levels of mistrust in insurance contracts (Cai et al. 2009) and with few liquidity constraints. Therefore we may expect that if the new payment scheme increases demand, the increased demand would be a result of the impact of the payment scheme on the perceived risk of insurer default and/or the liquidity constraints. To explore whether this is true, we look at whom the new payment scheme has the largest impact on. We also examine the nature of demand for insurance under the new payment scheme. Doherty and Schlesinger (1990) show that demand does not increase in risk aversion if a risk of contractual nonperformance is evident. We estimate the relationship between risk aversion and demand for those in and those not in the new payment scheme. We find that the Doherty and Schlesinger results hold for purchases with up-front premium payments but not for those in the new payment scheme. This could indicate that the new payment scheme helps mitigate the risk of insurer default.

Our experimental design also allows us to test whether an information effect may be driving our results. Providing households with information on the new payment plan may have also provided them with information or a reminder on the insurance policies themselves. Therefore, we split our control into two groups. One group received the same information on swine insurance that was provided in the voucher given to farmers in the treatment group. If part of our treatment effect is driven by increased information or salience of the insurance, we would expect take-up to be higher in the control group with information than in the control group without information. We do not find this to be the case: Take-up is identical in both control groups, and insurance demand in the control group with information is significantly lower than insurance demand in our treatment group.

In addition to documenting the impact of the new payment plan, we estimate the impact of insurance on investment. If demand for insurance is low because households face barriers to purchasing a well-subsidized insurance product, we would expect that when these barriers are overcome, not only would demand increase but insurance would have an impact on behavior consistent with the fact that without the insurance contract, households were not able to satisfactorily insure income risk. In particular, we would expect investment in activities that the contract insures to increase (Sandmo 1971), with high-risk investments benefiting more than low-risk investments. We assess this by using the exogenous variation in insurance purchases induced by random allocation of households into the new payment plan, to instrument for insurance purchases. Using this instrumental variables method, we assess the impact of insurance on total investment in swine fattening and on investment in low-risk and higher-risk breeds of swine. We find insurance to increase the total number of swine purchased for fattening and, in particular, to increase purchase of higher-risk breeds. The moral hazard thus induced by the insurance contract is positive, reducing the time it takes to fatten swine by two months.

This positive impact suggests that without insurance, farmers were not able to fully insure; that the new payment plan helped farmers to overcome an important barrier to insurance purchases; and that encouraging insurance purchases in this way can have a positive long-term effect on the income and welfare of rural households in China. Low take-up of insurance has resulted in few studies that have shown a positive impact of insurance on investment and household welfare. This paper thus provides an important contribution to the literature on the negative impact of uninsured risk on household welfare. It fits with results of recent (as of yet, unpublished) studies that suggest that insurance has positive investment and welfare effects for farming households in developing economies (Cai et al. 2009; Cole et al. 2013b; Karlan et al. 2013).

The remainder of the paper is organized as follows: In Section 2 we provide a simple model to show that the delayed payment mechanism can increase insurance demand. In Section 3 we describe the context and design of the policy experiment. In Section 4 we present the data collected and details of the experimental implementation. In Section 5 we set our empirical strategy. In Section 6 we present our empirical results, and in Section 7 we conclude.

2. A SIMPLE MODEL

In this section we introduce a simple model to show that allowing individuals to defer payment of the premium to the end of the insured period will result in higher demand for insurance. The model uses a framework similar to that in Liu and Myers (2012). Consider a risk-averse agent who uses insurance to manage the risk of asset losses. Each period, the asset yields fixed revenue M if the asset survives and zero if it does not. With a known probability q, the agent loses her asset and receives no revenue. The insurance policy is defined by a couple (p, M), where p is the premium and M is the indemnity if the asset loss occurs before the end of the period. The agent can choose whether or not to insure the asset, which is denoted by a dummy variable k ($k = 1$, to insure; $k = 0$, not to insure). The agent perceives some probability of insurer default ξ. That is, when insurance is taken out and the loss occurs, the agent perceives she will get the indemnity with probability $(1-\xi)$. We also assume r is the one-period interest rate, which is fixed.

We consider the two insurance schemes: the traditional scheme, with the premium due at the beginning of the period, and the new scheme, which allows the insured to enter into an insurance contract and delay premium payment until the end of the insured period, after income has been realized, at the cost of an interest charge. In the new scheme, if the insured suffers the insured loss, the insurer deducts the premium from the indemnity. If not, the premium still has to be paid. We assume that both insurance policies are actuarially fair and have no deductible (that is, no expenses are required to be paid out of pocket by the insured before an insurer will pay any expenses). Thus in the traditional scheme, the premium is given by $p^1 = qM/(1+r)$. In the new scheme, the premium is $p^2 = qM = p^1(1+r)$.

We use a multiperiod setting. The insured is assumed to live forever and maximizes discounted lifetime utility subject to a budget constraint. When the insured does not choose any insurance in period *t*, her utility is

$$V_0(w_t) = \max_{c_t}\{U(c_t) + \beta E_t V(w_{t+1})\} \text{ s.t.} \tag{1}$$

$$S_t = w_t - c_t, \tag{2}$$

$$w_{t+1} = (1+r)S_t + (1-y_{t+1})M, \tag{3}$$

$$S_t \geq s, \tag{4}$$

$$\lim_{t\to\infty} \beta^t w_t = 0, \tag{5}$$

where $U(.)$ is an increasing and concave utility function; c_t and w_t are consumption and wealth, respectively, at period t; β is the rate of time preference; and S_t is savings (borrowing if negative) at period t. y_{t+1} is a binary random variable with 1 indicating the event of asset loss, which follows a Bernoulli distribution with mean q and variance $q(1-q)$. Equation (4) represents a liquidity constraint, where s is the minimum net wealth position allowed by the credit market. If $s = 0$, borrowing is not possible; and if $s = -\infty$, there is no liquidity constraint and any amount can be borrowed. Equation (5) is the transversality condition.

If the insured chooses to insure under the traditional insurance scheme, her utility is

$$V_1(w_t) = \max_{c_t}\{U(c_t) + \beta E_t V(w_{t+1})\}, \text{ s.t.} \tag{6}$$

$$S_t = w_t - c_t - p_t^1, \tag{7}$$

$$w_{t+1} = (1+r)S_t + (1 - y_{t+1}\Delta_{t+1})M \quad , \tag{8}$$

and Equations (4) and (5), where Δ_{t+1} is a binary random variable with 1 indicating the event of insurer default, which follows a Bernoulli distribution with mean ξ and variance $\xi(1-\xi)$.

If the insured chooses to insure under the new insurance scheme, her utility is

$$V_2(w_t) = \max_{c_t}\{U(c_t) + \beta E_t V(w_{t+1})\}, \text{ s.t.} \tag{9}$$

$$S_t = w_t - c_t, \tag{10}$$

$$w_{t+1} = (1+r)S_t + (1 - y_{t+1}\Delta_{t+1})(M - p^2), \tag{11}$$

and Equations (4) and (5).

Under either the traditional or the new insurance scheme, the insured will choose to insure if $V_1(w_t) > V_0(w_t)$ or if $V_2(w_t) > V_0(w_t)$. We denote optimal consumption at period *t* under no insurance, traditional insurance, and new insurance as c_t^0, c_t^1, and c_t^2, respectively. We next prove $V_2(w_t) > V_1(w_t)$ always holds.

Under the traditional insurance, $w_{t+1}^1 \mid (c_t = c_t^1) = (1+r)(w_t - c_t - p_t^1)$ with probability $q\xi$, and $w_{t+1}^1 \mid (c_t = c_t^1) = (1+r)(w_t - c_t - p_t^1) + M$ with probability $(1 - q\xi)$.

Under the new insurance, $w_{t+1}^2 \mid (c_t = c_t^1) = (1+r)(w_t - c_t)$ with probability $q\xi$, and $w_{t+1}^2 \mid (c_t = c_t^1) = (1+r)(w_t - c_t) + M - (1+r)p_t^1$ with probability $(1 - q\xi)$.

