The Impact of Insurance Provision on Households' Production and Financial Decisions*

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Abstract

Taking advantage of a natural experiment and a rich household-level panel dataset, this paper tests the impact of an agricultural insurance program on household level production, borrowing, and saving. The empirical strategy includes both difference-in-difference and triple difference estimations. I find that, first, introducing insurance increases the production area of insured crops by around 20% and decreases production diversification; second, provision of insurance raises the credit demand by 25%; third, it decreases household saving by more than 30%; fourth, the effect of insurance on borrowing persists in the long-run, while the effect on saving is significant only in the medium-run; and fifth, the impact of insurance is greater on larger farmers and on households with lower migration remittance.

Keywords: Insurance; Production; Borrowing; Saving
JEL Codes: D14, G21, G22, O16, Q12

1 Introduction

Poor households in rural areas are exposed to substantial negative shocks such as weather disasters, which can generate large fluctuations in income and consumption if insurance markets are incomplete. To protect themselves from these risks, rural households undertake risk management and coping strategies such as informal insurance, avoiding high risk-high return agricultural activities, holding precautionary savings, and reducing investment in

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production (Morduch (1995), Rosenzweig and Stark (1989)). However, existing evidence shows that informal insurance mechanisms cannot effectively reduce negative impacts 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)).

Although many developing countries have started to develop and market formal insurance products to shield farmers from risks, take-up is usually surprisingly low, even with heavy government subsidies[1]. While there is a growing literature studying ways to improve insurance demand (Cole et al. (2011), Cai (2012), Cai and Song (2011), Bryan (2010)), rigorous evaluations of the impacts of insurance provision are quite rare. With a rich household level panel data (2000-2008) from the Rural Credit Cooperative (RCC)[2] of China, this paper studies the effect of insurance provision on household's production, borrowing, and saving decisions. The program I am studying is a weather insurance policy for tobacco farmers offered by the People's Insurance Company of China (PICC), starting from 2003 in selected counties of Jiangxi province. It was expanded to more areas afterward and was implemented province-wide at the beginning of 2010. Purchase of insurance was made compulsory for tobacco farmers in treatment regions. I take advantage of the variation in insurance provision across both regions and household types (tobacco households vs. other households) to estimate the effect of insurance provision on household behavior, focusing on the initial stage of the policy in 2003.

The empirical strategy includes both difference-in-difference (DD) and triple difference (DDD) estimations. Because purchase of insurance in treatment regions was compulsory, household take-up decisions are not endogenous here. I use tobacco households outside of the treatment region to control for industry-specific trends in outcomes, and use non-tobacco households both within and outside the treatment region to control for region-specific trends in the absence of the policy intervention. Thus the extra changes in household behavior for tobacco households in treatment regions can be attributed to the insurance policy implementation. I find the following. First, insurance provision has a significantly positive effect on the production of the insured crop: it raises tobacco production by around 22% and decreases production diversification by around 29%. Second, insured households tend to borrow more from the rural bank for investment in tobacco production, and the

[1] For example, Giné et al. (2008) found a low take-up (4.6%) of a rainfall insurance policy among farmers in rural India in 2004, while Cole et al. (2011) found an adoption rate of 5% - 10% of a similar insurance policy in two regions of India in 2006

[2] RCC is the most important financial institution in rural China. It is the main provider of microcredit, and most farmers have saving accounts there.

magnitude of effect is about 25%. Third, the insurance policy decreases the household saving rate by more than 30%. Fourth, estimation of dynamic effects shows that, while the effect of insurance policy on both borrowing and saving became significant shortly after the policy was implemented, the impact on borrowing is persistent through the end of the sample period, while the effect on saving became significant several years after the intervention and decreased toward the end of the sample period. Finally, the impact of having insurance is greater on larger farmers and on households with lower migration remittance.

This paper contributes to the existing literature in the following ways. First, it provides insights on the literature about insurance take-up and impact. Estimating the causal effect of insurance policy on household behavior is made challenging by the endogenous insurance purchase decisions. There are a few papers studying the effects of insurance markets on household behavior using different estimation strategies. For example, Cole et al. (2011) use a randomized experiment which provided free rainfall insurance for selected farmers in India, and find that the insurance induced farmers to shift production towards higher-return but higher-risk cash crops. Karlan et al. (2012) use experimental methods and also find strong responses of investment in agriculture from insurance provision in Ghana. Gine and Yang (2009) implemented an experiment in Malawi which randomly bundled insurance with loans for selected farmers, and they found a negative effect of insurance on borrowing. Carter et al. (2007) use simulation method to show that insurance provision significantly improved producers' welfare, credit supply, and loan repayment in Peru. In contrast, Rosenzweig and Wolpin (1993) show by simulation that the gain from weather insurance for Indian farmers was minimal due to the existence of informal insurance mechanisms. This paper complements the existing literature by using rigorous estimation strategy to test both short-term and long-term effects of insurance provision on households' production, borrowing, and saving behavior in China, taking advantage of administrative borrowing and saving data from the rural bank. Because large and significant impacts of insurance policy are found in this paper, it supports the proposition that studying ways to improve voluntary insurance take-up is important.

Second, the paper contributes to the literature explaining low investment and technology adoption in developing countries. Credit constraints and the lack of information or knowledge are often proposed as explanations (Feder et al. (1985)). Duflo et al. (2011) argue that behavioral biases limit profitable agricultural investments. This paper shows that the riskiness of such investments is an important barrier, and therefore reducing risk can persistently improve investments.

The rest of the paper is organized as follows. Section 2 describes the background for the study and the insurance contract. Section 3 explains the data and summary statistics.

Section 4 presents estimation strategies and results, and section 5 concludes.

2 Background

Tobacco is an important cash crop in China. There are more than 2,000,000 rural households that live on tobacco production. The net profit of tobacco production is around 2000 RMB per mu[3], which is 3 to 5 times that of food crops such as rice.

In China, most tobacco producing counties are poor and mountainous areas. In the province that I study, there are 12 main tobacco production counties. Those counties are in two agricultural cities, Fuzhou and Ganzhou. Nearly half of those 12 counties are national poverty-stricken counties. To reduce poverty, in the late 1990s, these counties started to develop highly profitable tobacco industries by encouraging farmers to cultivate tobacco, organizing tobacco associations to teach farmers production techniques, etc. Taxes on tobacco production are now the main source of government revenue in these counties.

However, as other crops, tobacco production can be greatly influenced by weather risks. For example, in 2002, a flood destroyed most tobacco production in some of those 12 counties, which caused huge losses in household income and government revenue. The vice-head of Guangchang County, who is in charge of finance matters was previously a manager of an insurance company. He proposed to cooperate with insurance companies to shield tobacco farmers from frequent weather disasters in order to give them more incentives to continue tobacco production. In 2003, the People's Insurance Company of China (PICC) designed and offered the first tobacco production insurance program to households in four tobacco production counties, including Guangchang, Yihuang, Lean, and Zixi. The policy was extended to some other counties afterwards.

The insurance contract is as follows. The actuarially fair price estimated by the insurance company is 12 RMB per mu. The county and town level government gives a 50% subsidy on the premium, so farmers only pay the remaining half, around 6 RMB per mu. All households whose main source of income is tobacco production were required to buy the insurance for all their tobacco areas. The insurance covers natural disasters including heavy rain, flood, windstorm, extremely high or low temperature, and drought. If any of the above natural disasters happened and led to a 30% or more loss in yield, farmers were eligible to receive payouts from the insurance company. The amount of payout increases linearly with the loss rate in yield, with a maximum payout of 420 RMB. The loss rate in yield is investigated and determined by a group of insurance agents and agricultural experts[4]. The average net

[3] 1 RMB = 0.15 USD; 1 mu = 0.067 hectare

[4] For example, consider a farmer who has 5 mu in tobacco production. If the normal yield per mu is 500kg

income from cultivating tobacco is around 2000 RMB per mu, and the production cost is around 400 RMB to 600 RMB per mu (not including labor cost). Thus, this insurance program provides partial insurance that covers around 20% of the gross income or most of the production cost.

3 Theoretical Model

Here I provide a two period, two state model to show how the provision of insurance influences farmers' investment and financial decisions[5]. Intuitively, in the first period, insurance provision increases farmers' investment in production because the expected income from production is higher in that case. As a result, insurance has a negative effect on saving and a positive effect on borrowing. However, saving can be affected in two other ways. Because income uncertainty is reduced by insurance, people have less precautionary incentive to save, in this sense, saving tends to decrease. At the same time, if we assume that people have rational expectations, if they expect to become richer in future periods, they will smooth consumption across periods by increasing consumption and reducing saving in the current period. Furthermore, if the purchase of insurance is subsidized, this has a positive effect on farmers' wealth, which has a positive effect on saving.

Consider a representative farmer who lives for two periods with initial wealth W_0. In the first period, the farmer consumes C_1 and uses the remaining wealth for investment. There are two ways to invest this money: one is to save it in the bank with a saving interest rate R_f, the other is to invest it in a risky project like crop production which has a return function $F(\cdot)$. The farmer can borrow from a local bank for investment in a risky project with interest rate R_B. So the total investment I on the risky project includes the initial wealth less consumption and saving, and a loan equal to B from the bank. The return of the risky project is uncertain because it depends on whether a disaster happens in period one. In this simple model I assume that there are two states: a good state (no disaster) and a bad state (disaster). In the good state, the farmer gets $F(I)$, while in bad state he gets nothing. Assume that there is no strategic default and that farmers have limited liability, then in the good state, the farmer will repay fully in the second period; under a bad state, the farmer default on the loan if he does not have money to repay.

Suppose that for a farmer who invests I on the risky project (production), in order to buy

and because of a windstorm, the farmer's yield decreased to 250kg per mu, then the loss rate is 50% and he will receive 420*50% = 210 RMB per mu from the insurance company.

