Does agricultural insurance promote primary industry production? Evidence from a quasi-experiment in China

Article *in* Geneva Papers on Risk and Insurance - Issues and Practice · November 2020

DOI: 10.1057/s41288-020-00198-z

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Forthcoming in *The Geneva Papers on Risk and Insurance-Issues and Practice*

Abstract

Whether the agricultural insurance promotes the production of the primary industry has been debated for decades of years. Our paper studies this question based on the premium subsidy policy of agricultural insurance in China. We use this quasi-experiment to conduct difference-in-differences and event study estimations. We find that the development of agricultural insurance induced by the premium subsidy significantly promotes the production of primary industry. The primary industry production per person rises by 1430 RMB in the subsidized provinces compared to other provinces. We use county-level data to address the aggregation problem in our province-level analysis and get the same conclusion. We also find that the agricultural insurance primarily affects agriculture and husbandry among four sub-industries in the primary industry.

Key Words： Agricultural Insurance; Premium Subsidy; Primary Industry; Quasi-Experiment

JEL Classification: O13, Q14, Q18

Introduction

Agricultural insurance is critical in assisting agricultural producers to lessen the negative impacts of adverse natural events. It guarantees the progress of agricultural reproduction and stabilizes the income of agricultural producers (Coble and Barnett 2013; Cole and Xiong 2017). In many countries, the agricultural insurance market is supported by the government (Weng et al. 2017). Premium subsidies are the most common form of government intervention in agricultural insurance (Mahul and Stutley 2010). Although these domestic supports are costly, they create great benefit. To be more specific, they stimulate the market of agricultural insurance. Theoretically, with the development of agricultural insurance market, the primary industry production should increase (Xu and Liao 2013). Yet, empirical studies on this issue produce ambiguous results. Some researchers find the positive effects of agricultural insurance on primary industry production (e.g., Alhassan and Fiador 2014; Pradhan et al. 2015; Zhang et al. 2016), while others do not (e.g., Goodwin and Smith 2013; Lee et al. 2016; Ward and Zurbrugg 2000).

Our paper focuses on the agricultural insurance market in China. China initiated a government-sponsored agricultural insurance program in 2007. The government selected Inner Mongolia, Jilin, Jiangsu, Hunan, Xinjiang and Sichuan as the pilot provinces in that year. Agricultural insurance policyholders in pilot provinces could receive premium subsidy. The premium subsidy stimulates the demand for agricultural insurance in subsidized provinces. Because agricultural insurance subsidy policy was implemented in different provinces in different years, it formed the quasi-experiment. The average agricultural insurance premium income per person of subsidized provinces is significantly higher than that in other provinces since 2007 (in Figure 1). We use difference-in-differences method based on this quasi-experiment to evaluate the effect of agricultural insurance on primary industry output.

We use province-level data in our main estimations. The aggregation problem with province-level data makes it difficult to get the treatment effect out of confounding factors. This is because there is a good chance that some unobserved exogenous variations can take effect for every degree of aggregation. So, we need to address the aggregation problem carefully. Otherwise, we cannot attribute the differences in changes of outcomes between treatment and control groups to the development of agricultural insurance market. Keeping these concerns in mind we then estimate the treatment effect.

First, we find that the premium subsidy significantly promotes the development of agricultural insurance market. We estimate the differences in premium income between the treatment and control groups before the premium subsidy policy to test the parallel trends assumption. These differences are not statistically significant. Hence, it proves the parallel trends assumption. We then find that this policy increases the agricultural insurance premium income by 250 RMB per person in pilot provinces compared to other provinces.

Second, we find that the development of agricultural insurance induced by the premium subsidy significantly promotes primary industry production. In the event study, the differences in primary industry production between the treatment and control groups before the policy are statistically insignificant. It indicates that treatment and the control groups have no significant difference in primary industry production before the policy. Hence, concerns about differential trends of outcomes between treatment and the control groups do not affect our results. Our main result shows primary industry production increases by 1430 per person RMB in the subsidized provinces compared to other provinces.

We check the robustness of the main result in two ways. First, we use the sample without four municipalities (Beijing, Shanghai, Tianjin, Chongqing) to rerun the regressions. The results indicate the same conclusion. The premium subsidy policy increases primary industry production by 1360 RMB per person for the pilot provinces. Then, we conduct another difference-in-differences analysis in which we make treatments and controls over first three policy years orthogonal. For the estimation, the average treatment effect of premium subsidy policy on primary industry production is 1270 RMB per person.

Besides, we analyse the heterogeneity of treatment effects among different sub-industries of primary industry. In China, the primary industry consists of four sub-industries, namely agriculture, forestry, husbandry and fishery. In 2007, the premium subsidy only targeted at major grains. In the following years, agricultural insurance subsidies covered major grains and livestock, and some economic forests, but not fishery. Consistently, our results show that the agricultural insurance program has significant positive impact on the agriculture and husbandry, especially on the former one.

We then repeat the difference-in-differences estimations for the secondary and tertiary industries as a falsification test. The purpose of this test is to address the concern regarding unobservable variations in the province-level estimations. Theoretically, the agricultural insurance should not have significant impacts on the production of these two industries. If estimates were significant positive for these two industries, our main results might be driven by unobserved differences in provincial characteristics. Our results of the falsification test show no significant positive treatment effect on the outputs of these two industries. Thus, our results are not driven by those unobserved variations.

From the province-level analysis, we conclude that the agricultural insurance promotes the primary industry production. Yet, there still may be unobserved variations due to the aggregation problem. Hence, we re-examine the impacts of agricultural insurance using the county-level data of Hunan and Jiangxi provinces. These two provinces have little difference in other aspects except in agricultural insurance premium subsidy policy. So, this county-level estimation is good for addressing the aggregation problem. The results support our main conclusion that the agricultural insurance promotes the primary industry production.

Our work contributes to the literature on the relationship between insurance and economic development. There are three main hypotheses in this literature. To begin with, the demand side hypothesis claims that as the economy grows, the market may take on additional insurance as a result of higher demand for financial services (Outreville 1996; Browne et al. 2000; Pradhan et al. 2015). Another hypothesis, the supply side hypothesis suggests that insurance can smooth the consumption of individuals and enterprises, encourage them to convert savings into investment, and thus stimulate economic growth (Arena 2008; Chen et al. 2012; Lee et al. 2016). Besides, some researchers find interdependence instead of one-way relationship between insurance and economy development (Beck and Webb 2003; Pradhan et al. 2015). We focus on the causal effect of agricultural insurance on the primary industry production and provides new evidence of it.

Our paper also contributes to the interpretation of the connection between agricultural risks and insurance. Agricultural insurance is an essential tool to manage the agricultural risks. There are theoretical studies analysing this connection (Ahsan et al. 1982; Ramaswami 1993; Chambers and Quiggin 2001) and empirical studies on this topic as well (Horowitz and Lichtenberg 1993; Smith and Goodwin 1996; Goodwin and Deal 2004; Annan and Schlenker 2015). The challenge in empirical work is to disentangle the endogeneity on the agricultural insurance. We address the endogeneity problem using premium subsidy policy of agricultural insurance in China as one quasi-experiment.

The rest of this paper proceeds as following. First, we introduce the institutional background with an emphasis on the development of agricultural insurance market in China. Next, we introduce the empirical models and data. Subsequently, we report and discuss the empirical results, including main results, robustness check, falsification test and county-level estimations. The final section concludes and explores the significance of this study.