We note that $c_t = c_t^1$ is always feasible in the new insurance scheme because the budget constraint will not be binding in the new scheme if it is not binding in the traditional scheme. It is not difficult to see that $w_{t+1}^2 \mid (c_t = c_t^1)$ stochastically dominates $w_{t+1}^1 \mid (c_t = c_t^1)$ in the first degree. Thus $EV_2(w_{t+1}) \mid (c_t = c_t^1) > EV_1(w_{t+1}) \mid (c_t = c_t^1)$, which implies $V_2(w_t) \mid (c_t = c_t^1) > V_1(w_t) \mid (c_t = c_t^1)$. Intuitively, the first-degree stochastic domination is because the insured does not have to pay the premium under the scenario that a loss occurs and the insurer defaults (with probability $q\xi$). Equation (9) implies $V_2(w_t) \mid (c_t = c_t^2) > V_2(w_t) \mid (c_t = c_t^1)$. Therefore, we have $V_2(w_t) \mid (c_t = c_t^2) > V_1(w_t) \mid (c_t = c_t^1)$. That is, the insured always have higher utility under the new insurance scheme than under the traditional insurance scheme. As a result, the demand for insurance will be higher under the new insurance scheme than under the traditional scheme.

3. CONTEXT AND EXPERIMENTAL DESIGN

Our field experiment was conducted in Zizhong County of Sichuan Province, China. Swine production is a major source of economic income for households living in Sichuan province. Livestock (mostly swine) income accounts for 23.34 percent of the total income for farm households in Sichuan, as of 2009 (Li et al. 2009). Swine production is also an economic activity characterized by considerable risk. The mortality rate of fattening pigs is as high as 6–8 percent in China in the past decade, and most of the mortality is caused by infectious disease (Jia 2013).

Although some large swine producers are located in Sichuan, much swine production is done by small-and medium-income households residing in rural areas, with few resources available to help smooth the income shocks associated with swine production. Insurance for swine production is an important means by which households manage this risk. At the time of our experiment, two types of swine insurance were provided: insurance for sows and insurance for fattening pigs raised for meat use. Our study focuses on insurance for fattening pigs.

Insurance for fattening pigs is provided by the provincial government and a state-owned insurance company, the People's Insurance Company. The government defines the policy conditions and collects payments, while the insurance company handles contracting and indemnification. Each year, the government of Sichuan decides whether to provide insurance, when, and what policy. Usually the window for insurance purchases is open for several months each year. Before this window opens, farmers have no information on when it will be open and what kind of policy will be offered. When sales commence, the insurance premiums are collected by village veterinarians or other local government officials, and the settlement of claims is handled by the staff in township government and employees of the insurance company. In 2011, during our study period, two insurance policies were provided for fattening pigs. One policy was for a four-month fattening period and cost RMB 6 (Chinese renminbi), or about US$1, for one pig. A second policy was for a six-month fattening period and cost RMB 7.5 for one pig. In both policies, payouts are trigged by animal death, the guarantee level is RMB 500, the deductible is RMB 100, and the coverage level is 70 percent. That is, the indemnity is computed following the formula $Indemnity = Min[weight * market\ price * 70\% - 100, 500]$. As the formula indicates, the weight of the pig is the only characteristic of the pig that determines the amount of payout. The breed of the pig is inconsequential.

However, when it comes to raising pigs, not all breeds are equal in the time they take to mature, the risk they represent, and the skill and input level they require (Hu 2007). Three categories of swine are purchased for fattening: local hybrids, local cross-breeds, and foreign cross-breeds. Local hybrids take longer to fatten but are the lowest-risk type of investment, given their resilience to disease and the low skill level required to fatten them. Local cross-breeds take much less time to fatten but are not as resilient to disease and require more skill to fatten successfully; as a result they represent a riskier investment for farmers. Foreign cross-breeds take slightly less time to fatten than local cross-breeds but are much riskier, given their weak disease resistance and high skill requirement. This is summarized in Table 3.1.

Table 3.1 Characteristics of investments in swine production

Variable	Local hybrid	Local cross-breed	Foreign cross-breed
Fattening period	5 months	3–4 months	3 months
Disease resistance	Strong	Medium	Weak
Suitable number of pigs raised by farm	Small (<9)	Medium (<50)	Large (>50)
Skill requirement	Low	Medium	High
Feed requirement	Low	Medium	High
Environment requirement	Regular	Clean	Very clean
Reason to raise	Mostly self-consumption	For sale	For sale

Source: Table 6 in Hu (2007).

Given that the insurance policy compensates farmers equally for all breeds, we would expect that the insurance would encourage farmers to purchase the riskier types of cross-breeds for fattening. This moral hazard may be considered negative if changing investment in this way does not result in an increase in return to investment for farmers; however, it is positive if the additional risk undertaken allows farmers to realize a higher average return to their investments.

As is typical of a number of microinsurance products, this insurance product has quite low participation rates among farmers engaged in fattening pigs. This is the case even though it is an insurance product that is heavily subsidized by the government.[1] The low demand of a low-cost insurance product in a setting with an apparent need for insurance products to cover income risk provides a unique opportunity for an experiment to look at other, nonprice barriers to insurance purchases.

We designed and implemented an experiment to test whether payment of the premium at the end of the insurance contract would encourage demand and to assess the impact of any increase in insurance demand on investment behavior of households.

In this design we randomly selected study households to participate in a new payment scheme. Under the new payment scheme, those wishing to purchase insurance would not pay for the premium at the beginning of the season but instead would be able to purchase the insurance contract by promising to pay the premium prior to the end of the insurance contract. The cost of delaying the insurance premium payment was added as an additional interest fee that had to be paid by the participant. Thus, those that were offered the new payment scheme could choose whether to make a cash payment of the premium (as usual) in advance or to pay the premium plus interest at the end of the insured period.

Specifically, selected farmers were visited at their household and provided with a voucher that gave them the option to enter the insurance contract while delaying premium payment with an interest charge until the end of the insured period. If the farmer's insured pigs do not die during the insured period, the farmer pays the premium payment with an annual interest rate of 18 percent (the prevailing interest rate charged by local microfinance institutions at the time of the policy experiment) after the insured pigs are sold or slaughtered. If the farmer's insured pigs die and the farmer submits a valid claim, the premium and interest are deducted from the indemnity by the insurer.

In addition to the voucher provided to randomly selected households, we randomly selected half of the control households to receive a household visit providing all of the same information on the insurance product as the households receiving a voucher, but no voucher or information on delayed payment. This was done to control for any information effect that providing the voucher could have had. The remaining farmers in the control group were not visited or provided with information.

The random allocation of participants to the voucher scheme allows us to compare take-up among the treatment group with take-up among the control group and to attribute any significant difference in take-up to the new payment option. The role of the two control groups is to allow us to ascertain whether any of the treatment effect is a result of reminding the farmers of the insurance scheme. We compare take-up in the treatment group with take-up in both control groups combined, and then separately compare take-up in the treatment group with that in the group receiving information, to see the marginal effect of being provided the voucher. We also compare take-up between the two control groups to see any marginal effect of being offered information on the insurance scheme.

[1] In the theoretical model, we assume that the insurance policy is actuarially fair for simplicity. Our major results remain unchanged by introducing a negative loading factor (subsidization).

4. CONTEXT AND BASELINE DATA COLLECTION

In this section we provide information on the data we collected, the implementation of the experiment, and the characteristics of our sample population.

Baseline Data Collection

In December 2010, we conducted a baseline household survey of 1,684 swine-raising households from 162 teams (clusters of households in a geographically proximate area, "natural" villages) in 18 administrative villages in three towns in Zizhong County of Sichuan province, China. In each household, we interviewed the household member who was responsible for swine raising. In this survey, we collected information on household demographics, income, assets, swine production, knowledge of swine insurance, and insurance purchases in 2010.