[5] Throughout the model I assume that farmers who are provided with insurance buy it in every period, because it is compulsory, while those who are not provided with insurance cannot buy it in any period.

an insurance which covers all his production[6], he needs to pay a premium which equals δI[7]. The production insurance works as follows: in the bad state, the farmer will be reimbursed by the insurance company by an amount equals to part of the cost invested in the risky project, γI. As a result, even in the bad state, the farmer who purchased insurance will be able to repay part or all of the loan.

In order to compare farmers' financial and investment behavior depending on whether they have insurance or not, I will solve the two-period model separately for insured and uninsured farmers because in the second period, their consumptions are different in the bad state. Throughout the model I assume that farmers are price takers: they don't think their behavior can influence either the premium charged by the insurance company or the saving and borrowing interest rate set by the bank.

3.1 Two-period model when insurance is not provided

The optimization problem as follows:

$$\max_{C_1,I,B} U(C_1) + E\beta U(C_2)$$
$$\iff \max_{C_1,I,B} U(C_1) + \beta p U\left[F(I) - (1+R_B)B + (1+R_f)S\right] + \beta(1-p)U\left[(1+R_f)S\right]$$
$$\text{s.t. } I = W_0 - C_1 - S + B$$

Assume that the return function and the utility function are:

$$F(I) = I^\alpha, \alpha < 1^{8}$$
$$U(C) = \log C$$

Then the first order conditions are:

$$U'(C_1) = \beta p U'\left[F(I) - (1+R_B)B + (1+R_f)S\right] F'(I) = \beta p U'(C_g)F'(I) \quad (3.1)$$

$$\beta p U'(C_g)\left[(1+R_f) - F'(I)\right] + \beta(1-p)U'\left[(1+R_f)S\right](1+R_f) = 0 \quad (3.2)$$
$$\beta p U'(C_g)\left[F'(I) - (1+R_B)\right] = 0 \quad (3.3)$$

$$\Rightarrow F'(I^*) = 1 + R_B{}^{9} \quad (3.4)$$

According to the return function form, I can rewrite equation (3.4) as:

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[6] An assumption here is that to reduce the average risk and to prevent adverse selection, the insurance company requires the farmer to buy insurance for all his production area.

[7] In my data, δ should be quite low because farmers only need to pay 6 RMB per mu to buy the insurance, but the production cost (I) is around 400-600 RMB per mu.

[8] This return function form can exclude the case of infinite investment.

[9] This makes sense since project has return only in good states and it is the only time repayment is required.

$$F'(I^*) = \alpha I^{*\alpha-1} = 1 + R_B$$
$$\Rightarrow I^* = \left(\frac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}} \qquad (3.5)$$

So the optimal level of investment is decreasing in the borrowing interest rate R_B, or in other words, people tend to investment more on the risky project when the cost of borrowing is lower. Part 1 in Appendix A gives the solution of the above optimization problem.

3.2 Two-period model when insurance is provided

If a farmer has production insurance, the framework is as follows:

$$\max_{C_1,B,S} U(C_1) + \beta p U\left[C_g\right] + \beta(1-p)U\left[C_b\right]$$
$$s.t. I = B + \left[W_0 - C_1 - S - \delta I\right]$$
$$\Rightarrow I = \frac{W_0-C_1-S}{1+\delta} + \frac{B}{1+\delta}$$

Where C_g and C_b are the farmer's consumption in period two under good and bad state, respectively. The biggest difference in this model is that under bad state, the farmer receives a reimbursement from the insurance company which covers part of their cost, which equals $\gamma I = \gamma\frac{W_0-C_1-S}{1+\delta} + \gamma\frac{B}{1+\delta}$, so I can write the return of production under bad state as γI. Since I have assumed there's no strategical default, the farmer will repay the bank $\gamma\frac{B}{1+\delta}$, which is the return that is generated by a loan with size B. Given this, the consumption in period two under two states is defined as follows, respectively:

$$C_g = F(I) - (1+R_B)B + (1+R_f)S$$
$$C_b = \frac{\gamma}{1+\delta}(W_0 - C_1 - S + B) - \frac{\gamma}{1+\delta}B + (1+R_f)S$$

The three first order conditions are:

$$U'(C_1) - \beta p U'(C_g)F'(I)\frac{1}{1+\delta} - \beta(1-p)U'(C_b)\frac{\gamma}{1+\delta} = 0 \qquad (3.12)$$
$$\beta p U'(C_g)\left[-(1+R_B) + F'(I)\frac{1}{1+\delta}\right] = 0 \qquad (3.13)$$
$$\beta p U'(C_g)\left[(1+R_f) - F'(I)\frac{1}{1+\delta}\right] + \beta(1-p)U'(C_b)\left[-\frac{\gamma}{1+\delta} + 1 + R_f\right] = 0 \qquad (3.14)$$

The utility and return function forms are the same as that in previous sections:

$$U(C) = \log C$$
$$F(I) = I^\alpha, 0 < \alpha < 1$$

Part 2 in Appendix A gives the solution of the above optimization problem.

3.3 Combine the two models

The expressions of the optimal investment, consumption, saving and borrowing for insured and uninsured farmers are as follows:

$$
\begin{aligned}
I^*(insured) &= \left(\tfrac{(1+R_B)(1+\delta)}{\alpha}\right)^{\frac{1}{\alpha-1}}\\
I^*(unisured) &= \left(\tfrac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\\
C_1^*(insured) &= \tfrac{1}{D+E}\left[\tfrac{(R_B-R_f)\gamma+(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}{(1+R_B)(1+\delta)\left[(1+\delta)(1+R_f)-\gamma\right]}W_0+(\alpha^{-1}-1)(\tfrac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}}\right]\\
C_1^*(uninsured) &= \tfrac{1}{1+\beta}\left[W_0+(\alpha^{-1}-1)\left(\tfrac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]\\
S^*(insured) &= \tfrac{(1+R_B)(1+\delta)}{R_B-R_f}\tfrac{E}{D+E}\tfrac{(R_B-R_f)\gamma+(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}{(1+R_B)(1+\delta)\left[(1+\delta)(1+R_f)-\gamma\right]}W_0\\
&+\tfrac{(1+R_B)(1+\delta)}{R_B-R_f}\tfrac{E}{D+E}(\alpha^{-1}-1)(\tfrac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}}-\tfrac{\gamma W_0}{(1+R_f)(1+\delta)-\gamma}\\
S^*(unisured) &= \tfrac{(1+R_B)(1-p)\beta}{(1+\beta)(R_B-R_f)}\left[W_0+(\alpha^{-1}-1)\left(\tfrac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]\\
B^* &= (1+R_B)^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{\alpha}{\alpha-1}}\alpha^{-\frac{\alpha}{\alpha-1}}-\tfrac{D}{1+R_B}C_1^*+\tfrac{1+R_f}{1+R_B}S^*\\
B^*(unisured) &= (1+R_B)^{\frac{1}{\alpha-1}}\alpha^{-\frac{\alpha}{\alpha-1}}-\tfrac{\beta\left[p(R_B+1)-(1+R_f)\right]}{R_B-R_f}C_1^*
\end{aligned}
$$

3.4 Break-even conditions of the bank

Now I have solved farmers' optimization problem, the next step is to consider the break-even conditions of the bank[10].

If the bank's client does not have insurance, he gets nothing in bad state, so the break-even condition is:

$$
\begin{aligned}
B(1+R_f) &= p(1+R_B)B\\
\Rightarrow R_B &= [1+R_f]\,\tfrac{1}{p}-1
\end{aligned}
$$

If insurance is purchased, the break-even condition becomes:

$$
\begin{aligned}
(1+R_f)B &= p(1+R_B)B+(1-p)\tfrac{\gamma}{1+\delta}B\\
\Rightarrow R_B &= \left[1+R_f-\tfrac{(1-p)\gamma}{1+\delta}\right]\tfrac{1}{p}-1.
\end{aligned}
$$

In summary:

$$
R_B = \begin{cases} [1+R_f]\,\tfrac{1}{p}-1, & \text{if not insured}\\ \left[1+R_f-\tfrac{(1-p)\gamma}{1+\delta}\right]\tfrac{1}{p}-1, & \text{if insured}\end{cases}
$$

We can see that the bank will set a lower interest rate for people who have insurance because their repayments are better guaranteed.

[10] Here I assume that the institution's objective is to break-even for simplicity.

3.5 Conclusion of the model

Now I plug the interest rate into optimal decisions in 3.3 and compare the magnitude of investment, consumption, saving and borrowing between insured and uninsured farmers.

- Investment: Farmers will invest more when they have insurance

$$I^*(insured) = \left(\frac{(1+R_B)(1+\delta)}{\alpha}\right)^{\frac{1}{\alpha-1}} = \left(\frac{\frac{1+R_f}{p} - \frac{(1-p)\gamma}{(1+\delta)p}}{\alpha}\right)^{\frac{1}{\alpha-1}}$$

$$I^*(unisured) = \left(\frac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}} = \left(\frac{\frac{1+R_f}{p}}{\alpha}\right)^{\frac{1}{\alpha-1}}$$

Because $\alpha - 1 < 0$, so if $\frac{(1-p)\gamma}{(1+\delta)p} > 0$, the investment increase as a result of insurance provision. Intuitively, when insurance is provided, borrowing becomes cheaper and the expected return of the risky project will increase, so investing in the risky project becomes more attractive.

