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Impact of Weather Insurance on Household Production and Savings

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ABSTRACT
Extreme disasters caused by global climate change have increased the instability of agricultural production in China. In response to these weather hazards, adverse shocks and foregone opportunities for profitability will lead to large fluctuations in agricultural household capital and consumption if insurance markets are inadequate, and it is necessary to study the effect of weather insurance. This paper uses a natural experiment to analyze the impact of an agricultural weather insurance program on household production and saving behavior. The empirical methods are difference-in-difference and triple-difference methods. The results show that the provision of weather insurance effectively promotes household production and also affects the increase in the household savings rate.

Keywords: *weather insurance, household production, household saving, DID.*

1. INTRODUCTION

In the case of global warming, extreme weather events such as heavy precipitation and extremely high temperatures occur frequently. As a predominantly agricultural country, agriculture plays a fundamental role in the national economy. Meteorological disasters have caused severe losses to the economy. Agricultural production is deeply dependent on objective factors such as uncertain climate conditions, especially for low-income families in rural areas. For these weather disasters, if the insurance market is not perfect, the negative impact and giving up profit opportunities will lead to considerable fluctuations in agricultural families and consumption and lead to sustained poverty. Providing weather hazard insurance can go some way to protecting farmers from this risk. Although informal insurance can avoid high-risk agricultural activities and hold Preventive Savings, it still can not effectively reduce the negative impact of regional weather shocks. Therefore, some countries have improved the traditional insurance market and sold formal insurance products to farmers. Although there is much relevant literature on improving insurance demand, there is little impact on family economic behavior after implementing insurance.

Liu explained from the macro-level that the frequency of extreme weather events is higher and higher [1]. The damage degree of weather disasters is also increasing, which has caused considerable losses to farmers' lives, property, and economy. Skees et al. believe that weather index insurance does not need survey and claim settlement [2]. The premium rate is lower than traditional agricultural insurance, which is easier to understand by farmers. Although more and more literature has studied methods to improve insurance demand [3-4], there is very little rigorous assessment of the impact of insurance clauses on subsequent family behavior.

This paper uses the household-level panel data set of China Rural Credit Cooperative (RCC) from 2000 to 2008 to explore the impact of insurance provision on household production and savings decisions. To protect some farmers from this weather risk, the local government of Guangchang county, Jiangxi Province, in cooperation with the people's Insurance Company of China (PICC) in 2003, designed and provided compulsory insurance plans for tobacco producers. Since the insurance policy was implemented in Guangchang county rather than other counties in Jiangxi Province, we can take it as a "natural experiment" to evaluate the effect of insurance provision by comparing all farmers receiving the insurance policy in Guangchang county (treatment group) and those not in other counties in Jiangxi Province (control group). In addition, since we have the data of each family before (2000-02) and after (2003-08), we use DID and DDD to explore the effects.

2. METHODOLOGY

2.1. Difference-in-Difference

This study uses the Difference-in-Difference (DID) and Difference-in-Difference-in-Difference (DDD) to explore the impact of insurance on family production. DID method is an econometric method used to analyze policy impact. When doing random or natural experiments, the experimental results often take a period to show, and we are concerned about the changes of the explained variables before and after the investigation. For this purpose, the following two phases of panel data are considered

$$y_{it} = \alpha + \gamma D_t + \beta x_{it} + u_i + \epsilon_{it} \quad (i = 1,2,\dots,n; t = 1,2) \qquad (1)$$

where D_t is the dummy variable in the experimental period ($D_t = 1$, if t = 2; $D_t = 0$, if t = 1), u_i is an unobservable individual feature the policy dummy

$$x_{it} = \begin{cases} 1, & if \ \ i \in treatment \ \ group, and \ \ t = 2 \\ 0, & otherwise \end{cases} \qquad (2)$$