Institutional Background

Primary industry in China

China's economy is composed of the primary industry, secondary industry and tertiary industry (State Statistical Bureau 2011). The primary industry includes agriculture, forestry, animal husbandry and fishery.[1] The total output of the primary industry is expanding, but its growth rate tends to slow down. Inevitably, the share of the primary industry production in GDP is declining. The proportion of primary industry production declines from 25.2% in 1989 to 7.2% in 2018.[2]

Nevertheless, the primary industry remains essential. The primary industry is the foundation of the economy. It is closely related to our everyday life and determines the overall quality and balance of the domestic economy. Chinese government always treats the primary industry as a top priority. Annually, the No. 1 document of the CPC Central Committee focuses on issues of the primary industry, the rural community and the rural population. Moreover, the relative size of the rural population is still significantly high. By the end of 2018, China's rural population accounts for 40.85% of total population.[3] It is higher than 33.77%, the average rural population proportion in upper-middle-income countries.

Agricultural insurance market in China

Before 2007, the agricultural insurance market grew quite slowly in China. Until 2003, the People's Insurance Company of China is the only institution that provided the agricultural insurance. In 1985, the premium income of agricultural insurance was 43.3 million RMB

[1] The 2011 version of *Industrial classification for national economic activities* excludes the services related to the agriculture, forestry, animal husbandry and fishery in the primary industry compared to the 2003 version. The agriculture is defined as the planting of cereal, legume, oil, potato, cotton, vegetable, fruit and so on. The forestry consists of tree breeding and seedling cultivation, afforestation, forest management and cultivation, and collection of wood and bamboo materials. The animal husbandry includes raising livestock and poultry. The fishery is composed of aquaculture and fishing in seawater and inland.

[2] The data is from the China Statistical Yearbook, available at http://www.stats.gov.cn/tjsj/ndsj/.

[3] The population data of China and the upper-middle-income country is from Health Nutrition and Population Statistics of World Bank: https://databank.worldbank.org/source/health-nutrition-and-population-statistics.

which increased to 235.9 million RMB in 2003.[4] From 2004, some other insurance companies stepped in and started to offer agricultural insurance. However, since the fair price premium is unaffordable for the low-income farmers, the agricultural insurance market had not expanded much. In 2006, the premium income of agricultural insurance was only 848 million RMB, which only accounts for 0.15% of the whole insurance market. In contrast, the primary industry's production was 232.6 billion RMB in 2006, contributing for 10.6% of GDP in that year. So, the agricultural insurance market is not sufficient to support the enormous primary sector in China.

The agricultural insurance market in China changed dramatically since 2007. In 2007, China initiated a government-sponsored agricultural insurance program. The government selected Inner Mongolia, Jilin, Jiangsu, Hunan, Xinjiang and Sichuan (phase 1 pilot provinces) as the pilot provinces. Initially, the government only subsidized the crops, including corn, rice, soybeans, wheat and cotton. For the subsidized crop insurances, both the central government and the provincial government promised to cover 25% of the premium fees. The remaining is paid by the policyholders and the county government. Usually, the policyholders of agricultural insurance only need to pay 25% of the premium fees.

The premium subsidy policy significantly increases the premium income of agricultural insurance in China. It stimulates the agricultural producers' demand for agricultural insurance. The agricultural risks are so high that the agricultural producers cannot afford to buy agricultural insurance if the premium rate is fairly priced. The lack of demand is mainly due to the gap between the fairly priced insurance premium and the farmers' low-level budget constraints caused by the dissonance between subjective and historical risks (Turvey et al. 2013). The government's subsidies cover the major part of the premium, so the demand for agricultural insurance is growing. The insurance companies offer products based on the

[4] The data of agricultural insurance premium before 2002 is from Chen (2015), and the data after 2002 is from China Insurance Yearbook.

actuarially fair rate. While the supply curve remains the same, the demand curve is increasing after the subsidy. Therefore, the premium subsidy expands the overall equilibrium quantity of agricultural insurance, and the operation of the insurance will expand to match the newly created demand. The agricultural insurance premium income in 2007 increased to 5.19 billion RMB, and the growth rate was 510.6%. As shown in Figure 1, there is a jump of agricultural insurance premium income and payment in 2007. The premium and payment per person in pilot provinces is significantly higher than that in non-pilot provinces since 2007, due to their early implementation of agricultural insurance subsidy.

After 2007, Chinese government included other provinces into the agricultural insurance premium subsidy program gradually. In 2008, Heilongjiang, Hubei, Hebei, Liaoning, Zhejiang, Anhui, Fujian, Shandong, Henan and Hainan (phase 2 pilot provinces) were selected as the other group of pilot provinces. By 2008, sixteen out of thirty-one provinces are provided with agricultural insurance premium subsidies by the government. This agricultural premium subsidy program steadily expanded to the whole country in the next few years. By the end of 2017, agricultural insurance premium subsidies had been developing from five planting categories to fifteen categories including planting, breeding and forestry.

Empirical Model and Data

In this section, we first introduce the empirical models. We apply the premium subsidy policy of agricultural insurance in China as the quasi-experiment to address the endogeneity problem. We use difference-in-differences (DID) method to evaluate the policy. We then describe the data and summary statistics of variables.

Difference-in-differences estimation in province level

The key assumption for DID method is that outcomes in the treatment and control groups would follow the same trend without the treatment. Only when this assumption holds can we get true treatment effect (Angrist and Pischke 2009). Following the literature, we use the event study method to examine this assumption (e.g., Cabral et al 2018; Goodman-Bacon 2018). Event study model is a generalized difference-in-differences method. It requires panel data with more than two periods. The specification of the event study is as equation (1):

$$Y_{i,t} = \alpha Treat_{i,t} + Treat_{i,t} \cdot \left[\sum_{k=-m}^{0} \eta_k \cdot d_k + \sum_{k=1}^{n} \gamma_k \cdot d_k \right] + \boldsymbol{\varphi X_{i,t}} + \delta_i + \theta_{r,t} + \epsilon_{i,t} \tag{1}$$

where $Y_{i,t}$ is the outcome of province i in year t; $Treat_{i,t}$ is the group dummy that equals to 1 for the treatments, and 0 otherwise; phase 1 pilot provinces are treatments in our main estimation. d_k equals to $\mathbf{1}(t - t_s^* = k)$ measuring the time relative to policy year t_s^*, where $\mathbf{1}(\cdot)$ is logistic function; policy year is 2007 in our main estimation. $\boldsymbol{X_{i,t}}$ denotes the vector of province-level control variables; δ_i are province fixed effects, and $\theta_{r,t}$ are year fixed effects interacted with region dummies (region×year); [5] $\epsilon_{i,t}$ is an error term.

We use the dummy $Treat_{i,t}$ to measure the level of premium subsidy for two reasons. First, the governments subsidy 75% of total premium fees for agricultural insurance policyholders in all the pilot provinces. This means no variation in the subsidy rate among these pilot provinces. Using dummy variable is enough to measure the variation of subsidy level among provinces. Second, we can directly interpret η_k and γ_k as the differences in outcomes between the treatment and control groups before and after the policy by using dummy variable.