- Consumption: The first period consumption is higher when the farmer have insurance.

$$C_1^*(insured) = C_1^*$$

$$= \frac{1}{D+E}\left[\frac{(R_B-R_f)\gamma+(1+R_B)\big[(1+\delta)(1+R_f)-\gamma\big]}{(1+R_B)(1+\delta)\big[(1+\delta)(1+R_f)-\gamma\big]}W_0 + (\alpha^{-1}-1)(\frac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}}\right]$$

$$=$$

$$\frac{1}{1+\beta}\left\{\left[\frac{1+R_B}{1+R_f} + \frac{(R_B-R_f)\gamma}{(1+R_f)[(1+R_B)(1+\delta)-\gamma]}\right]W_0 + \frac{(1+\delta)(1+R_B)\big[(1+R_f)(1+\delta)-\gamma\big]}{(1+R_f)[(1+R_B)(1+\delta)-\gamma]}(\alpha^{-1}-1)(\frac{R_f/p+1/p-(1-p)\gamma/p(1+\delta)}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta\right.$$

$$C_1^*(unisured) = \frac{1}{1+\beta}\left[W_0 + (\alpha^{-1}-1)\left(\frac{R_f/p+1/p}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]$$

Because $\frac{1+R_B}{1+R_f} + \frac{(R_B-R_f)\gamma}{(1+R_f)[(1+R_B)(1+\delta)-\gamma]} > 1$, $(\frac{R_f/p+1/p-(1-p)\gamma/p(1+\delta)}{\alpha})^{\frac{1}{\alpha-1}} > \left(\frac{R_f/p+1/p}{\alpha}\right)^{\frac{1}{\alpha-1}}$
and $(1+R_f)(1-p)(1+\delta-\delta\eta) > R_f\delta\eta$[11]
then $C_1^*(insured) > C_1^*(unisured)$

So the second message from the model is that, people who bought insurance will consume more in the first period. This is because if a farmer has insurance, he expect himself to be richer in the second period compared to the condition when he does not have insurance, so he will smooth the consumption between periods by increasing the consumption in period one.

- Saving: The provision of insurance can decrease farmers' total saving and saving rate in period one.

[11]This condition holds in my data.

$$S^*(insured) = \frac{(1+R_B)(1+\delta)}{R_B-R_f}\frac{E}{D+E}\frac{(R_B-R_f)\gamma+(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}{(1+R_B)(1+\delta)\left[(1+\delta)(1+R_f)-\gamma\right]}W_0+$$
$$\frac{(1+R_B)(1+\delta)}{R_B-R_f}\frac{E}{D+E}(\alpha^{-1}-1)(\frac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}} - \frac{\gamma W_0}{(1+R_f)(1+\delta)-\gamma}$$
$$= \left[\frac{\beta}{1+\beta} - \frac{\beta\gamma p}{(1+\beta)\left[(1+\delta)(1+R_f)-\gamma\right]}\right] W_0 + (\alpha^{-1}-1)(\frac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}}\frac{(1+R_B)(1+\delta)}{R_B-R_f}\frac{E}{D+E}$$
$$S^*(unisured) = \frac{\beta}{(1+\beta)}\left[W_0 + (\alpha^{-1}-1)\left(\frac{1/p+R_f/p}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]$$
$$= \frac{\beta}{1+\beta}W_0 + (\alpha^{-1}-1)\alpha^{-\frac{1}{\alpha-1}}(\frac{1}{p}+\frac{R_f}{p})^{\frac{1}{\alpha-1}}\frac{\beta}{1+\beta}$$

Because $\left[\frac{\beta}{1+\beta} - \frac{\beta\gamma p}{(1+\beta)\left[(1+\delta)(1+R_f)-\gamma\right]}\right] < \frac{\beta}{(1+\beta)}$, so if W_0 is large enough, $S^*(insured) < S^*(unisured)$ and $Savingrate^*(insured) < Savingrate^*(unisured)$. This result is consistent with the precautionary saving story: farmers' future income uncertainty is decreased by introducing insurance, so people have less precautionary incentive to save in the first period for smoothing future consumption.

- Borrowing: The effect of insurance provision on borrowing is ambiguous.

The total investment on risky project is $I = B + [W_0 - C_1 - S]$, I have proved that the provision of insurance will increase C_1 and I, and decrease S, so the effect on B is ambiguous.

In summary, the conclusion from this two-period model is that insurance has a positive effect on investment in risky projects and consumption, and it reduces farmers' total saving and saving rate. As a result, its effect on borrowing is not determined.

4 Data and Summary Statistics

As shown in Table 1, the empirical analysis is based on data from 12 tobacco production counties in Jiangxi province of China: Guangchang, Yihuang, Lean, Zixi, Shicheng, Ningdu, Ganxian, Huichang, Xinfeng, Xinguo, Ruijin, and Quannan. Among these twelve counties, only tobacco farmers in Guangchang, Yihuang, Lean, and Zixi were eligible to buy the tobacco insurance policy after 2002. In eligible counties, only tobacco households whose main source of income is from tobacco production were offered insurance, while households working in other activities were not eligible to buy similar products.

The primary data source is the household level panel dataset, ranging from 2000 to 2008, provided by the Rural Credit Cooperatives (RCC). The whole sample includes around 6500 households. The data is composed of two parts. The first part is the administrative data of RCC, including their clients' saving and borrowing information[12]. Specifically, it has

[12]Because more than 90% of farmers in Jiangxi province are RCC clients, this data is representative of the whole sample of farmers

variables such as loan certification number, total borrowing during the year, interest rate, use of loan, repayment, total annual saving, savings in the deposit account, savings in the current account, and annual growth in savings[13]. The second part is RCC annual survey data[14], which contains two broad categories of information. The first is family background information: age, national ID, gender, occupation and education of household heads, primary and secondary source of household income, family address, and household size. The second is household income and production, including total annual income, household income from different sources, remittance income, area of land for cultivation, and production areas of different crops.

The data includes 6548 households in total, of which 3580 households are tobacco households, and 2968 households are other households whose main source of income is not tobacco production[15]. For tobacco households, 1429 of them are in the treatment region where the insurance policy was available, and 2151 of them are in control regions.

The summary statistics of key variables before the insurance policy was implemented (2000-2002) are provided in Table 2. Household heads are almost exclusively male and the average age is around 40. The average household size is around five people, and household heads have an average education level of between primary and secondary school. The above household characteristics are very similar across different household groups. The average annual household income of tobacco households in treatment regions equals 10,650 RMB, while that of tobacco households in control regions is a bit higher, around 12,000 RMB. Annual income of non-tobacco households is much lower, with only 7,270 RMB. Considering households' borrowing behavior, the average borrowing of non-tobacco households is the highest (4,980 RMB), followed by tobacco households in control regions (4,560 RMB), and tobacco households in treatment regions (3,900 RMB). The household saving rate is defined as the ratio between net annual saving and household income. For tobacco households in treatment regions, the saving rate is around 3.6%, which is lower than that of tobacco households in control regions (4.5%). Saving rate of non-tobacco households is similar as that of tobacco households in treatment regions, of around 3.4%[16]. This table suggests that, as treatment and control tobacco households behave statistically differently in pre-policy

[13]While RCC is the main place for farmers to make deposits, households may have saving accounts in other institutions. As a result, the amount of saving in RCC does not represent a household's total saving. To account for this factor, RCC reported the village-level ratio of RCC saving to total household saving. I adjusted the RCC saving data by this ratio in all of the empirical analyses

[14]RCC implements a household survey every year in order to adjust the lending interest rate and loan ceiling for each household

[15]These households work in agricultural activities such as rice production, cultivation, etc. or in non-agricultural activities

[16]Households with outliers (the lowest or highest 1%) in income, loan size, and savings were deleted from the sample for analysis

periods, I cannot study the policy impact by taking a simple difference.

In order to check whether Difference-in-Difference (DD) estimation can be a convincing strategy in this context, I test the common-trend assumption in Table 3, using the following regression:

$$Y_{irt} = \eta_0 + \eta_1 Year_t + \eta_2 Insurance_{ir} + \eta_3 Year_t * Insurance_{ir} + \epsilon_{irt} \quad (1)$$

Where i, r, t are household, region, and year indices respectively. $Insurance_{ir}$ is the treatment indicator equal to 1 for treatment regions and 0 for control regions. The common-trend assumption does not hold if the coefficient of the interaction term, η_3, is statistically significant. Results show that the common trend assumption is not valid for all outcomes in which I am interested in, so using only DD estimation is not sufficient.

To get a basic sense of how insurance provision impacts production, borrowing, and saving, I plot the evolution of these variables in Figures 1 to 5. Figure 1 shows that, while tobacco production was similar for tobacco households in treatment and control regions before insurance was in place, production increased greatly in treatment regions after 2002. Referring to Figure 2, we can see that, while tobacco households in treatment regions borrowed less than those in control regions before 2002, the pattern reversed after 2003. However, Figure 3 shows that the borrowing pattern is different across the sample period between non-tobacco households in treatment and control regions, which suggests that there might be some regional-specific trend for which we should control when estimating the policy effect. In Figure 4, I show that, for tobacco households, while the saving rate is higher in control regions than in treatment regions, the trend reversed slightly after 2004. The difference in saving rates of non-tobacco households between treatment and control regions is much larger, as shown in Figure 5.

Table 4 reports the average area of tobacco production, size of loans, and saving rate by time period, region, and sector eligibility. Consider loan size for example, for each region-sector category, the average loan size increases from the period 2000-2002 to the period 2003-2008, reflecting the aggregate economic trend. For tobacco households, the average loan size in treatment regions increases by 1,450 RMB more than that of households in control regions. This could be a result of both the implementation of the insurance policy and other region-specific changes. For example, for non-tobacco households, the average loan size also grows faster in treatment regions than in control regions, by 480 RMB. Taking into account this regional difference in the absence of the insurance policy, the loan size for tobacco households in treatment regions increases by 970 RMB more than that for tobacco households in control regions. The regression analysis in the next section demonstrates that this effect is robust to controlling for other confounding factors. These results suggest that triple difference estimation can be a more convincing empirical strategy than DD in this case.