We also asked questions to measure risk preference, trust, time preference, and liquidity constraint. To measure risk preferences, we followed Binswanger (1980, 1981) to ask households to choose one of the following five lotteries:[2]

1. RMB1000 for sure
2. Half chance of RMB900 and half chance of RMB1600
3. Half chance of RMB800 and half chance of RMB2000
4. Half chance of RMB400 and half chance of RMB3000
5. Half chance of 0 and half chance of RMB4000

According to the answers, we then generate a constant relative risk-aversion index from Binswanger (1980, 1981). To estimate respondents' discount rates, we asked respondents to indicate whether they would prefer a gift of a certain amount tomorrow or a larger gift one month from now.

It is difficult to derive an accurate quantitative measure of trust. We asked respondents to self-report using a Likert scale how much they trusted (1) others in general, (2) an insurance company to honor payments, (3) neighbors to take RMB 1,000 to a family member, and (4) neighbors to look after the hogs while away. We generate a trust index using a simple average of the answers to the questions. We also asked for the perceived probability that the insurance company would pay the indemnity if insured events occur.

We use a number of indicators to measure the liquidity constraint of households in our sample. We collected data on a variety of income sources and on household size to generate a measure of per capita income; however, this measure is inherently noisy. In addition to using per capita income, we use responses to a number of questions that were asked regarding a household's borrowing capacity. We asked whether the household felt the need to apply for a loan. We also asked if the household can access RMB 5,000 of cash within a couple of days and, if yes, what the sources are. Based on these questions, we generate four dummy variables on liquidity constraint: (1) no need to apply for the loan, (2) whether or not the household can access RMB 5,000 within couple of days, (3) whether the household can get this amount from savings, and (4) whether the household can get this amount from savings and loans (that is, no need to sell assets and so forth).

We report the sample means of the explanatory variables generated from the baseline survey in the first column of Table 4.1. We see that baseline demand for insurance is about 11 percent, even though the government subsidizes about three-quarters of the commercial premium. However, we also see that few households (17 percent) know that the insurance is subsidized, even though 91 percent of households are aware of the insurance product (although not the policy details; only 5–9 percent can correctly provide information on the specifics of the insurance policy).

[2] In the interviews, this question and all other questions were reworded and adapted to certain contexts to make them understandable to the farmers.

Table 4.1 Test of balance between treatment and controls

Variable	Total	TG	CG1	CG2	TG–CG1	TG–CG2	CG2–CG3
Bought insurance in 2010	0.108	0.115	0.091	0.117			
Household size	3.77	3.71	3.92	3.69	*		*
Female headed	0.11	0.1	0.1	0.13			
Age of head	53.95	53.57	54.41	54.24			
Head has middle school and above education	0.75	0.76	0.74	0.76			
Anyone has high school and above education	0.29	0.29	0.28	0.32			
Total household income (RMB)	32,155	31,245	33,213	32,855			
Total household asset value (RMB)	44,003	42,625	42,981	48,864			
Per capita income	8,234	8,270	8,299	8,054			
Per capita asset	12,340	12,340	12,013	13,258			
CRRA coeff. >7.33	0.617	0.632	0.592	0.618			
CRRA coeff. 1.86-7.33	0.187	0.169	0.221	0.181	**		
CRRA coeff. 0.63–1.86	0.127	0.132	0.115	0.134			
CRRA coeff. 0.27–0.63	0.045	0.043	0.058	0.032			
CRRA coeff. <0.27	0.022	0.023	0.014	0.032			
Risk aversion index	5.38	5.43	5.3	5.38			
Number of pigs raised in 2010	10.39	9.75	12.14	9.42			
Number of pigs raised in 2009	8.84	8.77	10.04	7.29			
Number of pigs raised in 2008	6.87	7.8	6.57	5.02			
Percent dead in 2010	5.20	4.90	5.60	5.20			
Percent dead in 2009	6.40	6.30	7.10	5.60			
Percent dead in 2008	5.80	5.90	6.10	4.90			
Perceived percentage death	13.20	13.60	13.00	12.80			
If insured in 2010	0.11	0.12	0.09	0.12			
Number insured in 2010	1.89	1.45	2.55	2.02			
If know of insurance	0.91	0.93	0.86	0.92	**		*
If mobilized by village officials	0.45	0.43	0.45	0.51			
If know when to buy insurance	0.14	0.14	0.14	0.15			
If know insurance is subsidized	0.17	0.16	0.18	0.18			
If know the guarantee level	0.09	0.09	0.08	0.09			
If know the deductible	0.05	0.04	0.07	0.06	*		
If purchase decision affected by others	0.2	0.19	0.21	0.2			
Index of insurance knowledge	0.27	0.27	0.27	0.28			
If mobilized by village officials	0.45	0.43	0.45	0.51			
Trust index	3.41	3.41	3.44	3.39			
Perceived risk of insurer default = 0	0.26	0.26	0.26	0.27			
Perceived risk of insurer default = 10%	0.09	0.08	0.09	0.1			
Perceived risk of insurer default = 20%	0.08	0.08	0.07	0.08			
Perceived risk of insurer default = 30%	0.17	0.17	0.18	0.18			
Perceived risk of insurer default = 40%	0.14	0.13	0.13	0.16			
Perceived risk of insurer default > 50%	0.26	0.28	0.27	0.22			
Perceived risk of insurer default	0.24	0.23	0.24	0.25			
Time premium	0.143	0.14	0.147	0.146			
If no need to borrow	0.481	0.469	0.473	0.522			
Having high borrowing capacity	0.47	0.469	0.469	0.475			
Having enough savings	0.055	0.064	0.054	0.032			

Source: Baseline survey data collected in 2010.

Notes: TG = Treatment group; CG = Control group; RMB = Chinese renminbi; CRRA= Constant relative risk aversion; coeff = coefficient. Significance level: * 10%, ** 5%, *** 1%.

The baseline characteristics also provide some indications on reasons for low demand. Perhaps most strikingly, we find that only one-quarter of respondents thought the insurance company would definitely not default, and another quarter of respondents thought that the probability of the insurer default was higher than 50 percent. This suggests very low levels of trust in the insurance company and that the perceived risk of insurer default may be a considerable constraint to insurance purchases. Our risk-aversion results suggest a highly risk-averse population, so perceptions of insurer default will considerably dampen demand. However, the incidence of insurer default in the data is quite low: Among those who bought insurance and lost their pigs, only 4 percent complained that the insurance company refused to repay. The perceived risk associated with pig production was much closer to the actual risk of pig production recorded in our data. Households perceived the probability of losing a pig as 0.13, and our data suggest that it ranges from 0.05 to 0.07from 2008 to 2010.

Liquidity constraints do not seem to be too much of a concern for households in our sample. Almost half of the households interviewed (48 percent) stated that they did not feel they needed to borrow, and almost half (47 percent) could get RMB 5,000 (US$800) within a couple of days if needed. This suggests that if the voucher has an effect, it may be a result of its ability to mitigate the perceived risk of insurer default rather than addressing liquidity constraints that farmers face.

We correlate purchases of insurance at baseline with selected household characteristics using nonparametric kernel-weighted local polynomial smoothing to estimate and plot the probability of insurance participation conditional on a set of key continuous or categorical variables in Figure 4.1.[3] The plots depict how insurance participation changes with each of the explanatory variables, including per capita income, trust index, perceived probability of insurance company to pay indemnity, risk aversion, and knowledge of insurance. The upward-sloping curves suggest that insurance demand increased in per capita income, trust, and knowledge of insurance and decreased in risk aversion and perceived insurer default. The negative correlation between risk aversion and insurance purchases is in line with the predictions of Doherty and Schlesinger (1990) in the presence of high perceived insurer default.