The coefficients of interest are η_k and γ_k. The dummy for the year just before the implementation of premium subsidy policy ($k = 0$) is omitted. This normalizes the estimate of η_0 to zero. The η_k are falsification tests that capture the differences in outcomes between treatment and control groups in the m years leading up to the premium subsidy policy

[5] According to geographical features, thirty-one provinces in China mainland are divided into seven areas. They are East China (Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Shanghai), South China (Guangdong, Guangxi, Hainan), North China (Hebei, Shanxi, Beijing, Tianjin, Inner Mongolia), Central China (Hubei, Hunan, Henan), Northeast China (Liaoning, Jilin, Heilongjiang), Southwest China (Sichuan, Yunnan, Guizhou, Chongqing, Xizang), Northwest China (Ningxia, Xizang, Qinghai, Shaanxi, Gansu).

compared to the year just before the implementation (Goodman-Bacon 2018). Their pattern and statistical significance are a direct test of the parallel trend assumption. The coefficients γ_k represent the differences in outcomes between treatment and control groups in the n years after policy compared to the year just before the implementation. They measure treatment effect and analyse whether it changes over time after assignment.

When $m = 0$ and $n = 1$, the event study becomes an ordinary DID estimation shown in equation (2). We use it to estimate the average treatment effect of the premium subsidy policy:

$$Y_{i,t} = \beta_1 Treat_{i,t} + \beta_2 Post_{i,t} + \gamma_1 Treat_{i,t} \cdot Post_{i,t} + \boldsymbol{\varphi X_{i,t}} + \delta_i + \theta_{r,t} + \epsilon_{i,t} \qquad (2)$$

where $Y_{i,t}$ is the outcome of province i in year t; $Treat_{i,t}$ is the dummy that equals to 1 for the treatments, and 0 otherwise; $Post_{i,t}$ is the year dummy that equals to 1 for years after the policy shock, and 0 otherwise. The $\boldsymbol{X_{i,t}}$ are province-level control variables. δ_i are province fixed effects, $\theta_{r,t}$ are region×year fixed effects, and $\epsilon_{i,t}$ is an error term. Standard errors are clustered by province.

The coefficient of interest, γ_1, represents the difference-in-differences, i.e., the treatment effect of the premium subsidy policy. Before the policy shock, the difference in outcome between treatment and control groups is β_1. After the policy, the difference in outcome between these two groups is $\beta_1 + \gamma_1$. Hence, the γ_1 measures the treatment effect in the difference-in-differences estimation. Significant positive γ_1 indicates the promoting effect of agricultural insurance.

We add controls ($\boldsymbol{X_{i,t}}$) in equation (1) and (2) to address the omitted variables problem. Our controls include direct inputs and indirect factors affecting the agricultural production. Our direct inputs variables contain farmland acreage, the agricultural machinery power, usage of fertilizers and pesticides. The farmland is an important input in agricultural production. Machine power is a measure of fixed assets investment in the production. The utilization of fertilizer and pesticide are used to control the heterogeneity of nondurable inputs among provinces. We capture the variations of direct inputs of agricultural production by adding these three control variables. Moreover, we use these controls to account for variables correlated with the development of agricultural insurance market. For example, provinces have higher farmland acreage may have more demand for the agricultural insurance.

Indirect factors include agricultural risks, fiscal expenditure, and the ratio of primary industry production to the gross domestic production. We add agricultural risks to control the variations among provinces in flood, draught, and other risks causing damage to the production. Agricultural risks are correlated with the primary industry production and the development of agricultural insurance market. Fiscal expenditure of government captures other variations that may be correlated with the development with agricultural insurance market, like highways and railways and pavement of roads during our sample period. Besides, we use the ratio of the primary industry production to GDP to reflect the importance of the primary industry in a province. This variable is to capture other variations among provinces that may not be contained in controls above, like the provision of education to the agricultural producers.

We also include fixed effects in equation (1) and (2) to address the omitted variables problem. Province fixed effects, δ_i, absorb province characteristics that do not change within time, disentangling the policy effect from many possible sources of omitted variable bias. We use the year fixed effects interacted with region dummies, $\theta_{r,t}$, to control the variations among seven regions in China, like the agricultural products price hike at region level. They also neutralize any common trends and thus help ensure that the relationships of interest are identified from policy shock.

Difference-in-differences estimation in county level

In the province-level analysis, for every degree of aggregation, there is a good chance that some unobserved exogenous variations can take effect. Although we have taken efforts to deal with this problem, one may be still concerned about it. To address this issue, we make a county-level analysis. The county-level analysis solves aggregation problem though it only estimates the local treatment effect.

We use county data in Hunan and Jiangxi provinces. This is for two reasons. First, Hunan was selected as the pilot province in 2007, and Jiangxi in 2009. We use the region and time differences to construct DID estimation. Second, Hunan and Jiangxi are similar in many ways. They share almost the same geographical and climatic characteristics and agricultural practices. This means that these two provinces have few differences in other factors except for the difference in agricultural insurance premium subsidy policy.

This county-level DID estimation is shown in equation (3):

$$Y_{i,t} = \alpha Hunan_{i,t} + \beta Year_{i,t}^{07} + \gamma Hunan_{i,t} \cdot Year_{i,t}^{07} + \boldsymbol{\varphi C_{i,t}} + \delta_i + \theta_{c,t} + \epsilon_{i,t} \tag{3}$$

where $Y_{i,t}$ is the primary industry production in county i in year t; $Hunan_{i,t}$ equals to 1 for counties in Hunan and 0 in Jiangxi; $Year_{i,t}^{07}$ is a dummy that equal to 1 for year 2007 and beyond. $\boldsymbol{C_{i,t}}$ denotes the vector of county-level control variables. Finally, δ_i are county fixed effects, $\theta_{c,t}$ are time fixed effects interacted with city dummies (city ×year), and $\epsilon_{i,t}$ is the error term. Standard errors are clustered at county level.

We include control variables and fixed effects to address the omitted variables problem. Control variables include farmland acreage, the agricultural machinery power, fiscal expenditure, and the ratio of primary industry production to the gross production of county.[6] We capture the variations across counties by adding these controls. The county fixed effects δ_i absorb fixed county characteristics, whether observed or unobserved, disentangling the policy shock from many possible sources of omitted variable bias. The year fixed effects interacted with city dummies, $\theta_{c,t}$, controls the variations among cities.

[6] Indicators in statistical yearbooks of Hunan and Jiangxi are so different that we only get four controls variables after merging county data of these two provinces together.

The coefficient of interest, γ, measures the differences in outcome between Hunan and Jiangxi before and after the policy. Before 2007, the difference in primary industry production between Hunan and Jiangxi is α. After that, the difference is $\alpha + \gamma$. Hence, γ measures the treatment effect of premium subsidy policy. Significant positive γ indicates the promoting effect of agricultural insurance but only measures the local treatment effect. We cannot interpret γ as the policy effect of the nationwide premium subsidy program. Thus, the county-level estimation only serves as the supplementary evidence to our provincial analysis.

Data description

Two administrative datasets are used in our province-level analysis. The *China Insurance Yearbook* provides yearly premium income and claim payment of agricultural insurance in each province since 2002. The data on the production of primary industry and its four sub-industries, and other control variables are from the *China Rural Statistical Yearbook*. These two datasets are matched by the year and the province. Our provincial data covers the period from 2002 to 2015.

The summary statistics of province-level variables are shown in Table 1. Our baseline dependent variable of interest, primary industry production (*Pind*), has a mean of 10000 RMB/person and a standard deviation of 8770 RMB/person. The primary industry in China consists of the agriculture, forestry, husbandry, and fishery. The productions of these four sub-industries are 5130 RMB/person, 450 RMB/person, 3110 RMB/person, and 1010 RMB/person.[7]

We use the premium income per person (*Prem*) and insurance payment per person (*Paym*) to describe the development of the agricultural insurance market. The mean of *Prem* and *Paym* are 298.9 RMB/person and 184.9 RMB/person, and their standard deviation are 527.7

[7] The sum of production of these four sub-industries do not equal to the primary industry production. This is because the production of service industry related to these four sub-industries is also included when accounting the primary industry production before 2012. This part is quite small, and the empirical results will not be altered if we subtract it from the total production.