5 Estimation Strategies and Results

5.1 Empirical Strategies

The implementation of the tobacco insurance policy introduced variations in insurance provision in three dimensions: years before and after the policy was introduced, regions with and without the policy, and eligible and ineligible households (tobacco households v.s. non-tobacco households). These variations allow me to use both difference-in-difference (DD) and difference-in-difference-in-difference (DDD) estimation as the empirical strategy. First, the DD analysis compares the change in tobacco households' behavior in treatment regions before and after 2002 with that of tobacco households in control regions, assuming that tobacco households in treatment and control regions follow the same trend in the absence of the provision of insurance policy. The estimation equation is as follows:

$$Y_{irt} = \alpha_0 + \alpha_1 After_{it} + \alpha_2 Insurance_{ir} + \alpha_3 After_{it} * Insurance_{ir} + \epsilon_{irt} \tag{2}$$

Where i, r, t are household, region, and year indices respectively. This framework is based on tobacco households only. Y represents outcome variables including tobacco production area, size of loan borrowed from the rural bank, and saving rate. $After$ is a dummy variable equal to 1 for the 2000-2002 period and 0 for years 2003-2008, which reflects the impact on outcomes of time-varying aggregate economic environment and policies. $Insurance_{ir}$ is the treatment indicator equal to 1 for treatment regions and 0 for control regions. The coefficient of interest is the one before the interaction term, between $After$ and $Insurance_{ir}$, α_3.

However, the DD estimation cannot remove all confounding factors. For example, there may be some other contemporary changes in the economic environment or other policies specific to the treatment region that can influence households' production and financial decisions. This can be captured by taking another DD analysis, which compares behavior of non-tobacco households in treatment regions before and after 2002 with that of non-tobacco households in control regions. As a result, the DDD framework, which takes the difference between the two differences from the first two steps, can further control for region-specific trends. Under the DDD framework, we don't need to assume that behaviors of tobacco households in both treatment and control regions evolve similarly in expectation, but only need to assume that the difference affects tobacco households and other households similarly (in other words, there are no other region-sector specific policy changes). I will test this assumption later. The DDD regression is as follows:

$$
\begin{aligned}
Y_{ijrt} = \beta_0 + &\beta_1 After_{it} + \beta_2 Insurance_{ir} + \beta_3 Tobacco_{ij} + \beta_4 After_{it} * Insurance_{ir} \\
&+ \beta_5 After_{it} * Tobacco_{ij} + \beta_6 Tobacco_{ij} * Insurance_{ir} \\
&+ \beta_7 After_{it} * Insurance_{ir} * Tobacco_{ij} + \epsilon_{ijrt}
\end{aligned} \tag{3}
$$

Where j is sector indicator, and $Tobacco_{ij}$ is a dummy variable equal to 1 for tobacco households and 0 otherwise. The coefficient of the time, region, and sector interaction (β_7) captures the average effect of insurance provision on household behavior, after other confounding factors are removed.

Significant influences of insurance provision on households' production and investment decisions may take place either shortly after the policy was introduced or several years later, and the magnitude of the effect may change over time. Consequently, it would be interesting to test the dynamic effect of insurance provision on household behavior. The estimation equation is as follows:

$$
\begin{aligned}
Y_{ijrt} = \rho_0 + &\rho_1 Year_t + \rho_2 Insurance_{ir} + \rho_3 Tobacco_{ij} + \rho_4 Year_t * Insurance_{ir} \\
&+ \rho_5 Year_t * Tobacco_{ij} + \rho_6 Tobacco_{ij} * Insurance_{ir} \\
&+ \rho_7 Year_t * Insurance_{ir} * Tobacco_{ij} + \epsilon_{ijrt}
\end{aligned} \tag{4}
$$

Where $Year_t$ includes a set of year dummies. Estimating the above equation not only allows me to test the dynamic effect, but also to test the crucial assumption that validates the DDD estimation: in the absence of the insurance policy, the production and financial behaviors of tobacco households and non-tobacco households should evolve similarly.

The magnitude of the impact of insurance provision on household behavior can be different for different groups of households. I consider two types of heterogeneity here, depending on farming size and the importance of migration remittance in household income. The regression is as follows:

$$
\begin{aligned}
Y_{ijrt} = \gamma_0 + &\gamma_1 After_{it} + \gamma_2 Insurance_{ir} + \gamma_3 Tobacco_{ij} + \gamma_4 After_{it} * Insurance_{ir} \\
&+ \gamma_5 After_{it} * Tobacco_{ij} + \gamma_6 Tobacco_{ij} * Insurance_{ir} \\
&+ \gamma_7 After_{it} * Insurance_{ir} * Tobacco_{ij} + \gamma_8 Index_{it} + \gamma_9 Index_{it} * After_{it} \\
&+ \gamma_{10} Index_{it} * Insurance_{ir} + \gamma_{11} Index_{it} * Tobacco_{ij} + \gamma_{12} Index_{it} * After_{it} * Insurance_{ir} \\
&+ \gamma_{13} Index_{it} * After_{it} * Tobacco_{ij} + \gamma_{14} Index_{it} * Insurance_{ir} * Tobacco_{ij} \\
&+ \gamma_{15} Index_{it} * After_{it} * Insurance_{ir} * Tobacco_{ij} + \epsilon_{ijrt}
\end{aligned} \tag{5}
$$

Where $Index_{it}$ is an indicator equal to 1 if, in the pre-policy period (2000-2002), the households' total production area or the percentage of migration remittance in total income is higher than the sample median, and 0 otherwise. The coefficient of interest is γ_{15}.

5.2 Estimation Results

Tables 5 - 8 report DD and DDD estimation results on the effect of insurance provision on households' production, borrowing, and saving decisions, respectively[17]. Look first at the effect on production. Refer to Column (1) in Table 5, the increase in tobacco production post of 2002 is 1.161 mu larger for households in treatment regions compared with households in control regions. Because the pre-policy mean of tobacco production in treatment regions is about 5.25 mu (refer to Table 2), this result means that insurance provision can raise tobacco production by 22%. This is consistent with the story that, as the expected return of tobacco production increases once insurance is provided, insurance gives households greater incentives to invest more heavily in tobacco production. Column (2) includes year dummies in addition, and the magnitude of the effect increased slightly. In Column (3), I further control for household characteristics, including household size, annual household income, age, and education of household head. The magnitude of the treatment effect remains similar, at around 1.2 mu (23%). Column (3) also shows that households with higher annual income tend to produce more tobacco, as the production cost of tobacco cultivation is high relative to that of other crops. Moreover, larger households, and those with more well-educated and younger household heads, are likely to have a larger production scale. This can be explained by the fact that tobacco production not only requires more labor than other production, but also thorough knowledge of the techniques necessary to have high yield and good quality tobacco.

In Table 6, I look at the impact of insurance provision on households' choice of production diversification, which is defined as one minus the Herfindahl index of agricultural production. The results show that agricultural production became less diversified after the insurance was provided, by around 29%. This means that households tend to focus more on producing the insured crop after the intervention.

Second, Table 7 reports the DDD estimation results on the effect of insurance on borrowing. Results suggest a significant insurance treatment effect on borrowing, of around 972 RMB. Comparing this result to the average loan size of tobacco households in treatment regions before 2003 (shown in Table 2) tells us that tobacco households borrow 25% more once their production is insured.

[17] Please note that the DDD framework is not applicable to estimating the effect on tobacco production area, because there is almost no tobacco production for non-tobacco households

Third, the effect of insurance provision on household saving is reported in Table 8. According to Columns (1) and (2), after the tobacco insurance policy was introduced, the increase in the average saving rate of tobacco households in treatment regions is around 1.24 percentage points lower than that of tobacco households in control regions. This means that providing insurance can decrease a household's saving rate by more than 30%. In Columns (3) and (4), I consider the level of net saving rather than the saving rate. The estimation results show that, while the insurance policy has a significant impact on saving rate, it does not significantly influence the level of saving. Finally, in Columns (5) and (6), I estimate the effect of insurance on the composition of saving. In China, households can have two types of saving accounts: fixed-term saving or flexible-term saving (like checking accounts in the United states). I show that the insurance policy does not have any statistically significant impact on the composition of saving.

The dynamic impact of insurance provision on households' borrowing and saving behavior is illustrated in Table 9. The result shows that first, before the insurance policy was introduced, there is no significant difference between households with or without tobacco production, because interactions of 2001-2002 year dummies, region, and sector are insignificant. Second, according to Column (1), the effect of insurance provision on borrowing is insignificant until two years after the intervention. However, both the magnitude and significance of the effect persists through the end of our sample period. In contrast, according to Column (2), insurance impact on household saving become significant three years after the policy was introduced, but the magnitude and significance decrease and become insignificant toward the end of the sample period.

In Table 10, I report the heterogeneity in the impact of insurance, depending on how large the farming size is, and how important is the migration remittance to the household's income. Columns (1) - (3) shows that insurance provision has a larger effect on borrowing for large farmers, while the effect on production and saving is not statistically different for farmers with different farming sizes. In Columns (4) - (6), I show that the effect of insurance policy has a smaller impact on the production and borrowing decisions of households who depend more on migration remittance.

Once the insurance policy was implemented for tobacco farmers, we may expect an endogenous switch of non-tobacco households to tobacco households. If a significant number of households do so, the effect might be overestimated. In Table 11, I report the percentage of households that stay in the same sector, switch from tobacco to the non-tobacco sector, and switch from the non-tobacco sector to the tobacco sector between the previous and current year, for treatment and control regions. This table shows that only a very small fraction of households changed sectors during the sample period. I did a robustness check by excluding all households that had ever switched sectors and it does not change the effect much.