Figure 4.1 Insurance participation of 2010 (preintervention year) conditional on some key factors

Figure 4.1a—Insurance participation of 2010 conditional on income

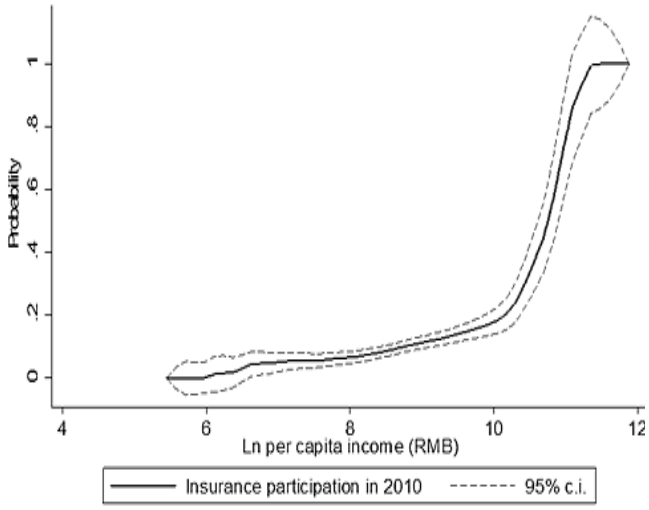
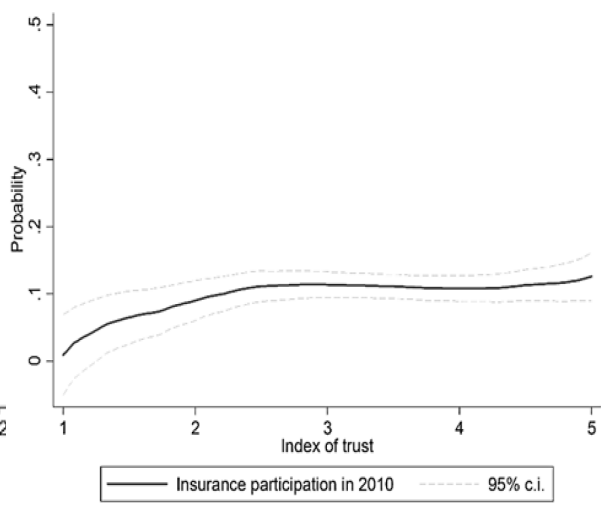


Figure 4.1b—Insurance participation of 2010 conditional on measure of trust



[3] The procedure we use is the "lpoly" in Stata 12 with default optimal bandwidth.

Figure 4.1 Continued

Figure 4.1c—Insurance participation of 2010 conditional on perceived probability of insurer to pay indemnity

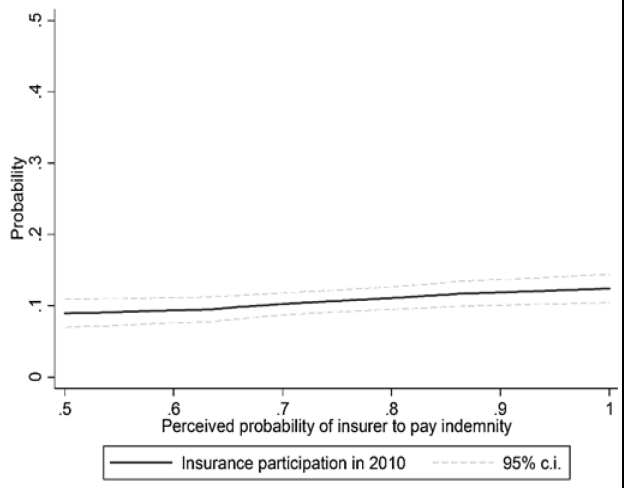


Figure 4.1d—Insurance participation of 2010 conditional on measure of risk aversion

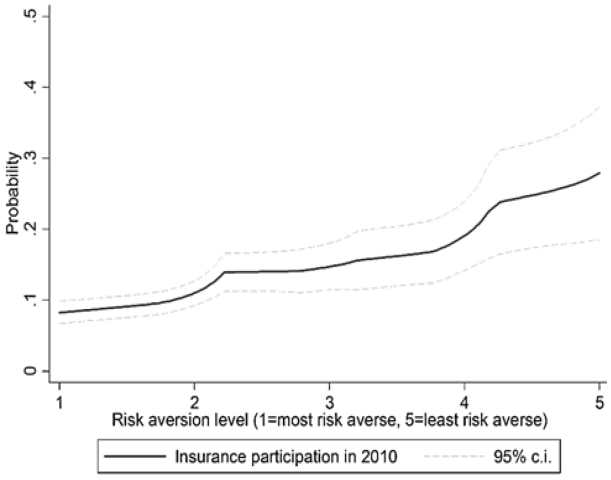
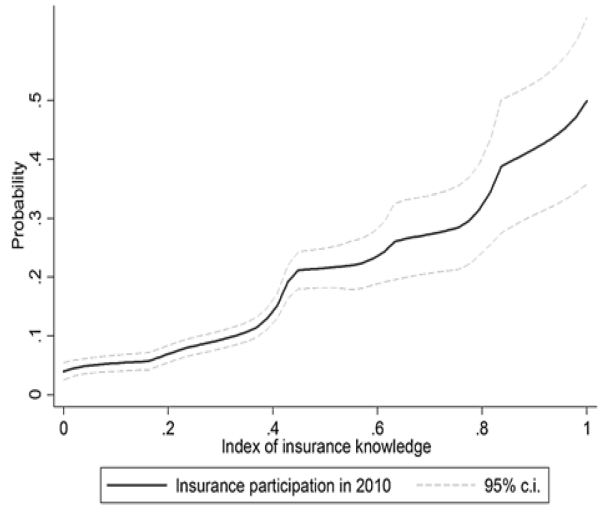


Figure 4.1e—Insurance participation of 2010 conditional on insurance knowledge



Source: Baseline survey data collected in 2010.

Implementation of the Experiment

The government opened the sales window in June 2011 for insurance policies for swine-raising households. Prior to the opening of the window we randomly assigned the 162 teams in our baseline sample into three groups: the treatment group (TG), comprising of 81 teams and 842 households; control group 1 (in which households received information, CG1), comprising 41 teams and 497 households; and control group 2 (in which households received nothing, CG2), comprising 40 teams and 343 households.

Randomization was conducted at the team level to avoid information spillovers regarding the availability of the voucher. We were concerned that farmers would object to differential treatment if we randomized at the individual level, even if we were able to make the random selection mechanism transparent. We were also concerned that farmers without the voucher may ask other farmers in their team with the voucher to purchase insurance on their behalf. Randomizing at the team level allowed us to mitigate these two risks to the randomization design.

We conducted pair-wise t-tests using the baseline household data to compare the means among groups to test whether our randomization resulted in balance on observed characteristics. The results are shown in Table 4.1 and indicate that our treatment and control groups are well balanced. Nearly all of the 46 variables presented are balanced across the treatment and control groups. There are two exceptions at the 5 percent significance level and six exceptions at the 10 percent significance level. This is to be expected, given that 138 pair-wise t-tests were performed.

Farmers in both TG and CG1 were visited at their household by village veterinarians. The village veterinarians were trained by the research team, and voucher distribution was supervised by the research team. During this visit, farmers in both TG and CG1 received a sheet containing information on the swine insurance policy. Farmers in TG also received the voucher providing them with the option to participate in the swine insurance plan featured with the new design. The voucher was printed with the farmer's name and national identification number. National identification had to be provided when executing the voucher. This ensured that vouchers were used by the farmers they had been issued to.

Follow-Up Data Collection

In December 2011, we collected the insurance sales data from the township governments in charge of premium collection. These data were matched with the baseline data using national identification numbers.

At this time we also worked with the village veterinarians to complete a short household survey on all households in the baseline survey. This survey was designed to collect data on the number of pigs each household had bought and fattened during the season. The attrition rate on this survey was quite high, with only 67.5 percent of baseline households responding. In Table 4.2 we present data on the characteristics of those who attrited. We find that the poorer, less-educated households that owned fewer pigs and knew less about insurance were not included in the follow-up survey. We surmise that this was because the village veterinarians did not invest as much time in interviewing poorer, less socially connected households. Below we discuss the implications of this attrition for our analysis. This attrition affects only our estimates of the impact of insurance on investment, not our estimates of the impact of the new payment plan on demand. There was no attrition in the collection and matching of administrative data on demand.