RMB/person and 356.6 RMB/person. The large standard deviations are in line with the policy difference in the agricultural insurance between pilot provinces and other provinces.

Table 1 also reports the summary statistics for the control variables. Control variables include direct inputs and indirect factors. Direct inputs contain farmland acreage (*Acre*), the agricultural machinery power (*Apow*), usage of fertilizers (*Fert*) and pesticide (*Pest*). Farmland acreage has a mean of 2.196 hectare/person with a standard deviation of 1.634 hectare/person. The mean agricultural machinery power is 1.274 kilowatt/person with a standard deviation of 0.679 kilowatt/person. The mean usage of fertilizers is 0.077 kilogram/person, and the mean of pesticide is 0.023 kilogram/person. Indirect factors include disaster area (*Disa*), fiscal expenditure (*Fisc*), and the ratio of primary industry production to the gross domestic production (*Pgdp*). Disaster area (*Disa*) is the measure of agricultural risks. It is defined as the ratio of the farmland that occurs natural disaster to the total farmland. Its mean is 0.293 with a standard deviation of 0.179. We use the ratio of primary industry production and the gross domestic production (*Pgdp*) to measure the importance of primary industry. It has a mean of 0.124 with a standard deviation of 0.641.

The data we use for county-level estimates come from the *Hunan Statistical Yearbook* and the *Jiangxi Statistical Yearbook*. The indicators in these two statistical yearbooks are different. We can only use those indicators that are common to both. In the final sample, we have primary industry production, farmland acreage, agricultural machinery power, fiscal expenditure, and the ratio of primary industry production to the total production in the county. Our county data covers the period from 2002 to 2015. See Table A1 for summary statistics of county data.

4. Empirical Results

We present the empirical results in this section. First, we report the results of balance test of covariates (Table 2). This test is to examine other variations that may be in parallel with premium subsidy policy. Second, we verify the promoting effect of premium subsidy policy on the development of agricultural insurance market (Table 3). Then, we investigate whether the primary industry production increases with the development of agricultural insurance market. We demonstrate that the agricultural insurance has significantly positive impacts on the primary industry production (Table 4 and Table 5). We also show the heterogeneity in the effects on the four sub-industries of primary industry (Table 6).

The results above show the causal effect of policy-based agricultural insurance on the primary industry. Nevertheless, there may exist other unobservable variations due to the aggregation problem. To address this concern, we rerun the difference-in-differences estimations for the secondary and tertiary industries as a falsification test (Table 7). This falsification test demonstrates that our main results are not driven by unobserved variations. On the other hand, we re-examine the impacts of agricultural insurance using the county-level data of Hunan and Jiangxi provinces (Table 8).

Balance Test of Covariates

The results in Table 2 show no significant difference in changes of direct inputs between treatment and control groups after the policy. Before the policy, the mean of acreage in the treatment group is 3.303 hectare/person, and 1.736 hectare/person in the control group. The difference is 1.597 hectare/person. After the shock, the difference is 1.489 hectare/person. The difference in differences between these two groups is small. The coefficient in column (5) is -0.078 with a standard error of 0.148. It indicates that difference does not significantly change after the policy. As for the agricultural machinery power, usage of fertilizers and pesticide, the results also show that differences in these variables between two groups do not change much after the policy.

Those indirect factors are also balanced. For instance, the mean of the ratio of primary industry production to GDP (*Pgdp*) is 0.148 for the treatment group, and 0.149 for the control group before the subsidy policy. The difference is -0.001. It means that the ratio of primary industry production to GDP in the treatment is slightly 0.001 lower than in the control group. After the shock, the difference is 0.008. The difference in differences is quite small. Also, the coefficient in column (5) is 0.009 with a standard error of 0.012. This means that differences in *Pgdp* between these two groups are not significant.

In summary, the results provide little evidence that the premium subsidy policy shock is correlated with these control variables. Treatment and control groups have no significant difference in changes of control variables after the policy. Hence, comparing changes in outcomes across pilot provinces and other provinces is unlikely to confound the effect of premium subsidy policy with other variations that affect primary industry production.

Results for policy effects on agricultural insurance

In this sub-section, we show that treatment and control groups have no significant difference in changes in agricultural insurance premium income before the premium subsidy policy. We also find a significant positive treatment effect of this policy on the agricultural insurance market. It increases the agricultural insurance premium income by 250 RMB/person in the treatment compared to the control group.

Panel A of Figure 2 plots event-study estimates for the effect of premium subsidy on the agricultural insurance premium income. Before the policy, the estimates were small and statistically insignificant. This means that pilot and non-pilot provinces had no significant difference in changes in agricultural insurance premium income. It proves that the pre-treatment trends of these two groups are parallel. The estimates become positive and statistically significant after the policy. They remain positive and significant for several years and go decreasing after 2013. This proves the promoting effect of premium subsidy policy on the premium income of agricultural insurance.

Table 3 reports the results of difference-in-differences (DID) and grouped event study for the development of agricultural insurance market. In column (1), the estimates for differences in premium income between the treatment and control groups before the policy are -1.197 and -0.558 with standard errors of 1.126 and 0.612. They are statistically insignificant. It indicates no significant difference in trends of premium income between treatment and control groups before the policy. The estimates for difference between these two groups after the policy are statistically and economically significant. The DID estimate in Panel B is 2.502 with a standard error of 0.57. This means that this premium subsidy policy increases the premium income by 250 RMB/person in the phase 1 pilot provinces compared to other provinces.

In column (2), we drop the observations of four municipalities (Beijing, Tianjin, Shanghai, and Chongqing), as they differ greatly in many aspects from other provinces. It does not alter the results. In the grouped event study, the coefficients remain statistically insignificant before the policy, and significant after the policy. The DID estimate is 2.281 with a standard error of 0.560. The premium subsidy policy increases the agricultural insurance premium income by 228 RMB/person.

We further use the insurance payment to measure the development of agricultural insurance market. The results remain robust. Panel B of Figure 2 plots event-study estimates for insurance payment. The small pre-treatment estimates verify the parallel trends assumption. The estimates rise sharply in the year of implementation of premium subsidy policy. This means that the premium subsidy policy significantly increases the agricultural insurance payment. Also, results in columns (3) and (4) of Table 3 support the conclusion.

To summarize, we find that the premium subsidy policy promotes the development of agricultural insurance. As the government covers most of the premium fees, it stimulates the agricultural producers' demand for agricultural insurance. Hence, the phase 1 pilot provinces have higher development of agricultural insurance after the policy than other provinces.

Results for primary industry production

Our results for primary industry production demonstrate that the treatment and control groups have no significant difference in trends of primary industry production. We also show that the premium subsidy increases the primary industry production by 1430 RMB/person for the treatment group. We now discuss the details of our main results.

In Figure 3, we plot the coefficients and 95% confidence intervals from estimating equation (2) for primary industry production. The pre-policy estimates are statistically insignificant. This means that the treatment and control groups have no significant difference in change of primary industry production. Since the introduction of premium subsidy policy, the estimates for post treatment effects become positive and statistically significant. This indicates the promoting effects of agricultural insurance on the primary industry production.