6 Conclusions

Household incomes in developing rural economies are subject to great uncertainty. As a result, many developing countries are making efforts to improve the quality and coverage of agricultural insurance products. Taking advantage of a natural experiment of insurance provision in rural China, this paper uses both DD and DDD estimations to study the effect of insurance provision on households' production and financial decisions. I find that households tend to increase tobacco production once it is insured. Moreover, insurance not only makes households borrow more from the bank, but also decrease the household saving rate. However, while the impact of insurance on borrowing persists in the long-run, the impact on saving is only significant in the medium-run and vanishes in the long-run.

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Figure 1. Evolution of Tobacco Production, by Treatment

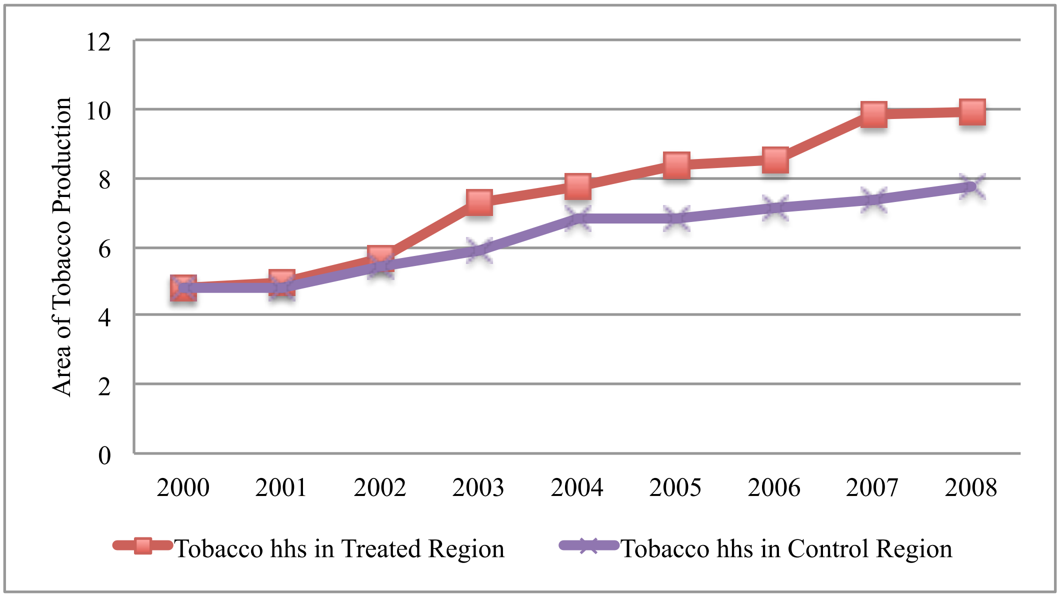

Figure 2. Evolution of Loan Size for Tobacco Households, by Treatment

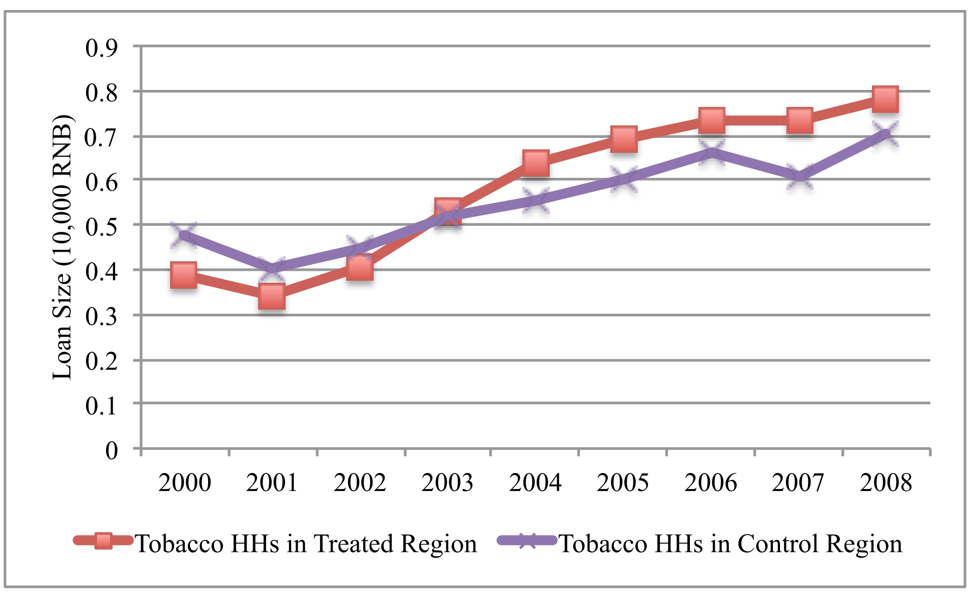

Figure 3. Evolution of Loan Size for Other Households, by Treatment

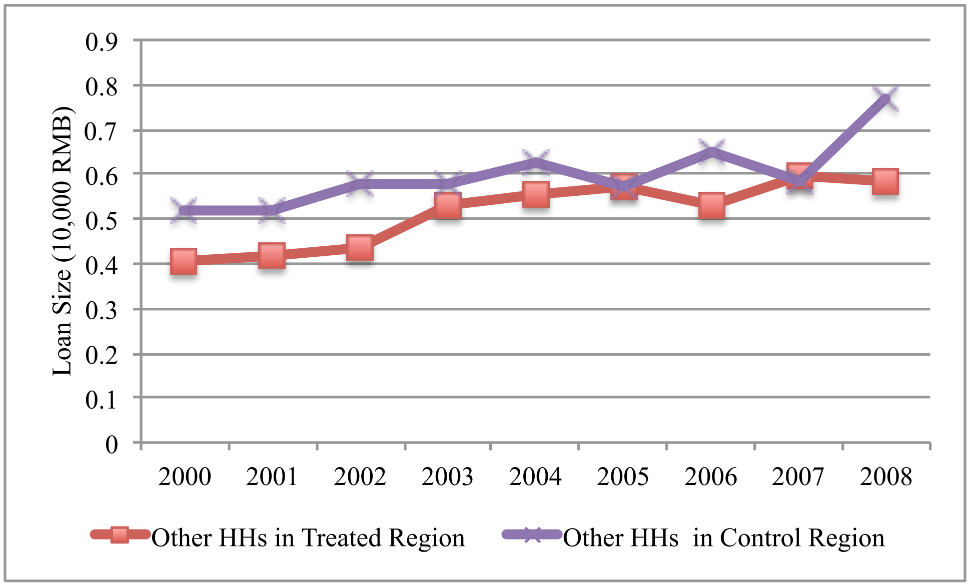

Figure 4. Evolution of Saving for Tobacco Households, by Treatment

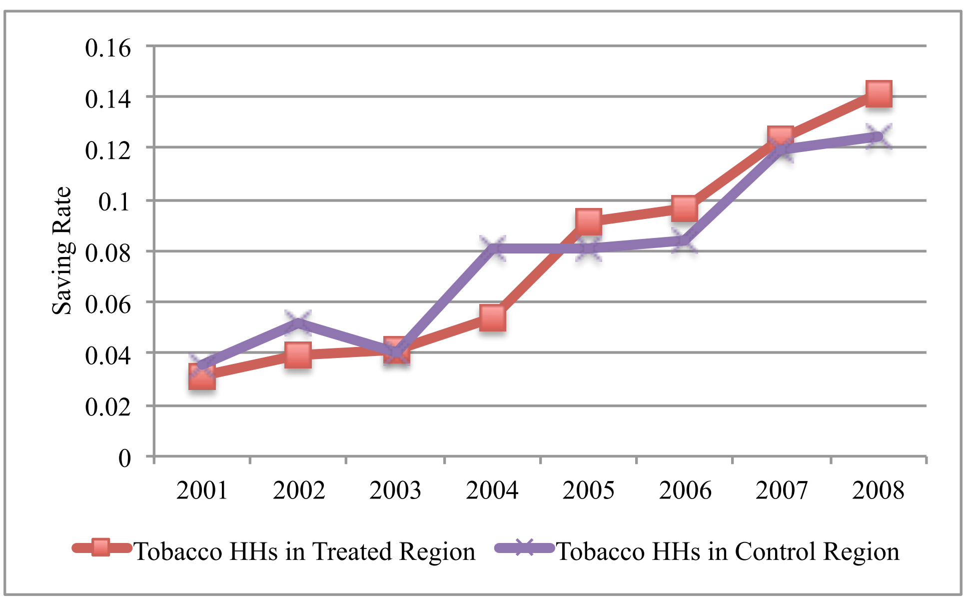

Figure 5. Evolution of Saving for Other Households, by Treatment

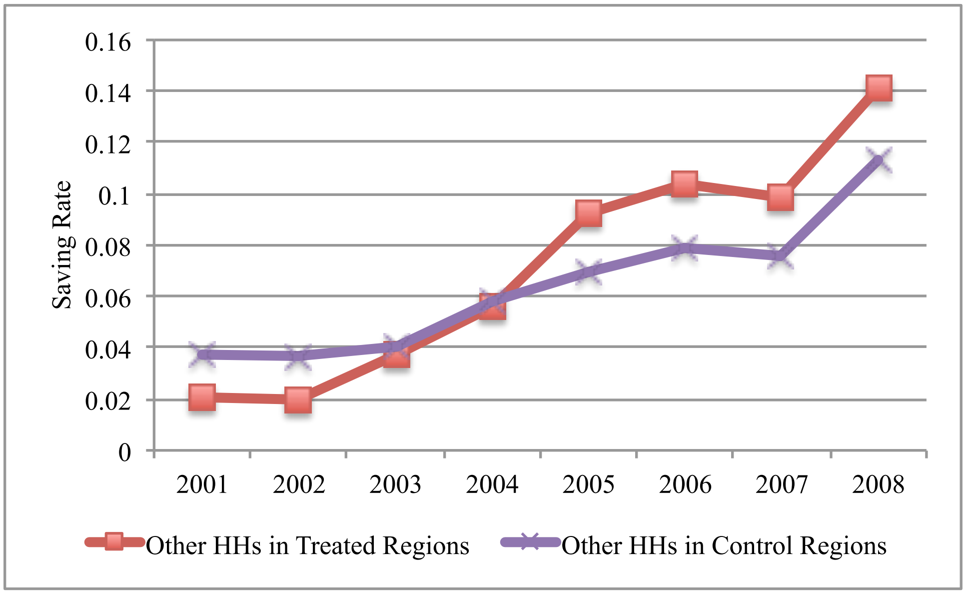

Table 1. Insurance Provision in Tobacco Production Counties of Jiangxi Province

County	Insurance Provision	Start Year	Premium	Subsidy of Premium	Maximum Payout
Guangchang	Yes	2003	12	50%	420
Yihuang	Yes	2003	12	50%	420
Lean	Yes	2003	12	50%	420
Zixi	Yes	2003	12	50%	420
Shicheng	No				
Ningdu	No				
Ganxian	No				
Huichang	No				
Xinfeng	No				
Xingguo	No				
Quannan	No				
Ruijin	No				

Notes: The unit of premium and payouts is RMB per mu (1 mu = 1/15 hectare). The exchange rate between US dollars and RMB is around 6.3.