Table 4.2 Comparison of attrited and panel households

Variable	Panel household	Attrited household	Test of difference
Household size	3.83	3.61	***
Female headed	0.11	0.12	
Age of head	54	54	
Head has middle school and above education	0.77	0.71	**
Anyone has high school and above education	0.30	0.29	
Total household income	35,293	25,033	***
Total household asset value	46,175	38,637	**
Per capita income	8,917	6,722	***
Per capita asset	12,748	11,679	
CRRA coeff. >7.33	0.62	0.62	
CRRA coeff. 1.86–7.33	0.19	0.17	
CRRA coeff. 0.63–1.86	0.12	0.14	
CRRA coeff. 0.27-0.63	0.05	0.04	
CRRA coeff. <0.27	0.02	0.02	
Risk aversion index	5.38	5.40	
Number of pigs in 2010	12.86	4.64	***
Number of pigs in 2009	10.69	4.10	***
Number of pigs in 2008	7.95	3.99	***
Percent dead 2008–2010	0.06	0.05	
Perceived percentage death	0.13	0.14	
If purchased insurance in 2010	0.12	0.08	**
Number insured in 2010	2.59	0.30	***
If know of insurance	0.92	0.87	**
If mobilized by village officials	0.44	0.47	
If know when to buy insurance	0.14	0.12	
If know insurance is subsidized	0.17	0.18	
If know the guarantee level	0.10	0.07	**
If know the deductible	0.06	0.03	*
If purchase decision affected by others	0.19	0.23	**
Index of insurance knowledge	0.28	0.25	*
Trust index	3.36	3.50	***
Percent income from pig raising	0.21	0.15	***
Perceived risk of insurer default = 0	0.26	0.27	
Perceived risk of insurer default = 10%	0.09	0.08	
Perceived risk of insurer default = 20%	0.07	0.07	
Perceived risk of insurer default = 30%	0.16	0.19	
Perceived risk of insurer default = 40%	0.14	0.13	
Perceived risk of insurer default > 50%	0.27	0.25	
Time premium	0.15	0.14	
If no need to borrow	0.49	0.46	
Having high borrowing capacity	0.49	0.42	**
Having enough savings	0.07	0.03	***

Source: Baseline survey data collected in 2010.

Notes: CRRA= Constant relative risk aversion; coeff = coefficient. Significance level: * 10%, ** 5%, *** 1%.

5. EMPIRICAL STRATEGY

In this section, we first discuss our empirical strategy in assessing the impact of the new insurance scheme on insurance demand. Given the new insurance scheme has a significant effect on insurance demand, we then explore the randomized voucher distribution to study the impact of insurance on investment behavior.

Assessing the Impact on Demand for Insurance

Given that we have baseline data on insurance purchases, we have a choice of three methods for estimating the treatment effects: We can estimate the treatment effect by considering only take-up after the intervention; we can difference postintervention take-up with the baseline data and estimate a double-difference model; or we can estimate an analysis of covariance (ANCOVA) model. The correlation between demand before and after the intervention is quite low, 0.15, which indicates that to estimate the treatment effect it is better to use only take-up after the intervention than to use the difference of take-up between the post- and preintervention periods.

If we include data on take-up collected at baseline as a regressor in our analysis by estimating the ANCOVA model, we could see further increases in power (McKenzie 2012). Freedman (2008) shows that although the ANCOVA is consistent, in small samples it may be biased. Although Freedman's simulations suggest that for the size of our sample we are unlikely to see a meaningful bias, we follow his suggestion and estimate both the treatment effect using only endline data and the treatment effect using ANCOVA. We therefore estimate

$$Y_{i,1} = \alpha + \gamma_{TG} D_{i,TG} + \varepsilon_{i,1} \tag{12}$$

$$Y_{i,1} = \alpha + \theta Y_{i,0} + \gamma_{TG} D_{i,TG} + \varepsilon_{i,1}, \tag{13}$$

where $Y_{i,t}$ is whether or not farmer i bought insurance at t (where t is equal to 0 at baseline and 1 after intervention) and $D_{i,TG}$ indicates whether the farmer was in the treatment group. We first estimate equations (12) and (13) for the full sample, essentially pooling CG1 and CG2. We then estimate equations (12) and (13) for the farmers in TG and CG1. In this estimation, γ_{TG} estimates the impact of the voucher, controlling for any possible information effect. Finally we estimate the following equations using the farmers in CG1 and CG2:

$$Y_{i,1} = \alpha + \gamma_{CG1} D_{i,CG1} + \varepsilon_{i,1} \tag{14}$$

$$Y_{i,1} = \alpha + \theta Y_{i,0} + \gamma_{CG1} D_{i,CG1} + \varepsilon_{i,1}\,, \tag{15}$$

where $D_{i,CG1}$ indicates whether the farmer was in CG1. This allows us to test whether any information effect (γ_{CG1}) was present. For each regression we estimate two specifications: with and without additional controls from the baseline $x_{i,0}$.

In addition to assessing the impact of our intervention on demand for insurance, we are interested in looking at whether the intervention had a larger effect on those who reported being liquidity constrained during the baseline survey; on those who reported lower levels of trust in the insurance provider; and on those who were more impatient, valuing money more today than tomorrow. This allows us to test the predictions of the theoretical model set out in Liu and Myers (2012) and to explore whether liquidity or low trust is the most important in constraining demand in this setting. We do this by estimating the following equation:

$$Y_{i,1} = \alpha + \theta Y_{i,0} + \gamma D_{i,TG} + \beta h_i + \delta h_i * D_{i,TG} + \varepsilon_{i,1}\,, \tag{16}$$

where h is a dummy variable indicating an initial condition of households including liquidity constraint, trust, risk attitude and perspective, and time preference. When initial conditions are continuous or categorical variables, h_i takes the value of 1 if the farmer was in the top half of the income distribution (or trust distribution in the case of trust). The coefficient on the interaction term, δ, allows us to test whether the treatment effects estimated in each group are significantly different from each other. However, given our sample size, we have limited power to detect differences in the impact of the voucher between groups.

Finally we look at the relationship between risk aversion and insurance demand for households in TG and for households in CG1 and CG2 to identify any differences in determinants of insurance demand under the new scheme. If the voucher addresses liquidity constraints, we would expect income to no longer correlate with demand for insurance. The model in Doherty and Schlesinger (1990) would suggest that when characterized by high perceived default by the insurance company, insurance purchases will decrease as risk aversion increases. If the voucher reduces the risk of default to households, insurance purchases will no longer decrease with risk aversion. To test this we run the following regressions separately for treatment and control groups:

$$Y_{i,0} = \alpha + \beta r_{i,0} + \varepsilon_{i,1}, \quad (17)$$

$$Y_{i,1} = \alpha + \beta r_{i,0} + \varepsilon_{i,1}, \quad (18)$$

where $r_{i,0}$ is the risk aversion coefficient assuming constant relative risk aversion.

Assessing the Impact of Insurance on Investment Behavior

The random allocation of households to the new premium payment plan brought about an exogenous variation in the likelihood that a household would purchase insurance, without changing the overall wealth level of the household. This contrasts to insurance premium subsidies, which encourage insurance purchases but also represent a wealth transfer to households (Cole et al. 2013a). We use this exogenous variation in the probability of insurance purchases to identify the impact of insurance on investment by instrumenting insurance take-up with treatment assignment. It is important to note that although allocation to TG did not change the wealth of a household, it did increase liquidity of households prior to the end of the insured period, given that households did not have to pay the insurance premium until then. The impact we estimate is this combined effect of insurance and increased liquidity for those in TG.