Results in Table 4 support this conclusion. In column (1), the estimates for differences between treatment and control groups before the policy are statistically insignificant. This proves the parallel trends assumption. The estimates after the policy are 0.061, 0.143, and 0.161 with standard errors of 0.034, 0.073 and 0.139. During the first two periods, the estimates are both statistically and economically significant. The DID estimate is 0.143 with a standard error of 0.041. The premium subsidy increases the primary industry production by 1430 RMB/person for the phase 1 pilot provinces.

In column (2), the result remains robust without observations of four municipalities. The pre-policy estimates are statistically insignificant. The estimates for post treatment effects are 0.040, 0.144, and 0.187 with standard errors of 0.033, 0.082 and 0.148. This mean that the premium subsidy policy has a significant positive impact on the primary industry production. The DID estimate in column (2) of Panel B also shows a significant treatment effect. The coefficient 0.136 means that the premium subsidy increases primary industry production by 1360 RMB/person for the phase 1 pilot provinces.

In column (3) and (4), we take phase 1 provinces in 2007, phase 2 provinces in 2008, and phase 1 provinces in 2008 as the treatments, making all combined in one regression. The results remain robust. In column (3), the pre-policy estimates are statistically insignificant. It indicates no significant difference in change of primary industry production between the treatment and control groups before the policy. The estimates for the post treatment effects are 0.025, 0.110, 0.192 with standard errors of 0.020, 0.047 and 0.095. This means that averaged treatment effects in these periods are 250, 1100 and 1920 RMB/person. The corresponding DID estimate is 0.127 with a standard error of 0.056. The premium subsidy policy increases the primary industry production by 1270 RMB/person for the treatment group. In column (4), after dropping the observations of four municipalities, the results show that the treatment effect is 1130 RMB/person.

We further take phase 1 provinces in 2007, phase 2 provinces in 2008, and phase 1 provinces in 2008 as the treatments in separate regressions. The results are in Table 5. In column (1), the treatment effect of the premium subsidy policy when taking phase 1 provinces in 2007 as treatments is 1070 RMB/person. Treatment effects when taking phase 1 provinces in 2008 and phase 2 provinces in 2008 as treatments are 770 RMB/person and 840 RMB/person. In column (4), we take phase 2 provinces in 2007 as treatments, which is a falsification test. There should be no post treatment effect for phase 2 provinces in 2007. Correspondingly, the DID estimate is statistically insignificant.

In brief, agricultural insurance promotes the primary industry production. To be more specific, the premium subsidy policy stimulates the development of agricultural insurance, and then increases the primary industry production. The positive effects of agricultural insurance on the primary industry are mainly through its loss compensation functions. Risk-averse agricultural producers could get payment from insurance companies if they have purchased agricultural insurance. It encourages them to expand inputs and increases their inputs flexibility. For example, they could put more inputs in management and purchasing machines. This increases the efficiency, thus promoting the production.

Results for production of four sub-industries

We analyse the heterogeneity of treatment effects for sub-industries of primary industry in this sub-section. The government initially provided premium subsidies only for grains and later extended to forestry and animal husbandry, while there is still no insurance premium subsidy for fishery. Hence, the influence of the premium subsidy policy on the four sub-industries should be various. To test this hypothesis, we estimate the equations (1) and (2) separately for four sub-industries. We find that treatment effects are economically and statistically significant only for agriculture and husbandry. We now discuss the details of these results.

The results are reported in Table 6. Column (1) presents results for the agriculture. In the event study, the pre-policy estimates are statistically insignificant. So, treatment and control groups have no significant difference in changes of production of agriculture. The estimates for treatment effects after the policy are 0.009, 0.110, and 0.145 with standard errors of 0.032, 0.035 and 0.043. They are both statistically and economically significant during the last two periods. The DID estimate is 0.089 with a standard error of 0.023. This means that the premium subsidy policy increases production of the agriculture by 890 RMB/person for treatment group.

Column (2) reports results for the husbandry. The pre-policy estimates are statistically insignificant. The estimates for treatment effects after the policy are 0.024, 0.026, 0.026 with standard errors of 0.028, 0.032 and 0.037. In Panel B, the DID estimate for treatment effect is positive and statistically significant. The coefficient 0.045 with standard error of 0.016 means that the policy increases production of the husbandry by 450 RMB/person for the treatment group.

Results for forestry and fishery are shown in columns (3) and (4) of Table 6. The estimates for treatment effects after the policy are statistically insignificant in event study. It indicates that the premium subsidy policy does not affect these two sub-industries. The DID estimate in equation (2) for forestry is -003 with a standard error of 0.005, and for fishery is -0.002 with a standard error of 0.011. They are statistically insignificant.

In short, the results show that the treatment effects of premium subsidy policy on the four sub-industries are different. The premium subsidy policy has significantly positive effects on the agriculture and the husbandry, especially for the former. The results are in line with the current policy implementation in China that the government provides the most premium subsidies for the agriculture and husbandry.

Falsification test: Estimations for the secondary industry and the tertiary industry

The results above show the causal relationship of policy-based agricultural insurance on the primary industry production. Yet, the unobservable variations may affect our results. To address this problem, we repeat the difference-in-differences estimations for the secondary and tertiary industries. We find that DID estimates are statistically insignificant for the secondary industry or the tertiary industry. This falsification test excludes the existence of such omitted variables that affect the treatment and control groups and change sharply simultaneously as the implementation of premium subsidy policy. We now discuss the details of this falsification test.

The results are reported in Table 7. The DID estimates for the secondary industry are statistically insignificant. In column (1), the DID estimate is -0.407 with a standard error of 1.209. It is statistically insignificant. The estimate in column (2) is -0.536 with standard error of 0.383, which is statistically insignificant. Column (3) and (4) show that the DID estimates for the tertiary industry are statistically insignificant. In column (3), the estimate is 2.138 with a standard error of 3.575. After adding some controls, as shown in column (4), the DID estimate remains statistically insignificant.

Overall, this falsification test helps allay omitted-variables concerns. Theoretically, the agricultural insurance premium subsidy policy should not affect the secondary and tertiary industries. If the DID estimates are significantly positive for secondary and tertiary industries, then we may miss some variations that affect the three industries simultaneously. In short, the results show no significant evidence of these omitted variations, like the boom of highways, railways and roads, that may affect our main results.

County-level analysis

The province-level results show that the agricultural insurance promotes the primary industry production. Nevertheless, there may still exist unobserved variations due to the aggregation problem. Hence, we use county data in Hunan and Jiangxi to make a further analysis. Hunan was selected as the pilot province in 2007, and Jiangxi in 2009. They have almost same geographical and climatic characteristics. This means that these two provinces have little difference in other factors except in agricultural insurance subsidy policy. Thus, the county-level estimation is good for addressing the aggregation problem. The results support our main conclusions. We now discuss more about the results.

We report the results from estimating equation (3) in Table 8 (see Table A1 for balance test of county-level covariates). In column (1), we use the full sample with 204 counties from 2002 to 2015. The DID estimate is 0.236 with a standard error of 0.030. This means that the premium subsidy program increases primary industry production by 2360 RMB/person in the treatment (Hunan) compared to the control (Jiangxi).

In column (2), we keep the sample from 2005 to 2008, two years before the policy and the two years after the policy. This is because Jiangxi was enrolled in the subsidy policy in 2009. Using shorter period avoids the influence of other shocks that may occur in longer period. The DID estimate is 0.095 with a standard error of 0.033. It indicates that the treatment effect of premium subsidy policy is 950 RMB/person.