Table 2. Summary Statistics

	Tobacco Households			Other Households	All Sample
	Treated	Control	Difference		
	(1)	(2)	(3)	(4)	(5)
Number of Households	*1429*	*2151*		*2968*	*6548*
Gender of Household Head (1 = Male, 0 = Female)	0.996	0.982	0.014***	0. 978	0.983
	(0.062)	(0.134)	(0.000)	(0.146)	(0.131)
Age	40.418	40.731	-0.313*	40.205	40.429
	(8.959)	(8.124)	(0.091)	(8.645)	(8.526)
Household Size	4.781	4.728	0.053*	4.930	4.832
	(1.022)	(1.355)	(0.054)	(1.312)	(1.284)
Education (0 = illiteracy, 1 = primary,	1.626	1.759	-0.133***	1.813	1.760
2 = secondary, 3 = high school, 4 = college)	(0.54)	(0.929)	(0.000)	(0.644)	(0.746)
Area of Tobacco Production (mu)	5.249	4.999	0.249***	0.307	2.857
	(2.119)	(2.874)	(0.000)	(1.194)	(3.175)
Production Diversification Index (0-1)	0.389	0.275	0.114***	0.119	0.237
	(0.229)	(0.261)	(0.000)	(0.203)	-0.256
Annual Household Income (10,000 RMB)	1.065	1.202	-0.137***	0.727	0.956
	(0.477)	(1.402)	(0.000)	(0.941)	(1.094)
Loan Size (10,000 RMB)	0.390	0.456	-0.066***	0.498	0.483
	(0.203)	(0.189)	(0.003)	(0.089)	(0.13)
Saving Rate (Net Saving Divided by Income)	0.036	0.045	-0.009***	0.034	0.038
	(0.079)	(0.12)	(0.003)	(0.093)	(0.101)

Notes: This table reports the mean of key variables in pre-treatment periods (2000-2002). For columns (1), (2), (4) and (5), standard deviations are in brackets. For column (3), P-value for F test of equal means of two groups are in brackets.

Table 3. Test Common Trend in Key Outcome Variables Before Policy Intervention

VARIABLES	Area of Tobacco Production (mu)	Loan Size (10,000 RMB)	Saving Rate (Net Saving Divided by Income)
	(1)	(2)	(3)
Year	0.322	-0.0543**	0.0163**
	(0.305)	(0.0233)	(0.00776)
Insurance	0.123	-0.110***	0.00429
(= 0 if control region, = 1 if treatment region)	(0.305)	(0.0161)	(0.0383)
Year*Insurance	0.160	0.0708***	-0.00860
	(0.308)	(0.0233)	(0.00776)
Observations	9,201	659	5,761
R-squared	0.080	0.034	0.006

Notes: Bootstrap clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Area of Tobacco Production, Loan Size, and Saving Rate by Region, Sector, and Year

	Tobacco Households			Other Households		
	2000-2002	2003-2008	Difference	2000-2002	2003-2008	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
I. Area of Tobacco Production (mu)						
Treatment	5.249	8.464	3.215***			
	(0.038)	(0.043)	(0.000)			
Control	4.999	7.054	2.054***			
	(0.037)	(0.027)	(0.000)			
DD			1.161***			
			(0.000)			
II. Loan Size (10,000 RMB)						
Treatment	0.390	0.724	0.004***	0.412	0.568	0.156***
	(0.022)	(0.016)	(0.000)	(0.006)	(0.011)	(0.000)
Control	0.456	0.645	0.189***	0.523	0.630	0.108***
	(0.008)	(0.013)	(0.000)	(0.002)	(0.032)	(0.000)
DD			0.145***			0.048
			(0.000)			(0.163)
DDD			0.097**			
			(0.036)			
III. Saving Rate (Net Saving Divided by Income)						
Treatment	0.036	0.086	0.049***	0.020	0.098	0.078***
	(0.002)	(0.002)	(0.000)	(0.003)	(0.003)	(0.000)
Control	0.045	0.093	0.049***	0.037	0.064	0.028***
	(0.002)	(0.001)	(0.000)	(0.002)	(0.002)	(0.000)
DD			0.001			0.05***
			(0.804)			(0.000)
DDD			-0.05***			
			(0.000)			

Notes: For columns (1), (2), (4) and (5), standard deviations are in brackets. For columns (3) and (6), P-value are in brackets.

Table 5. Effect of Insurance Provision on Production

VARIABLES	Area of Tobacco Production (mu)		
	(1)	(2)	(3)
After	2.054***	7.938***	7.279***
(= 0 if 2000-2002, = 1 if 2003-2008)	(0.320)	(2.261)	(1.938)
Insurance	0.249	0.175	0.338***
(= 0 if control region, = 1 if treatment region)	(0.370)	(0.195)	(0.112)
After * Insurance	1.161***	1.450***	1.223***
	(0.320)	(0.167)	(0.116)
Household Size			0.0727***
			(0.00790)
Annual Household Income (10,000 RMB)			0.787***
			(0.257)
Education (0 = illiteracy, 1 = primary,			0.343*
2 = secondary, 3 = high school, 4 = college)			(0.178)
Age			-0.0252**
			(0.0112)
No. of Observation	31,207	31,207	31,207
Year Fixed Effects	No	Yes	Yes
R-squared	0.105	0.131	0.226

Notes: Bootstrap clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6. Effect of Insurance Provision on Production Diversification

VARIABLES	Production Diversification (0-1)		
	(1)	(2)	(3)
After	0.0543	0.0364	0.0268
(= 0 if 2000-2002, = 1 if 2003-2008)	(0.0536)	(0.063)	(0.0550)
Insurance	-0.0492	-0.0525	-0.0470
(= 0 if control region, = 1 if treatment region)	(0.0753)	(0.0524)	(0.0759)
Tobacco Household	0.144**	0.144***	0.145***
(= 0 if No, = 1 if Yes)	(0.0585)	(0.0214)	(0.0491)
After * Insurance	0.0755	0.0670	0.0657
	(0.0536)	(0.0607)	(0.0612)
After * Tobacco Household	-0.0320	-0.0433	-0.0482
	(0.0320)	(0.0386)	(0.0336)
Tobacco Household * Insurance	0.164***	0.168***	0.171***
	(0.0585)	(0.0237)	(0.0496)
After * Insurance * Tobacco Household	-0.129***	-0.116***	-0.113***
	(0.0320)	(0.0440)	(0.0366)
Household Size			0.00382
			(0.00256)
Education (0 = illiteracy, 1 = primary,			0.0510***
2 = secondary, 3 = high school, 4 = college)			(0.0195)
Age			0.00312***
			(0.000371)
No. of Observation	47951	47951	47951
Year Fixed Effects	No	Yes	Yes
R-squared	0.106	0.112	0.141

Notes: Bootstrap clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7. Effect of Insurance Provision on Borrowing

VARIABLES	Loan Size (10,000 RMB)		
	(1)	(2)	(3)
After	0.108	1.889***	1.679***
(= 0 if 2000-2002, = 1 if 2003-2008)	(0.0769)	(0.659)	(0.328)
Insurance	-0.111***	-0.111***	-0.133***
(= 0 if control region, = 1 if treatment region)	(0.0109)	(0.0119)	(0.0185)
After * Insurance	0.0481	0.0505	0.0923**
	(0.0769)	(0.0615)	(0.0368)
Tobacco Household	-0.0665**	-0.0669***	-0.147***
(= 0 if No, = 1 if Yes)	(0.0272)	(0.0240)	(0.0172)
After * Tobacco Household	0.0810	0.0636	0.146***
	(0.0583)	(0.0649)	(0.0389)
Tobacco Household * Insurance	0.0441	0.0183	0.0267
	(0.0272)	(0.0309)	(0.0336)
After * Insurance * Tobacco Household	0.0972*	0.134*	0.115**
	(0.0583)	(0.0757)	(0.0556)
Household Size			0.00125
			(0.00656)
Annual Household Income (10,000 RMB)			0.0911***
			(0.0137)
Area of Tobacco Production (mu)			0.00208
			(0.00292)
Education (0 = illiteracy, 1 = primary,			0.0642***
2 = secondary, 3 = high school, 4 = college)			(0.0163)
Age			-0.00103
			(0.000739)
No. of Observation	8,382	8,382	8,382
Year Fixed Effects	No	Yes	Yes
R-squared	0.017	0.029	0.081