The correlation between investment in swine production (the number of pigs purchased for fattening) in 2011 and 2010 is 0.554, which means that we have more power to detect an impact when estimating a double-difference model. We thus present results for regressions using both an ANCOVA and a double-difference model in which insurance is instrumented with allocation to treatment group.

As indicated in the previous discussion, we expect that insurance will result in an increase in household investment in risky but remunerative income-earning activities that are covered by the insurance contract. In particular, we expect that overall investment in swine fattening will increase and that investment in the riskier aspects of this production will increase more than other aspects. We estimate overall investment as the number of piglets purchased subsequent to purchasing the insurance contract, and the increase in riskier aspects of production by looking at the types of piglets purchased.

First, we have to address concerns regarding the attrition of households between the baseline and the follow-up surveys. We know that poorer, less educated households differentially attrited between baseline and follow-up. This means that our results will not be representative of all households but are the effect of insurance on wealthier and middle-income farmers. For these results to be valid, however, we need to show that attrition was not correlated with treatment status and, further, that the characteristics of those that attrited are not different across treatment categories. In Table 5.1 we show the rate of attrition across treatment categories. We show that no significant difference exists in the rate of attrition between TG and CG1, TG and CG2, and CG1 and CG2. In the rest of the table we test whether the characteristics

of those that were not found in the follow-up survey are the same across all treatment categories. We find this to be the case. As a result, the panel households are also balanced on observed characteristics (see Appendix Table A.1).

This suggests that although attrition leaves us with a nonrepresentative sample at endline, which has implications for the generalizability of the estimates of impact, the results are internally consistent.

Table 5.1 Comparison of characteristics of attrited households across treatment groups

Variable	TG	CG1	CG2	TG–CG1	TG–CG2	CG1–CG2
Rate of attrition	32.1%	33.4%	33.5%			
Household size	3.49	3.85	3.51	**		*
Female headed	0.12	0.13	0.11			
Age of head	53	54	54			
Head has middle school and above education	0.68	0.77	0.70	**		
Anyone has high school and above education	0.28	0.30	0.28			
Total household income	24,454	24,252	27,458			
Total household asset value	36,246	38,840	43,760			
Per capita income	6,896	6,137	7,161			
Per capita asset	11,416	11,344	12,751			
CRRA coeff. >7.33	0.63	0.61	0.62			
CRRA coeff. 1.86–7.33	0.14	0.20	0.21			
CRRA coeff. 0.63–1.86	0.16	0.13	0.13			
CRRA coeff. 0.27–0.63	0.04	0.06	0.02			*
CRRA coeff. <0.27	0.03	0.01	0.02			
Risk aversion index	5.38	5.36	5.48			
Number of pigs in 2010	4.49	4.61	5.01			
Number of pigs in 2009	4.39	3.93	3.68			
Number of pigs in 2008	4.30	3.67	3.74			
Percent dead 2008–2010	0.05	0.07	0.04			
Perceived percentage death	0.15	0.14	0.13			
If purchased insurance in 2010	0.08	0.05	0.09			
Number insured in 2010	0.34	0.18	0.37			
If know of insurance	0.88	0.83	0.91			
If mobilized by village officials	0.40	0.52	0.59		**	
If know when to buy insurance	0.11	0.13	0.14			
If know insurance is subsidized	0.16	0.19	0.19			
If know the guarantee level	0.05	0.06	0.11		*	
If know the deductible	0.03	0.05	0.03			
If purchase decision affected by others	0.20	0.27	0.22			
Index of insurance knowledge	0.25	0.25	0.28			
Trust index	3.55	3.41	3.52			
Percent income from pig raising	0.15	0.17	0.13			*

Table 5.1 Continued

Variable	TG	CG1	CG2	TG–CG1	TG–CG2	CG1–CG2
Perceived risk of insurer default = 0	0.26	0.27	0.29			
Perceived risk of insurer default = 10%	0.07	0.10	0.08			
Perceived risk of insurer default = 20%	0.07	0.07	0.09			
Perceived risk of insurer default = 30%	0.20	0.18	0.16			
Perceived risk of insurer default = 40%	0.13	0.11	0.18			
Perceived risk of insurer default > 50%	0.26	0.27	0.19			
Time premium	0.13	0.14	0.16			
If no need to borrow	0.43	0.44	0.56		**	*
Having high borrowing capacity	0.39	0.42	0.49			
Having enough savings	0.03	0.03	0.02			
Number of observations	240	151	106			

Source: Baseline survey data collected in 2010.

Notes: CRRA= Constant relative risk aversion; coeff = coefficient. Significance level: * 10%, ** 5%, *** 1%.

6. RESULTS

In this section, we present the empirical results. We find significant effects of voucher of delayed premium payment on insurance demand. Instrumenting insurance demand by randomized voucher distribution, we identify a significant effect of insurance on investment.

Impact of the Voucher on Demand

In Table 6.1 we present our main treatment effects using postintervention and ANCOVA estimation. In addition to presenting results for treatment effects estimated with and without controlling for baseline demand, we present results with and without additional controls from the baseline.[4] All standard errors are corrected for clustering within the team, given this was the unit of randomization.

Table 6.1 Impact of the voucher and information on insurance participation

	(1)	(2)	(3)	(4)
Variable	**Post**	**Post**	**ANCOVA**	**ANCOVA**
Panel 1: Comparing treatment group with the combination of control groups 1 and 2				
Treatment	0.109***	0.108***	0.107***	0.107***
	(4.87)	(4.97)	(4.99)	(4.99)
Insurance participation in 2010			0.146***	0.105***
			(3.84)	(2.77)
Baseline characteristics included	no	Yes	no	yes
Township dummies	no	yes	no	yes
Number of observations	1,682	1,510	1,682	1,510
Panel 2: Comparing treatment group with control group 1				
Treatment	0.113***	0.112***	0.109***	0.110***
	(4.71)	(4.68)	(4.76)	(4.64)
Other explanatory variables	no	yes	no	yes
Number of observations	1,339	1,208	1,339	1,208
Panel 3: Comparing control group 1 with control group 2				
Information	–0.00821	–0.0113	–0.00482	–0.00862
	(–0.45)	(–0.64)	(–0.28)	(–0.50)
Other explanatory variables	no	yes	no	yes
Number of observations	840	750	840	750

Source: Administrative data on sales (2011) and baseline survey data (2010).
Notes: ANCOVA = Analysis of covariance t-statistics are in parentheses. Significance level: * 10%, ** 5%, *** 1%..

[4] These additional controls from the baseline include household size, female headship, age of household head, whether or not any member of the household has education of high school or higher, logarithm of total income per capita, logarithm of total value of asset per capita, risk-aversion index, share of income from swine raising, death ratio of swine from 2008 to 2010, total heads of fattening pigs raised, index of insurance knowledge, trust index, perceived risk of insurer default, whether a household would wait for one more month for additional award of RMB 10 (rather than RMB 100 immediately), whether a household feels no need to borrow, whether a household can access RMB 5000 within a couple of days, whether a household has savings over RMB 5000, and township dummies.

Before discussing the results of the policy intervention we note that the estimation method did not influence the results found. This suggests that for the sample size we are considering, ANCOVA is unbiased. However the results also indicate that, given the low correlation between pre- and postintervention take-up, very little power gain results from estimating the ANCOVA. Therefore, for the rest of our analysis we present results without controlling for demand at baseline.

The treatment effects suggest a strong positive increase in take-up as a result of receiving the voucher. Households with the voucher are 10–11 percentage points more likely to purchase insurance than those without the voucher. We also note from the data in the treatment group that about 93 percent of households who purchased insurance in 2011 chose to do so using the new payment plan. The treatment effects presented in panel 1 (comparing TG with CG1 and CG2 combined) and panel 2 (comparing TG with CG1) are almost identical, which suggests little, if any, effect of providing information on insurance demand. We test this formally in panel 3 and find indeed no statistical difference between the two control groups: those who received no visit and those who received an informational visit. No information effect was found. Data on farmers' knowledge about insurance that was collected as part of the follow-up survey shows that knowledge of the deductible was higher among CG2 than among TG or CG1, but knowledge of other aspects of the policy was no different (see Table 6.2). This was evidently not large enough to result in a difference in demand. We also find no difference in knowledge between TG and CG1 households. This suggests that the full 10–11 percentage point effect resulted from receipt of the voucher.