In column (3), we only use the data of counties in prefecture-level cities along the boundary of Hunan and Jiangxi.[8] In this way we can make the counties in Hunan and Jiangxi more similar except the premium subsidy policy of agricultural insurance. The DID estimate is both statistically and economically significant. The coefficient 0.449 with a standard error of 0.104 means that the premium subsidy policy increases primary industry production by more 4490 RMB/person for Hunan than Jiangxi.

In short, our county level estimations also give strong evidence that agricultural insurance promotes the primary industry production. This is a very strong support of our main results in province-level analysis though it only gets the local treatment effect.

Conclusion

This paper examines the casual relationship between agricultural insurance and primary industry production. We use the premium subsidy policy of agricultural insurance in China as a quasi-experiment to address endogeneity problems. We find that the agricultural insurance exerts significant promoting effects on the production of primary industry. We use the county-level data to deal with the aggregation problem in our province-level estimations and find the same conclusion. We also find that the agricultural insurance primarily affects agriculture and husbandry, which is in line with the policy implementation in China.

The results in our paper have important implications for individuals, enterprises and governments. Our paper confirms that the agricultural insurance is an important risk management tool for individuals and enterprises engaged in the primary industry. When the loss occurs, without agricultural insurance, the income of agricultural producers would reduce dramatically. It decreases inputs for reproduction. But if these risks were mitigated by

[8] The along-boundary cities in Hunan are Yueyang, Changsha, Zhuzhou, Hengyang and Chenzhou, and in Jiangxi are Jiujiang, Yichun, Pingxiang, Ji'an and Ganzhou.

agricultural insurance, the reproduction would not be affected that much. Hence, it is imperative for these agricultural producers to manage agricultural risks with agricultural insurance.

Our results also show that the government should provide premium subsidy to induce the development of agricultural insurance market. Because of the high agricultural risks and loss rate, there is no complete agricultural insurance market. If the premium rate is priced on the actual loss, then the agricultural producers cannot afford to buy agricultural insurance. This is due to a considerable gap between the fairly priced insurance premium and the farmers' low-level budget constraints. If lowering the premium rate, then the insurance company will suffer paying the losses. Under this market failure, it is crucial that government intervene and help agricultural insurance market with policies and aids. Providing premium subsidies for policyholders is the most common form of government intervention in agricultural insurance. Our results show that the premium subsidy can effectively stimulate the agricultural insurance market and benefit the development of primary industry. This reflects the importance of the premium subsidy policy.

Our work has given strong evidences of the promoting effects of agricultural insurance on primary industry production. There are at least three further researches based on our work. First, one can analyse the mechanism of how agricultural insurance influence the agricultural production using the micro data. Also, as premium subsidy is only one kind of government supports of agricultural insurance, it is essential and interesting to investigate the impacts of other types of supports on the primary industry. Third, as many governments call for the mode of "agriculture plus finance", how to synergize those financial instruments in increasing production and farmers' income needs to be further studied.

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Table 1 Summary Statistics

Variables	Mean	S.D.	Median	Min	Max
Primary industry production (10000RMB/person), Pind	1.000	0.631	0.877	0.161	3.275
Agriculture production (10000RMB/person), Agri	0.513	0.327	0.436	0.100	1.874
Forestry production (10000RMB/person), Fore	0.045	0.051	0.029	0.005	0.372
Husbandry production (10000RMB/person), Husb	0.311	0.212	0.270	0.048	1.189
Fishery production (10000RMB/person), Fish	0.101	0.140	0.037	0.001	0.794
Premium income (100RMB/person), Prem	2.989	5.277	0.748	0	32.399
Payment (100RMB/person), Paym	1.849	3.566	0.415	0	19.645
Acreage (hectare/person), Acre	2.196	1.634	1.665	0.635	10.098
Agricultural machine power (kilowatt/person), Apow	1.274	0.679	1.142	0.262	3.817
Utilization of fertilizer (kg/person), Fert	0.077	0.036	0.072	0.016	0.230
Utilization of pesticide (kg/person), Pest	0.023	0.161	0.021	0.003	0.108
Disaster area, Disa	0.293	0.179	0.260	0	1.000
Fiscal expenditure(10000RMB/person), Fisc	1.864	3.019	0.930	0.095	20.708
Pind / GDP, Pgdp	0.124	0.641	0.123	0.040	0.379

Note: This table reports summary statistics at the province-year level, including mean, standard deviation, median, minimum and maximum. Our full sample consists of 31 provinces from 2002 to 2015.

Table 2 Balance Testing of Covariates

	(1)	(2)	(3)	(4)	(5)
Variables	Pre-Policy		Post-Policy		DID
	Treatment	Control	Treatment	Control	
Acre	3.303	1.736	3.256	1.767	-0.078 (0.148)
Apow	0.963	0.901	1.600	1.419	0.119 (0.183)
Fert	0.078	0.056	0.111	0.075	0.014 (0.009)
Pest	20.515	16.741	28.994	25.516	-0.295 (3.754)
Disa	0.333	0.327	0.298	0.263	0.032 (0.035)
Pgdp	0.148	0.149	0.116	0.108	0.009 (0.012)
Fisc	0.686	0.608	2.764	2.461	0.225 (0.950)

Note: This table presents the results of balance test of covariates. For the treatment and control group, we report the mean of control variables before the policy in columns (1) and (2), and after the policy in columns (3) and (4). Column (5) reports difference-in-differences estimates when covariates are the outcome. All the regressions control for the province and year fixed effects. Standard errors, clustered at province level, are included in parentheses.

Table 3 Estimates for the Development of Agricultural Insurance Market

	Premium Income		Payment	
	(1)	(2)	(3)	(4)
	A. Grouped Event-Study Estimates			
Pre-Policy				
Treat× (Year -4 to -3)	-1.197	-0.384	-0.390	-0.336
	(1.126)	(0.454)	(0.693)	(0.415)
Treat × (Year -2 to -1)	-0.558	-0.332	-0.214	-0.297
	(0.612)	(0.278)	(0.393)	(0.283)
Post-Policy				
Treat× (Year 1 to 3)	2.315^{**}	1.278^{**}	1.516^{*}	0.676^{*}
	(0.981)	(0.496)	(0.770)	(0.394)
Treat× (Year 4 to 6)	3.434^{**}	1.874^{**}	2.115	0.635
	(1.628)	(0.800)	(1.252)	(0.528)
Treat× (Year 7 to 9)	2.662	3.151^{**}	2.145	2.149
	(1.797)	(1.494)	(1.486)	(1.453)
Adjusted R^2	0.872	0.880	0.788	0.716
	B. Difference-in-Differences Estimates			
Treat × Post	2.502^{***}	2.281^{***}	1.095^{**}	1.071^{**}
	(0.570)	(0.560)	(0.491)	(0.510)
Adjusted R^2	0.862	0.862	0.777	0.721
N	434	324	434	324
Province FE	Yes	Yes	Yes	Yes
Region ×Year FE	Yes	Yes	Yes	Yes

Note: This table reports the regression results when the outcome variables are premium income and payment of agricultural insurance. Panel A presents the results from estimating equation (1), and Panel B reports the results from estimating equation (2). Columns (1) and (3) use the full sample. Columns (2) and (4) drop the observations of four municipality and limit the sample before year 2013. Standard errors, clustered at region-year level, are included in parentheses. * < 0.10, ** < 0.05, *** < 0.01.