Therefore, when t = 1 (phase I), the treatment group and the control group are not treated differently, and x_{it} Is equal to 0. When t = 2 (phase II), the treatment group $x_{it} = 1$ and the control group x_{it} Is still equal to 0. If the experiment is not entirely randomized (e.g., observed data), x_{it} maybe related to the missing individual features u_i Resulting in inconsistent OLS estimates. Due to the panel data, the first-order difference of Equation (1) can be carried out to eliminate u_i,

$$\Delta y_i = \gamma + \beta x_{i2} + \Delta\epsilon_i \qquad (3)$$

Using OLS to estimate the above formula, we can get a consistent estimation. According to the reasoning of differences estimator

$$\hat{\beta}_{ols} = \Delta\bar{y}_{treat} - \Delta\bar{y}_{control} = \left(\bar{y}_{treat,2} - \bar{y}_{treat,1}\right) - \left(\bar{y}_{control,2} - \bar{y}_{control,1}\right) \qquad (4)$$

Therefore, this estimation method is called Difference-in-Difference estimator (DID), which is denoted as $\bar{\beta}_{DD}$, that is the difference between the mean change in the treatment group and the mean change in the control group. It can be shown that Equation (3) is equivalent to the following two-period panel model:

$$y_{it} = \beta_0 + \beta_1 G_i \cdot D_t + \beta_2 G_i + \gamma D_t + \epsilon_{it} \quad (i = 1,2,\dots,n; t = 1,2) \qquad (5)$$

where G_i is the treatment group dummy variable ($G_i = 1, if \ \ i \ \in treatment \ \ group$; $G_i = 0, if \ \ i \ \in control \ \ group$); D_t is the experimental period dummy variable ($D_t = 1, if \ \ t = 2$; $D_t = 0, if \ \ t = 1$), the interaction item $G_i \cdot D_t = x_{it}$. In Equation (5), the group dummy variable G_i portrays the difference between the treatment group and the control group itself (this difference exists even without treatment), the time dummy variable D_t portrays the difference between the two periods before and after the treatment itself (this trend exists even without treatment), and the interaction term $G_i \cdot D_t$ To truly measure the policy effect of the treatment group.

2.2. Triple-Difference

Compared to the DID, the Triple-Difference (DDD) is equivalent to performing a difference on top of the DID, thus eliminating the difference in time trends. The variable B_j, which causes the difference in time trends, is introduced, and the following Equation is estimated

$$y_{itj} = \beta_0 + \beta_1 B_j + \beta_2 G_i + \beta_3 B_j \cdot G_i + \gamma_0 D_t + \gamma_1 D_t \cdot B_j + \gamma_1 D_t \cdot G_i + \delta D_t \cdot B_j \cdot G_i + \epsilon_{it} \qquad (6)$$

where $B_j = 1$ individuals have the same time trend as the treatment group, otherwise $B_j = 0$, and the other signs are the same as in Equation (6). The coefficient δ of the interaction term $D_t \cdot B_j \cdot G_i$ is the policy effect, and its estimator $\hat{\delta}_{DDD}$ It is called the "Triple Difference estimator" (DDD).

3. RESULTS

3.1. Data

The study is based on data from 12 tobacco-producing counties in Jiangxi Province, China. Among them, only households in Guangchang County and whose primary source of income is growing tobacco are insured. The data for this study was provided by Rural Credit Cooperatives (RCC). Our dataset includes 3,466 households that grow tobacco in Jiangxi Province, China, and each family was observed annually between 2000 and 2008. That is, our dataset is a panel. In the case of tobacco households, 1259 of them are in the treatment group with insurance, and the other 2207 are in the control group.

The introduction of tobacco insurance policies has led to changes in insurance terms across time, geographic areas, and household eligibility conditions. Given these changes, we use DID and DDD for estimation in our empirical analysis.