Table 6.2 Impact of treatments on knowledge of insurance

Variable	TG	CG1	CG2	TG–CG1	TG–CG2	CG1–CG2
Proportion of farmers that know:						
the insurance deductible	0.145105	0.178248	0.311404		**	*
the minimum guarantee level	0.480769	0.362538	0.495614			
that insurance is subsidized	0.263986	0.353474	0.342105			
when to buy insurance	0.433566	0.392749	0.425439			
Number of observations	572	331	228			

Source: Follow-up survey data (2011).
Note: TG = treatment group; CG1 = control group 1; CG2 = control group 2.

Although the insurance take-up in the treatment group is still low (about 15.7 percent), it is about two times higher than the take-up in the control groups (about 4.7 percent). The insurance take-up in the control groups dropped considerably from 11 percent in 2010 to less than 5 percent in 2011. This is because many of our sampled households did not raise pigs in 2011 because the price of both feed and piglets largely increased in 2011, which makes swine raising less profitable. We learned that 59 percent of households in the treatment group did not raise pigs at the time of distributing vouchers. Among the 499 households who did not raise pigs in 2011, only 4 purchased insurance later on, in contrast to 128 households who purchased insurance among the 343 households who raised pigs in 2011.[5] Therefore, the participation rate for those who raised pigs at the timing of distributing vouchers is as high as 37 percent, which is roughly three times greater than the participation rate in 2010 (11 percent).

We now turn to exploring heterogeneity in treatment effects. We do this by interacting the treatment dummy with dummies reflecting baseline characteristics. The results are presented in Table 6.3. It is interesting to see that the treatment effect is significant for all subgroups separated by a variety of criteria: liquidity constraint, trust, risk attitudes, and time preferences. However, the difference in treatment effects between subgroups is virtually insignificant. This could reflect the fact that a number of

[5] Unfortunately, we do not know how many households raised pigs at the time of distributing the voucher in the control groups.

these variables, such as income and trust, are likely to be quite noisy, or it could result from lack of power to detect differences between groups. However, it could also indicate that the treatment effect is the same for households along a number of dimensions.

Table 6.3 Heterogeneity in treatment effects

	TG versus CG1 and CG2					
Variable	**Yes**		**No**		**Difference**	
Indicators for liquidity constraint						
Having higher per capita income	0.127	***	0.088	***	0.039	
If no need to borrow	0.111	***	0.103	***	0.008	
If can get cash immediately	0.127	***	0.089	***	0.038	
If can get cash immediately from savings	0.140	*	0.105	***	0.035	
If can get cash immediately from savings or loans	0.114	***	0.101	***	0.014	
Indicators for trust						
Higher trust index	0.108	***	0.107	***	0.001	
If trust that insurance company will repay	0.119	***	0.098	***	0.021	
If trust often in general	0.103	***	0.109	***	–0.005	
If trust seldom in general	0.109	***	0.104	***	0.005	
Indicators for risk attitude and perspectives						
If more risk averse	0.106	***	0.111	***	–0.005	
Higher death ratio of fattening pigs	0.126	***	0.097	***	0.029	
Raising more fattening pigs	0.151	***	0.072	***	0.079	**
Higher percentage of income from fattening pigs	0.114	***	0.102	***	0.011	
Time preference						
If being patient	0.113	***	0.096	**	0.017	

Source: Administrative data on sales (2011) and baseline survey data (2010).
Note: TG = treatment group; CG1 = control group 1; CG2 = control group 2. Significance level: * 10%, ** 5%, *** 1%.

The only exception is between the subgroups separated based on the number of pigs fattened in 2010. The result suggests that swine-raising farmers with larger numbers of swine in 2010 were more responsive to the voucher. It is not clear what this result means for our hypothesis that liquidity-constrained farmers would respond more to the voucher. We may expect that those who raise more pigs are in general wealthier and therefore less liquidity constrained. However, we see no relationship between other measures of income or wealth and responsiveness to the voucher. What is more likely is that those who raised a large number of pigs in 2010 were more likely to continue raising pigs in 2011 (given that for the number of pigs purchased for fattening, we observe a correlation of 0.54 between 2010 and 2011). Thus, for these farmers, the insurance voucher had more relevance.

As a further test (and one with potentially more power) of the role of perceived default risk in explaining our results, we examine the relationship between risk aversion and demand for insurance for the treatment and control groups before and after the intervention. We use the finding from Doherty and Schlesinger (1990) that in the presence of contractual nonperformance, demand does not always increase in risk aversion. If perceived default risk is important in constraining demand and is mitigated by the presence of the new payment plan, we would expect to observe a different relationship between risk aversion and demand for the treatment group after the intervention. Results are presented in Table 6.4 and show that for both the treatment and control groups prior to the intervention, increased risk aversion was associated with reduced insurance demand. This relationship also held true for the control group after the

intervention. However, this negative relationship was no longer observed among the treatment group after the intervention. No significant relationship between risk aversion and demand was found among the treatment group after the intervention. In summary, these results are consistent with the hypothesis that part of the voucher's effectiveness was a result of allaying fears of default risk but that measuring default risk is difficult.

Table 6.4 Relationship between risk preferences and insurance demand

Variable	Demand for insurance among CG1+CG2 in 2010	Demand for insurance among TG in 2010	Demand for insurance among CG1+CG2 in 2011	Demand for insurance among TG in 2011
Risk aversion	0.060 (0.010)***	0.035 (0.011)***	0.019 (0.007)**	0.012 (0.012)
Constant	0.001 (0.020)	0.058 (0.021)***	0.016 (0.014)	0.136 (0.024)***

Source: Administrative data on sales (2011) and baseline survey data (2010).
Notes: Robust standard errors are in parentheses. Significance level: * 10%, ** 5%, *** 1%.

Impact of Insurance on Productive Investments

The large and significant impact of the voucher on insurance demand allows us to estimate the impact of insurance on production choices by using the random allocation of the voucher as an instrument for insurance purchases. Table 6.5 presents regression results from an instrumental variable estimation of the impact of insurance on productive investments undertaken by households, instrumenting insurance with dummies indicating a household's allocation to group TG and to group CG1. [6] The coefficient estimates on insurance provide an estimate of the local average treatment effect of insurance for those induced into taking insurance by the new payment plan. Given that these households did not have to pay the premium until the end of the insured period, the new payment plan also increased the liquidity of these households relative to those who purchased insurance in the control groups. The low premium rates and the limited evidence of liquidity constraints suggest that this will not be a primary driver of any results we observe, but we cannot rule out this potential impact pathway. The previous section suggests that the first stage of these regressions will allow us to predict insurance purchases well, and indeed this is what we find (see the Appendix Table A.2 for results from the first-stage regression).

[6] In Table 6.5, Columns 1, 4, 7, and 10 report ANCOVA results with no additional controls from the baseline; columns 2, 5, 8, and 11 report ANCOVA results with additional controls from the baseline; columns 3, 6, 9, and 12 report double-difference estimation results. The additional controls include household size, female headship, age of household head, whether or not any member of the household has education of high school or higher, logarithm of total income per capita, logarithm of total value of asset per capita, risk-aversion index, share of income from swine raising, death ratio of swine from 2008 to 2010, total heads of fattening pigs raised, index of insurance knowledge, trust index, perceived risk of insurer default, whether a household would wait for one more month for additional award of RMB 10 (rather than RMB 100 immediately), whether a household feels no need to borrow, whether a household can access RMB 5000 within a couple of days, whether a household has savings over RMB 5000, and township dummies.