Notes: Bootstrap clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8. Effect of Insurance Provision on Saving

VARIABLES	Saving Rate (Net Saving Divided by Income)		Net Saving (10,000 RMB)		Ratio of Net Checking to Net Total Saving	
	(1)	(2)	(3)	(4)	(5)	(6)
After	0.0275***	0.0906***	0.0561***	0.190	-0.0212	-0.173***
(= 0 if 2000-2002, = 1 if 2003-2008)	(0.00576)	(0.0311)	(0.00372)	(0.129)	(0.0791)	(0.0545)
Insurance	-0.0166	-0.0149***	-0.00219	0.0101	-0.472***	-0.487***
(= 0 if control region, = 1 if treatment region)	(0.0218)	(0.00391)	(0.00797)	(0.00865)	(0.166)	(0.114)
After * Insurance	0.0504***	0.0294***	0.0834***	0.00267	0.272***	0.269***
	(0.00576)	(0.00509)	(0.00372)	(0.0142)	(0.0791)	(0.0857)
Tobacco Household	0.00781	0.0132***	0.0360	0.0347	-0.352	-0.349
(= 0 if No, = 1 if Yes)	(0.0244)	(0.00263)	(0.0456)	(0.0340)	(0.294)	(0.243)
After * Tobacco Household	0.0211*	-0.00141	0.0562	-0.000966	-0.0420	-0.0534
	(0.0109)	(0.00332)	(0.0583)	(0.0304)	(0.290)	(0.296)
Tobacco Household * Insurance	0.00801	0.00343	-0.00975	-0.0194	0.121	0.120
	(0.0244)	(0.00471)	(0.0456)	(0.0422)	(0.294)	(0.244)
After * Insurance * Tobacco Household	-0.0495***	-0.0124**	-0.0708	0.0414	0.169	0.190
	(0.0109)	(0.00617)	(0.0583)	(0.0359)	(0.290)	(0.299)
Household Size		0.00285***		0.00599*		0.00570
		(0.000544)		(0.00338)		(0.00464)
Annual Household Income (10,000 RMB)		-0.0117***		0.00731		-0.0512
		(0.000448)		(0.0115)		(0.0329)
Education (0 = illiteracy, 1 = primary,		0.0235***		0.0322***		-0.0208
2 = secondary, 3 = high school, 4 = college)		(0.000951)		(0.00796)		(0.0186)
Age		0.000540***		0.000542		-0.00173***
		(8.34e-05)		(0.000429)		(0.000620)
No. of Observation	40,561	40,559	40,561	40,559	20,975	20,975
Year Fixed Effects	No	Yes	No	Yes	No	Yes
R-squared	0.027	0.077	0.012	0.043	0.12	0.13

Notes: Bootstrap clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9. Dynamic Effects of Insurance Provision on Borrowing and Saving

VARIABLES	Loan Size (10,000 RMB)	Saving Rate (Net Saving Divided by Income)
	(1)	(2)
Insurance	-0.122***	-0.00960**
(= 0 if control region, = 1 if treatment region)	(0.0136)	(0.00428)
Tobacco Household	-0.0224	0.0127***
(= 0 if No, = 1 if Yes)	(0.0261)	(0.00167)
Tobacco Household * Insurance	0.00750	-0.00168
	(0.0309)	(0.00475)
2001 * Insurance * Tobacco Household	-0.0591	
	(0.0364)	
2002 * Insurance * Tobacco Household	-0.0176	0.00822
	(0.0395)	(0.00860)
2003 * Insurance * Tobacco Household	0.0185	-0.00740
	(0.107)	(0.00919)
2004 * Insurance * Tobacco Household	0.0970	-0.0127
	(0.107)	(0.00903)
2005 * Insurance * Tobacco Household	0.138***	-0.0115
	(0.0395)	(0.0108)
2006 * Insurance * Tobacco Household	0.217***	-0.0187**
	(0.0287)	(0.00955)
2007 * Insurance * Tobacco Household	0.150***	-0.0147**
	(0.0561)	(0.00713)
2008 * Insurance * Tobacco Household	0.210***	-0.0111
	(0.0568)	(0.00902)
No. of Observation	8,382	40,561
Year Fixed Effects	Yes	Yes
Year Dummies * Insurance	Yes	Yes
Year Dummies * Tobacco Household	Yes	Yes
R-squared	0.021	0.057

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 10. Heterogeneity of the Insurance Effect: Production Size and Migration Income

	Production Size			Migration Income		
VARIABLES	Area of Tobacco Production (mu)	Loan Size (10,000 RMB)	Saving Rate (Net Saving Divided by Income)	Area of Tobacco Production (mu)	Loan Size (10,000 RMB)	Saving Rate (Net Saving Divided by Income)
	(1)	(2)	(3)	(4)	(5)	(6)
After	8.180***	1.875***	0.0588***	7.616***	2.018***	0.0655***
(= 0 if 2000-2002, = 1 if 2003-2008)	(3.141)	(0.114)	(0.0137)	(1.807)	(0.0676)	(0.0251)
Insurance	0.764***	-0.0924***	0.0358***	0.381***	-0.104***	-0.00684
(= 0 if control region, = 1 if treatment region)	(0.283)	(0.00290)	(0.00182)	(0.132)	(2.47e-05)	(0.0508)
Tobacco Household		-0.0834***	-0.0172**		-0.102***	-0.00981
(= 0 if No, = 1 if Yes)		(0.00157)	(0.00718)		(0.00645)	(0.0305)
After * Insurance	1.225***	0.0631***	0.0361***	1.493***	-0.0323	0.0318*
	(0.175)	(0.0220)	(0.00197)	(0.0816)	(0.0490)	(0.0187)
After * Tobacco Household		0.113***	0.0222***		-0.00452	0.0247
		(0.00939)	(0.000263)		(0.0288)	(0.0209)
Tobacco Household * Insurance		0.0180***	-0.0233***		0.0437***	0.0263
		(0.00125)	(0.00785)		(0.0101)	(0.0310)
After * Insurance * Tobacco Household		0.0294***	0.00355***		0.258***	-0.0396*
		(0.0108)	(0.000700)		(0.0527)	(0.0206)
Pre-treatment Total Production Area	2.178***	-0.0102***	-0.0288***			
(= 0 if < Median, = 1 if > Median)	(0.637)	(0.00211)	(0.00213)			
Pre-treatment Total Production Area * After	-0.163*	0.203***	0.00760***			
	(0.0873)	(0.0649)	(0.00164)			
Pre-treatment Total Production Area * Insurance	-1.374**	-0.0126***	-0.0327***			
	(0.676)	(0.00234)	(0.00218)			
Pre-treatment Total Production Area * Tobacco Household		0.0295	0.0606***			
		(0.0289)	(0.0195)			
Pre-treatment Total Production Area	0.0177	-0.178***	-0.0187***			
*After * Insurance	(0.112)	(0.0658)	(0.00198)			
Pre-treatment Total Production Area		-0.224***	-0.0309**			
* After * Tobacco Household		(0.0286)	(0.0148)			
Pre-treatment Total Production Area		-0.0107	-0.00221			
* Tobacco Household * Insurance		(0.0289)	(0.0199)			
Pre-treatment Total Production Area		0.291***	-0.00808			
* After * Insurance * Tobacco Household		(0.0290)	(0.0153)			
Pre-treatment Share of Migration Income in Total Income				-0.291**	-0.00283	0.0180
				(0.117)	(0.00211)	(0.0316)
Pre-treatment Share of Migration Income in Total Income				0.239*	-0.146***	-0.00792
* After				(0.124)	(0.00939)	(0.0141)
Pre-treatment Share of Migration Income in Total Income				-1.092***	-0.0279***	-0.0254
* Insurance				(0.0873)	(0.00407)	(0.0315)
Pre-treatment Share of Migration Income in Total Income				-0.280***	0.218***	-0.00658
* Tobacco Households				(0.0948)	(0.0158)	(0.0141)
Pre-treatment Share of Migration Income in Total Income					0.0132	0.0281
*After * Insurance					(0.0608)	(0.0351)
Pre-treatment Share of Migration Income in Total Income					0.194*	-0.0347
* After * Tobacco Household					(0.115)	(0.0236)
Pre-treatment Share of Migration Income in Total Income					-0.0458	-0.0393
* Tobacco Household * Insurance					(0.0768)	(0.0351)
Pre-treatment Share of Migration Income in Total Income					-0.278**	0.0319
* After * Insurance * Tobacco Household					(0.129)	(0.0237)
Observations	34,207	8,382	40,561	34,207	8,382	40,561
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Household Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.208	0.030	0.074	0.157	0.036	0.070

Notes: Bootstrap clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 11. Percentage of Households Changing Sector by Region and Year

	Treatment Regions			Control Regions		
Year	Tobacco to Non-Tobacco	No Change	Non-Tobacco to Tobacco	Tobacco to Non-Tobacco	No Change	Non-Tobacco to Tobacco
2000	N/A	N/A	N/A	N/A	N/A	N/A
2001	0	100	0	0.08	99.92	0
2002	0	98.72	1.28	0	94.97	5.03
2003	0.32	99.68	0	0.53	99.42	0.05
2004	0.63	99.37	0	0.32	99.17	0.51
2005	0	99.81	0.19	0	99.63	0.37
2006	0.23	99.53	0.23	0	99.9	0.1
2007	0.4	99.6	0	0.54	99.29	0.17
2008	0.42	99.43	0.14	0.11	99.33	0.56