Table 4 Estimates for Primary Industry Production

	(1)	(2)	(3)	(4)
		A. Grouped Event-Study Estimates		
Pre-Policy				
Treat× (Year -4 to -3)	-0.032	-0.002	-0.022	-0.013
	(0.086)	(0.086)	(0.026)	(0.026)
Treat × (Year -2 to -1)	-0.026	-0.023	-0.025	-0.017
	(0.080)	(0.081)	(0.020)	(0.021)
Post-Policy				
Treat× (Year 1 to 3)	0.061^{*}	0.040	0.025	0.022
	(0.034)	(0.033)	(0.020)	(0.018)
Treat× (Year 4 to 6)	0.143^{*}	0.144^{*}	0.110^{**}	0.102^{**}
	(0.073)	(0.082)	(0.047)	(0.044)
Treat× (Year 7 to 9)	0.161	0.187	0.192^{**}	0.178^{*}
	(0.139)	(0.148)	(0.095)	(0.090)
Adjusted R^2	0.946	0.953	0.955	0.962
		B. Difference-in-Differences Estimates		
Treat × Post	0.143^{***}	0.136^{***}	0.127^{**}	0.113^{**}
	(0.041)	(0.040)	(0.056)	(0.052)
Adjusted R^2	0.962	0.968	0.953	0.960
N	434	378	434	378
Province FE	Yes	Yes	Yes	Yes
Region ×Year FE	Yes	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes	Yes

Note: This table reports the regression results for the primary industry production. Panel A presents the results of estimating equation (1), and Panel B reports the results of estimating equation (2). Columns (1) and (2) are results when only taking phase 1 pilot provinces in 2007 as treatments. Columns (3) and (4) are results when combining treatments and controls over first three policy years. Columns (1) and (3) use the full sample, and column (2) and (4) drop the observations of four municipalities. Standard errors, clustered at region-year level, are included in parentheses. * < 0.10, ** < 0.05, *** < 0.01.

Table 5 Estimates for Primary Industry Production Combining All Treatments and Control

	(1)	(2)	(3)	(4)
Treat × Post	0.107***	0.077*	0.084*	0.049
	(0.029)	(0.044)	(0.046)	(0.041)
Adjusted R^2	0.974	0.964	0.965	0.972
N	186	217	217	186
Province FE	Yes	Yes	Yes	Yes
Region ×Year FE	Yes	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes	Yes

Note: This table reports difference-in-differences estimates from equation (2) for primary industry production. In column (1), phase 1 pilot provinces in 2007 are treatments. In column (2), phase 1 pilot provinces in 2008 are treatments. In column (3), phase 2 pilot provinces in 2008 are treatments. In column (4), phase 2 pilot provinces in 2007 are treatments. Columns (1) and (4) use sample from 2002 to 2007. Columns (2) and (3) use sample from 2002 to 2008. Standard errors, clustered at region-year level, are included in parentheses. $^{*} < 0.10$, $^{**} < 0.05$, $^{***} < 0.01$.

Table 6 Estimates for the Four Sub-Industries in the Primary Industry

	(1)	(2)	(3)	(4)
	Agriculture	Husbandry	Forestry	Fishery
	A. Grouped Event-Study Estimates			
Pre-Policy				
Treat× (Year -4 to -3)	-0.003	-0.024	0.007	0.021
	(0.038)	(0.041)	(0.008)	(0.022)
Treat × (Year -2 to -1)	-0.015	-0.007	0.002	0.005
	(0.035)	(0.035)	(0.007)	(0.018)
Post-Policy				
Treat× (Year 1 to 3)	0.009	0.024	0.001	0.006
	(0.032)	(0.028)	(0.005)	(0.014)
Treat× (Year 4 to 6)	0.110***	0.026	0.002	0.006
	(0.035)	(0.032)	(0.006)	(0.014)
Treat× (Year 7 to 9)	0.145***	0.026	-0.002	0.017
	(0.043)	(0.037)	(0.009)	(0.023)
Adjusted R^2	0.956	0.955	0.900	0.907
	B. Difference-in-Difference Estimates			
Treat × Post	0.089***	0.045***	-0.003	-0.002
	(0.023)	(0.016)	(0.005)	(0.011)
Adjusted R^2	0.953	0.955	0.901	0.908
N	378	378	378	378
Province FE	Yes	Yes	Yes	Yes
Region ×Year FE	Yes	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes	Yes

Note: This table reports the regression results when the productions of four sub-industries in the primary industry are the outcome variables. Columns (1)-(4) present the results for agriculture, forestry, husbandry, and fishery separately. Panel A presents the results of estimating equation (1), and Panel B reports the results of estimating equation (2). Standard errors, clustered at region-year level, are included in parentheses. * < 0.10, ** < 0.05, *** < 0.01.

Table 7 Estimations for Secondary and Tertiary Industries

	Secondary Industry Production		Tertiary Industry Production	
	(1)	(2)	(3)	(4)
Treat × Post	-0.407	-0.536	2.138	0.950
	(1.209)	(0.383)	(3.575)	(0.730)
Adjusted R^2	0.871	0.978	0.796	0.986
N	434	434	434	434
Province FE	Yes	Yes	Yes	Yes
Region ×Year FE	Yes	Yes	Yes	Yes
Control Variables	No	Yes	No	Yes

Note: This table reports difference-in-differences estimates from equation (2) for secondary and tertiary industries. The explained variables are secondary industry production in column (1) and (2), and tertiary industry production in column (3) and (4). All the regressions have controlled the province and region×year fixed effects. The control variables for secondary industry include investment in fixed assets of secondary industry, the fiscal expenditure, and the ratio of secondary industry production to GDP. The controls for tertiary industry consist of the fixed assets investment of tertiary industry, the fiscal expenditure, and the ratio of tertiary industry production to GDP. Standard errors, clustered at region-year level, are included in parentheses. $^{*} < 0.10$, $^{**} < 0.05$, $^{***} < 0.01$.

Table 8 Difference-in-Differences Estimations for Primary Industry Production of Counties

	(1)	(2)	(3)
Hunan $\times Year^{07}$	0.226^{***}	0.095^{***}	0.449^{***}
	(0.030)	(0.033)	(0.104)
Adjusted. R^2	0.759	0.849	0.817
N	2172	761	987
City ×Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes

Note: This table reports the results of difference-in-differences estimations shown in the equation (3) using the county-level data of Hunan and Jiangxi. In column (1), we use data of all 204 counties from 2002 to 2015. In column (2), we only use the data from 2005 to 2008. In column (3), we use the data of counties that are in the boundary of Hunan and Jiangxi. Regressions in all the columns have city ×year and county fixed effects. Control variables include farmland acreage, the agricultural machinery power, fiscal expenditure, and the ratio of primary industry production to GDP. Standard errors, clustered at county level, are included in parentheses. $^{*} < 0.10$, $^{**} < 0.05$, $^{***} < 0.01$.