Table 6.5 Impact of insurance on investment

Variable	Total investment (number of pigs)			Low-risk investment (local hybrid pigs)			Medium-risk investment (local cross-bred pigs)			High-risk investment (foreign cross-bred pigs)		
Insured in 2011	8.574**	7.691**		1.176	0.114		4.322	5.933**		0.798	–0.0161	
	(2.00)	(1.96)		(0.84)	(0.10)		(1.37)	(2.05)		(0.46)	(–0.01)	
Change in insurance between 2011 and 2010			11.63**			–1.329			5.936*			5.905
			(2.02)			(–0.63)			(1.65)			(1.16)
Lag of dependent variable	0.574***	0.271		0.0190	–0.00228		0.0741	–0.0801		0.208*	0.236*	
	(3.00)	(1.12)		(0.60)	(–0.06)		(0.97)	(–0.87)		(1.91)	(1.86)	
Constant	–0.562	0.343	–0.898**	0.236*	–3.346	–0.587***	0.238	4.271	0.0659	0.0570	2.654	–0.988**
	(–0.86)	(0.07)	(–2.33)	(1.75)	(–1.31)	(–4.50)	(0.91)	(0.73)	(0.31)	(0.25)	(1.03)	(–2.48)
Estimation method	ANCOVA	ANCOVA	DD	ANCOVA	ANCOVA	DD	ANCOVA	ANCOVA	DD	ANCOVA	ANCOVA	DD
Other characteristics	No	yes	no	no	yes	no	no	yes	No	no	yes	no
Observations	1,131	1,024	1,131	1,131	1,024	1,131	1,131	1,024	1,131	1,131	1,024	1,131

Source: Administrative data on sales (2011) and baseline and follow-up survey data (2010).
Notes: t-statistics are in parentheses. Significance level: * 10%, ** 5%, *** 1%.

We examine the impact of insurance first on the total number of piglets purchased during the insurance window (columns 1 to 3) and then on the different types of piglets purchased (columns 4 to 12). We find that households who were induced to purchase insurance by provision of the delayed payment voucher invested more in pig production, measured by the number of piglets purchased for fattening, than those without insurance. This is as Sandmo (1971) predicts: Without insurance, households underinvest in remunerative but risky activities.

The results presented in the remaining columns of Table 6.5 suggest that the provision of insurance also has portfolio effects by altering the type of investment. We disaggregate investment into the three categories described above: low-risk and low-return investment (purchases of local breeds), medium-risk and medium-return investment (purchases of cross-breeds) and high-risk and high-return investment (purchases of foreign breeds). When we disaggregate the types of investments undertaken in this way, we find that households with insurance are no more likely to invest in low-risk breeds but are significantly more likely to undertake medium-risk investments by purchasing cross-breeds. Interestingly, we find no effect of insurance on the most risky type of investment, ownership of foreign pigs; however, we also find very few households owning pigs of this type, perhaps because the production technologies available to these households are not well suited to taking on this type of investment.

Local cross-breeds take a shorter time to reach the desired weight for slaughter and, as a result, provide households with a more remunerative investment option. Increased investment in these breeds suggests that insurance has a positive welfare effect on households.

7. CONCLUSION

Farmer participation in insurance markets in developing economies is constrained by many of the same barriers that limit participation in other markets. However, the role of trust in determining demand has been documented particularly in Cai et al. (2009) and also in other studies on demand for insurance products (for example, Cole et al. 2013a). Farmers who purchase insurance are putting their trust in the insurance company to provide support when it is most needed.

In this study we examine the impact of a small change in the premium payment schedule that might help mitigate this trust deficit that constrains demand. Delaying the payment of the insurance premium until the end of the insured period allows farmers to observe whether or not the insurer defaults before paying the insurer. We find that this change in the payment schedule results in a large increase in demand for insurance. This effect could be driven by ameliorating the cost of the perceived risk of insurer default or by the fact that it allows farmers to postpone payment of the premium to a season when they are likely to have more money.

This change in the premium payment schedule has a positive effect on investment by increasing the total investment in swine production and also by encouraging riskier, higher-return investments. This positive impact suggests that without insurance, farmers were not able to fully insure; that the new payment plan helped farmers to overcome an important barrier to insurance purchases; and that encouraging insurance purchases in this way can have a positive long-term effect on the income and welfare of rural households in China.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1 Balance in panel

Variable	TG	CG1	CG2	TG–CG1	TG–CG2	CG1–CG2
Household size	3.80	3.93	3.75			
Female headed	0.09	0.09	0.15		**	*
Age of head	54	55	54			
Head has middle school and above education	0.79	0.72	0.79	**		
Anyone has high school and above education	0.30	0.27	0.33			
Total household income (RMB)	33,937	37,324	35,745			
Total household asset value (RMB)	44,811	44,485	52,049			
Per capita income (RMB)	8,827	9,323	8,554			
Per capita asset (RMB)	12,591	12,300	13,791			
CRRA coeff. >7.33	0.63	0.59	0.61			
CRRA coeff. 1.86–7.33	0.18	0.23	0.17	*		*
CRRA coeff. 0.63–1.86	0.12	0.10	0.14			
CRRA coeff. 0.27-0.63	0.05	0.06	0.04			
CRRA coeff. <0.27	0.02	0.02	0.04			
Risk aversion index	5.45	5.33	5.31			
Number of pigs in 2010	11.88	15.40	11.66			
Number of pigs in 2009	10.32	12.51	8.95			
Number of pigs in 2008	8.94	7.87	5.59			
Percent dead 2008–2010	0.06	0.06	0.06			
Perceived percentage death	0.13	0.12	0.13			
If purchased insurance in 2010	0.12	0.11	0.13			
Number insured in 2010	1.91	3.59	2.86			
If know of insurance	0.95	0.88	0.93	**		
If mobilized by village officials	0.44	0.41	0.47			
If know when to buy insurance	0.15	0.13	0.15			
If know insurance is subsidized	0.16	0.16	0.18			
If know the guarantee level	0.10	0.09	0.09			
If know the deductible	0.04	0.08	0.07			
If purchase decision affected by others	0.19	0.18	0.19			
Index of insurance knowledge	0.28	0.27	0.28			
Trust index	3.34	3.43	3.33			
Percent income from pig raising	0.21	0.22	0.19			
Perceived risk of insurer default = 0	0.26	0.26	0.26			
Perceived risk of insurer default = 10%	0.09	0.09	0.10			
Perceived risk of insurer default = 20%	0.07	0.08	0.08			
Perceived risk of insurer default = 30%	0.15	0.18	0.17			
Perceived risk of insurer default = 40%	0.14	0.13	0.15			
Perceived risk of insurer default > 50%	0.29	0.26	0.24			

Table A.1 Continued

Time premium	0.15	0.15	0.14	
If no need to borrow	0.48	0.48	0.50	
Having high borrowing capacity	0.50	0.48	0.47	
Having enough savings	0.08	0.07	0.04	**
Number of observations	572	331	228	

Source: Baseline survey data (20100.

Note: TG = treatment group; CG1 = control group 1; CG2 = control group 2; CRRA= Constant relative risk aversion; coeff = coefficient.

Table A.2 First-stage results

	(1)	(2)	(3)
Variable	**If insured in 2011**	**If insured in 2011**	**Difference in insurance purchase between 2011 and 2010**
Treatment	0.152***	0.133***	0.134***
	(4.85)	(4.47)	(3.07)
Info	–0.0158	–0.00114	0.00566
	(–0.67)	(–0.05)	(0.15)
Total number of eligible pigs		0.00143	
bought in 2010		(1.18)	
Constant	0.0702***	-0.0765	–0.0570**
	(3.84)	(-0.44)	(–2.56)
Other baseline characteristics	No	Yes	No
Observations	1,131	1,131	1,131
R-squared	0.046	0.050	0.025

Source: Baseline (2010) and follow-up survey data (2011).

Note: t statistics are in parentheses. Significance level: * 10%, ** 5%, *** 1%.

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