Appendices

A Two-period model when insurance is not provided

Combine equation (3.1) and (3.4) we can get:

$$U'(C_1) = \beta p U'(C_g)F'(I) = \beta p U'(C_g)(1+R_B) \tag{3.6}$$

$$\Rightarrow \frac{C_g}{C_1} = \frac{F(I)-(1+R_B)B+(1+R_f)S}{C_1} = \beta p(1+R_B)$$

$$\Rightarrow C_1 = \frac{F(I)-(1+R_B)B+(1+R_f)S}{\beta p(1+R_B)}$$

$$= \frac{\left(\frac{1+R_B}{\alpha}\right)^{\frac{\alpha}{\alpha-1}}-(1+R_B)B+(1+R_f)S}{\beta p(1+R_B)} \tag{3.7}$$

Rewrite equation (3.3) as:

$$\beta p U'(C_g)F'(I) = \beta p U'(C_g)(1+R_f) + \beta(1-p)U'\left[(1+R_f)S\right](1+R_f) \tag{3.3'}$$

Then combine (3.3)' with equation (3.7) we have:

$$\frac{1}{C_1} = \frac{\beta p(1+R_f)}{F(I)-(1+R_B)B+(1+R_f)S} + \frac{\beta(1-p)}{S} = \frac{\beta p(1+R_B)}{\left(\frac{1+R_B}{\alpha}\right)^{\frac{\alpha}{\alpha-1}}-(1+R_B)B+(1+R_f)S}$$

$$\Rightarrow \frac{\beta p(R_B-R_f)}{F(I)-(1+R_B)B+(1+R_f)S} = \frac{\beta(1-p)}{S}$$

$$\Rightarrow \beta p(R_B-R_f)S = \beta(1-p)[F(I)-(1+R_B)B+(1+R_f)S]$$

$$\Rightarrow (1+R_B)B = F(I) - \frac{p}{1-p}(R_B-R_f)S + (1+R_f)S$$

$$\Rightarrow B = \alpha^{-\frac{\alpha}{\alpha-1}}(1+R_B)^{\frac{1}{\alpha-1}} - S\left[\frac{p}{1-p}\frac{R_B-R_f}{R_B+1} - \frac{1+R_f}{1+R_B}\right] \tag{3.8}$$

Plug equation (3.8) into (3.7)

$$\Rightarrow C_1 = \frac{1}{1-p}\frac{R_B-R_f}{\beta(1+R_B)}S \tag{3.9}$$

We know that the total investment is:

$$I = W_0 - C_1 + B - S$$

Replace C_1 and B by (3.9) and (3.8), respectively, we have:

$$I = W_0 - \frac{1}{1-p}\frac{R_B-R_f}{\beta(1+R_B)}S - S + \alpha^{-\frac{\alpha}{\alpha-1}}(1+R_B)^{\frac{1}{\alpha-1}} - S\left[\frac{p}{1-p}\frac{R_B-R_f}{R_B+1} - \frac{1+R_f}{1+R_B}\right]$$

$$\Rightarrow (1-\alpha^{-1})I = (1-\alpha^{-1})\left(\frac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}$$

$$= W_0 - \frac{1+\beta}{\beta(1-p)}\frac{R_B-R_f}{R_B+1}S$$

$$\Rightarrow S^* = \frac{(1+R_B)(1-p)\beta}{(1+\beta)(R_B-R_f)}\left[W_0 + (\alpha^{-1}-1)\left(\frac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]$$

$$= A * \left[W_0 + (\alpha^{-1}-1)\left(\frac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\right] \tag{3.10}$$

Now let's consider consumption. Plug the expression of S into equation (3.9):

$$
\begin{aligned}
C_1 &= \tfrac{1}{1-p}\tfrac{R_B-R_f}{\beta(1+R_B)}\tfrac{(1+R_B)(1-p)\beta}{(1+\beta)(R_B-R_f)}\left[W_0+(\alpha^{-1}-1)\left(\tfrac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\right] \\
&= \tfrac{1}{1+\beta}\left[W_0+(\alpha^{-1}-1)\left(\tfrac{1+R_B}{\alpha}\right)^{\frac{1}{\alpha-1}}\right] \qquad (3.11)
\end{aligned}
$$

The last variable that we are interested in is the borrowing. According to equation (3.8):

$$
B = \alpha^{-\frac{\alpha}{\alpha-1}}(1+R_B)^{\frac{1}{\alpha-1}} - S\left[\tfrac{p}{1-p}\tfrac{R_B-R_f}{R_B+1} - \tfrac{1+R_f}{1+R_B}\right] = D + S * E
$$
$$
\text{where } D = \alpha^{-\frac{\alpha}{\alpha-1}}(1+R_B)^{\frac{1}{\alpha-1}} \text{ and } E = \tfrac{1+R_f}{1+R_B} - \tfrac{p}{1-p}\tfrac{R_B-R_f}{R_B+1}
$$

B Two-period model when insurance is provided

From equation (3.13), we can see that the expression of optimal investment is:

$$
F'(I) = (1+R_B)(1+\delta) \Rightarrow I^* = \left(\tfrac{(1+R_B)(1+\delta)}{\alpha}\right)^{\frac{1}{\alpha-1}}
$$

Rewrite equations (3.12) and (3.14) as:

$$
\begin{aligned}
\tfrac{1}{C_1} &= \tfrac{\beta p(1+R_B)}{C_g} + \tfrac{\beta(1-p)\gamma}{C_b(1+\delta)} \qquad (3.15) \\
\tfrac{\beta p(R_B-R_f)}{C_g} + \tfrac{\beta(1-p)\gamma}{C_b(1+\delta)} &= \tfrac{\beta(1-p)(1+R_f)}{C_b} \\
\Rightarrow C_g = AC_b, A &= \tfrac{(R_B-R_f)p}{(1-p)\left[(1+R_f)(1+\delta)-\gamma\right]} \qquad (3.16)
\end{aligned}
$$

Plug expression (3.16) into (3.15):

$$
\begin{aligned}
\tfrac{1}{C_1} &= \tfrac{\beta p(1+R_B)}{AC_b(1+\delta)} + \tfrac{\beta(1-p)\gamma}{C_b(1+\delta)} \\
\Rightarrow C_b = \tfrac{\beta p(1+R_B)+\beta(1-p)\gamma A}{A(1+\delta)}C_1 &= \tfrac{\gamma}{1+\delta}(W_0-C_1-S+B) - \tfrac{\gamma}{1+\delta}B + (1+R_f)S \\
\Rightarrow \tfrac{\beta p(1+R_B)+\beta(1-p)\gamma A}{A(1+\delta)}C_1 &= \tfrac{\gamma}{1+\delta}W_0 - \tfrac{\gamma}{1+\delta}C_1 - \tfrac{\gamma}{1+\delta}S + (1+R_f)S \qquad (3.17) \\
\Rightarrow S = \tfrac{1}{1+R_f-\gamma/(1+\delta)}&\left[\tfrac{\gamma}{1+\delta} + \tfrac{\beta p(1+R_B)+\beta(1-p)\gamma A}{A(1+\delta)}\right]C_1 - \tfrac{\gamma W_0}{(1+R_f)(1+\delta)-\gamma} \qquad (3.18)
\end{aligned}
$$

Combining (3.16) and (3.17) we can get:

$$
\begin{aligned}
C_g &= \left[\beta p(1+R_B) + \beta(1-p)\gamma A\right]C_1 \\
\Rightarrow \left[\beta p(1+R_B) + \beta(1-p)\gamma A\right]C_1 &= f(R_B) - (1+R_B)B + (1+R_f)S \\
\Rightarrow B &= (1+R_B)^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{\alpha}{\alpha-1}}\alpha^{-\frac{\alpha}{\alpha-1}} - \tfrac{D}{1+R_B}C_1 + \tfrac{1+R_f}{1+R_B}S \qquad (3.19)
\end{aligned}
$$

Becasue the total investment is $I = \frac{B+[W_0-C_1-S]}{1+\delta}$, according to equation (3.18) and (3.19) we have:

$$\left(\frac{(1+R_B)(1+\delta)}{\alpha}\right)^{\frac{1}{\alpha-1}} =$$

$$\left[\frac{(R_B-R_f)\gamma+(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}{(1+R_B)(1+\delta)\left[(1+\delta)(1+R_f)-\gamma\right]}W_0 + (1+R_B)^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}}\alpha^{-\frac{\alpha}{\alpha-1}}\right] - \left[D+E\right]C_1$$

$$\Rightarrow C_1^* = \frac{1}{D+E}\left[\frac{(R_B-R_f)\gamma+(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}{(1+R_B)(1+\delta)\left[(1+\delta)(1+R_f)-\gamma\right]}W_0 + (\alpha^{-1}-1)(\frac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}}\right] \quad (3.20)$$

$$\text{Where } D = \frac{(1+\beta p)(1+R_B)+\beta(1-p)A}{(1+R_B)(1+\delta)}$$

$$E = \frac{R_B-R_f}{(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}\frac{A\gamma+\beta p(1+R_B)+\beta(1-p)A\gamma}{A(1+\delta)}$$

$$\Rightarrow S^* = \frac{(1+R_B)(1+\delta)}{R_B-R_f}\frac{E}{D+E}\frac{(R_B-R_f)\gamma+(1+R_B)\left[(1+\delta)(1+R_f)-\gamma\right]}{(1+R_B)(1+\delta)\left[(1+\delta)(1+R_f)-\gamma\right]}W_0$$

$$+\frac{(1+R_B)(1+\delta)}{R_B-R_f}\frac{E}{D+E}(\alpha^{-1}-1)(\frac{1+R_B}{\alpha})^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{1}{\alpha-1}} - \frac{\gamma W_0}{(1+R_f)(1+\delta)-\gamma} \quad (21)$$

$$B^* = (1+R_B)^{\frac{1}{\alpha-1}}(1+\delta)^{\frac{\alpha}{\alpha-1}}\alpha^{-\frac{\alpha}{\alpha-1}} - \frac{D}{1+R_B}C_1^* + \frac{1+R_f}{1+R_B}S^* \quad (3.22)$$