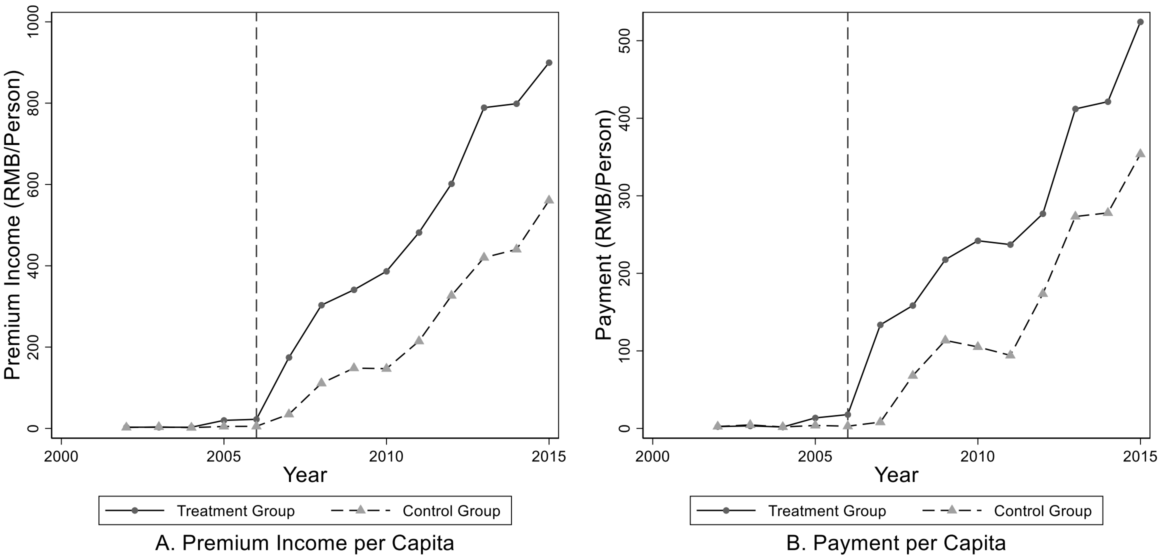

Figure 1 Development of Agricultural Insurance Market of Treatment and Control Groups. This figure shows the difference in agricultural insurance development between the treatment group (phase 1 pilot provinces) and control group. Panel A depicts the premium income per capita, and Panel B depicts the payment per capita. The premium income (payment) per capita for each group is the ratio of total premium income (payment) and the total rural population. The vertical dashed line is the year before the premium subsidy policy.

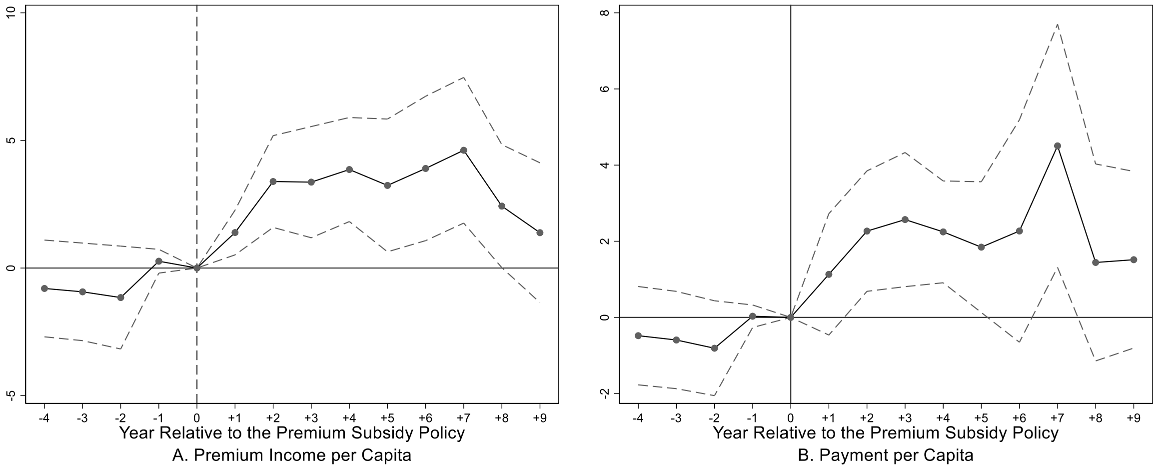

Figure 2 Estimates for the Development of Agricultural Insurance Market. This figure plots the coefficients and 95% confidence intervals from estimating equation (1) for the development of agricultural insurance market. Figure A plots the results for the agricultural insurance premium income. Figure B plots the results for the agricultural insurance payment. The connected dot line depicts the coefficients, and the two dashed lines are 95% confidence intervals. The estimate for the year just before the policy, η_0, is normalized to zero.

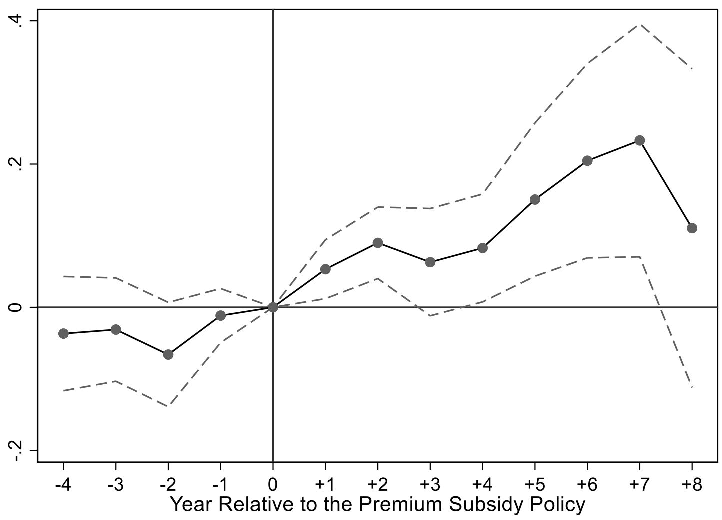

Figure 3 Estimates for Primary Industry Production. This figure plots the coefficients and 95% confidence intervals from estimating equation (1) when the primary industry production is the outcome. The connected dot line depicts coefficients, and the two dashed lines are 95% confidence intervals. The estimate for the year just before the policy, η_0, is normalized to zero.

Appendix

Table A1 Summary Statistics and Balance Test of County-level Variables

	(1)	(2)	(3)	(4)	(5)
Variable	Mean	S.D.	Median	Min	Max
Panel A: Hunan					
Pind	0.660	0.648	0.467	0.076	6.393
Apow	1.484	1.810	1.088	0.161	21.408
Acre	0.304	0.368	0.262	0.004	12.560
Fisc	1.557	8.167	0.353	0.030	151.388
Pgdp	0.214	0.119	0.223	0.000	0.506
Panel B: Jiangxi					
Pind	0.283	0.153	0.244	0.066	1.601
Apow	0.873	0.631	0.694	0.053	3.841
Acre	0.598	0.241	0.573	0.223	1.626
Fisc	0.264	0.245	0.176	0.037	2.341
Pgdp	0.256	0.092	0.249	0.030	0.509
Panel C: Balance Test of Covariates					
	Pre-Policy		Post-Policy		DID
	Jiangxi	Hunan	Jiangxi	Hunan	
Pind	0.192	0.293	0.358	0.842	0.267(0.099)
Apow	0.478	0.834	1.202	1.807	0.114(0.298)
Acre	0.559	0.286	0.648	0.314	-0.047(0.042)
Fisc	0.095	0.190	0.405	2.232	1.222(1.014)
Pgdp	0.305	0.278	0.208	0.183	0.020(0.012)

Note: Panel A and B report the summary statistics for of variables in county level for Hunan and Jiangxi separately. Panel C reports the results of balance test of covariates. Column (1)-(4) report the mean of variables of Hunan and Jiangxi before and after the policy. Column (5) reports difference-in-differences estimates when these control variables are the outcomes. All the regressions have the county fixed effect and city ×year fixed effects. Standard errors, clustered at county level, are included in parentheses. Our full sample consists of 204 counties from 2002 to 2015.