3.2. Effect of Insurance Provision on Household Production

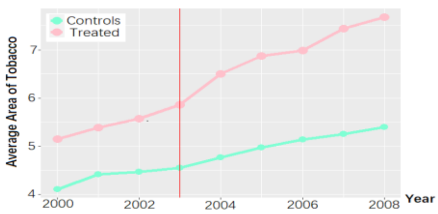

Figure 1 Trend of average tobacco acreage in the control and treatment group

Figure 1 shows the average tobacco acreage for each year for the treatment and control groups, with the vertical line in 2003 indicating the year insurance was introduced. According to figure 1, the trend in tobacco acreage comparing the control and treatment groups until 2003 satisfies the parallel direction. So we can use the DID for estimation. This paper uses DID estimate the effect of insurance policies on household production of tobacco.

Result (1) in Table 1 presents the regression results of the effect of insurance provision on household production of tobacco. The results show that the interaction term has a coefficient of 0.84 and corresponds to $p < 0.01$, indicating that tobacco farmers' insurance policies significantly affect a tobacco production increase. We also note that age, gender, and household size hurt the rise in tobacco production; the older the household head and the more family members, the lower the tobacco production. In contrast, the coefficient of basic income of tobacco farmers is 1.66, indicating that as the primary income of tobacco farmers increases, the area planted with tobacco will increase, thus increasing tobacco production. Taken together, these results suggest that providing weather insurance can be effective in promoting production.

3.3. Effect of Insurance Provision on Household Savings

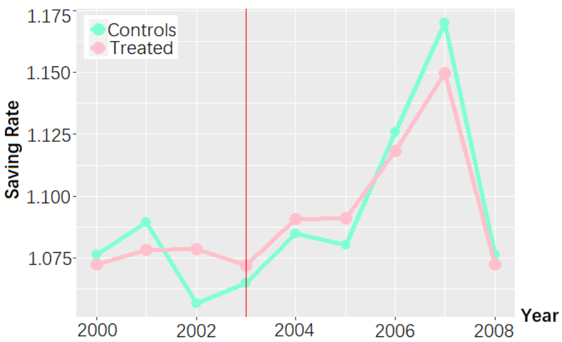

Figure 2 Trend of the average savings rate in the control and treatment groups

Figure 2 shows the average savings rate for each year for the treatment and control groups, with the vertical line in 2003 indicating the year insurance was introduced. According to figure 2, comparing the trend graphs of the saving rates of the control and treatment groups until 2003, the trends are not the same, and therefore DID cannot be used. Therefore, DDD is used to estimate the effect of insurance provision on household savings.

Table 1: Regression Results

	area_tob	save_rate	
	(1)	(2)	(3)
treatment	1.22***	-0.01*	0.02*
post	0.82***	0.01***	0.01***
edu			0.04***
age	-0.03***	0.001***	0.001***
gender	-0.13	0.02	0.01
hhsize	-0.06***	-0.002***	-0.001
baseincome	1.66***	-0.01***	-0.01***
tratment:post	0.84***		0.003
treatment: Edu			-0.03***
post: Edu			-0.001
treatment:post:edu			0.02*
constant	3.47***	1.05***	1.02***
F Statistic	1,796.3***	20.75***	24.50***

*Note: *p<0.1;**p<0.05;***p<0.01*

Result (3) in table 1 is the regression result of the effect of insurance provision on household saving rate. The results show that the coefficient estimate of the interaction term is 0.02, indicating that insurance policy provision increases the household saving rate. We also note that the age and gender of the household head have a positive effect on the increase in the household saving rate; that is, older male-headed households prefer to save. In contrast, household size and basic household income hurt the household saving rate, indicating that families with a more significant number of household members and higher basic income will have a lower saving rate. Taken together, these results suggest that weather insurance policy provision may increase household saving rates to some extent.

4. CONCLUSION

The research in this paper shows that insurance has a highly significant effect on both household production and savings. Weather insurance boosts agricultural household production and increases the household saving rate to some extent again. This suggests that insurance policies have a significant impact on both household production and financial behavior. The increase in household production contributes to the increase in household income, while the purchase of weather insurance also increases the total household savings rate, suggesting that the household's risk increases instead after purchasing insurance. A possible explanation is that weather insurance only covers production costs, so the increased risky investment of purchasing insurance is their exposure to more risk and therefore the need to save to protect against risk.

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