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Analysis on the Welfare Effect of Policy Agricultural Insurance

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Abstract: In 2007, China fully implemented policy-based agricultural insurance with premium subsidies from the central government and selected 6 provinces for pilots. By 2012, it had been fully implemented in 31 provinces and cities across the country. As a quasi-public good, Policy-based agricultural insurance has double positive externalities. In view of the impact of policy-based agricultural insurance on farmers' welfare, this article adopts a multi-time point double-difference model, using farmers' operating disposable income as the measure of farmers' welfare, and using 31 data from 2000 to 2022. An empirical study using panel data from provinces (municipalities and autonomous regions) found that policy-based agricultural insurance can help improve farmers' welfare, and the implementation of policy-based agricultural insurance can increase rural residents' operational disposable income by an average of 7.4%.

1. Introduction

Agriculture is the basic industry of the national economy. At the same time, due to low profits from agricultural production and frequent natural disasters, it is a weak industry in my country. Agricultural insurance refers to the insurance institution's insurance coverage for the insured's property caused by the agreed natural disasters, accidents, epidemics, diseases and other insurance accidents due to the insured subject matter in planting, forestry, animal husbandry and fishery production in accordance with the agricultural insurance contract. Insurance activities that bear the responsibility for compensation of insurance premiums. In practice, whether a region can carry out a certain business will be restricted by the minimum insurance participation rate. Due to the particularity of agricultural insurance, its demand curve and supply curve are difficult to intersect under natural circumstances[1]. National Agricultural insurance promoted through premium subsidies or operating expense subsidies is called policy agricultural insurance.

In 2004, the No. 1 document of the Central Government of my country, "Several Policy Opinions of the Central Committee of the Communist Party of China and the State Council on Promoting Increased Income of Farmers," stated that my country should "accelerate the establishment of a policy-based agricultural insurance system, select some products and some regions to take the lead in piloting, and where conditions permit, Farmers participating in planting and breeding industry insurance will be given certain premium subsidies" guidance, and the pilot work of regional policy-based agricultural insurance began. In 2007, the state comprehensively implemented policy-based agricultural insurance with premium subsidies from the central government, allocated 1.05 billion yuan in central government funds to support the pilot program of policy-oriented agricultural insurance, and issued the "Measures for the Administration of Pilot Subsidies for Agricultural Insurance Premium Subsidies from the Central Government", proposing that in five provinces, namely Hunan, Jilin, Jiangsu, Inner Mongolia and Sichuan. In 2008, policy-oriented agricultural insurance with premium subsidies from the central government was expanded to 16 provinces, municipalities, and autonomous regions. Subsidy funds reached 6.05 billion yuan. In the following years, the central government continued to expand the pilot provinces and pilot varieties of policy-based agricultural insurance. By 2012, policy-based agricultural insurance with premium subsidies from the central government was fully covered in 31 provinces, municipalities, and autonomous regions in Chinese mainland, with a subsidy fund of 5.39 billion. Yuan.

From 2007 to 2022, policy-based agricultural insurance has been in operation for 15 years. From a macro level, whether policy-based agricultural insurance can help improve farmers' welfare? This article uses a multi-time point double-difference model to conduct an empirical analysis of farmer's welfare, using Chinese mainland 2000-2022 Data on farmers' disposable income, rural permanent population, rural electricity consumption, total rural machinery power, effective irrigation area, and total sown area in 31 provinces (municipalities and autonomous regions), using farmers' operational disposable income as the explained variable[2].

2. Literature Review

There has been some discussion in the academic circles on the welfare effect of policy-oriented agricultural insurance. Sun Xiangyu and Zhong Funing took cotton insurance and other insurance products from a micro perspective as an example, and used the open dichotomous choice conditional valuation method to measure the agricultural performance of farmers. The insurance demand curve was used to calculate the welfare size under different subsidy rates. The study found that under a certain insurance participation rate, agricultural insurance subsidies in certain areas may bring about a net increase in social welfare. Zhu Zhongkun used provincial panel data from 2007 to 2012, taking farmers' income as the explained variable and the level of agricultural insurance development as the core explanatory variable. The study found that policy-based agricultural insurance has a significant negative effect on farmers' welfare. Chen Yan and Lin Lefen used a multi-time point DID model to examine the welfare effects of policy-based agricultural insurance on farmers from a macro level. The study found that policy-based agricultural insurance has a significant improvement effect on farmers' welfare.

This can also be extended to the research on the impact of policy-based agricultural insurance on farmers' income. Many scholars have conducted research, but the conclusions are mixed. From a macro level, one view is that agricultural insurance is an important means to increase farmers' income , and income redistribution is achieved through policy subsidies , can increase farmers' disposable income, and have a certain anti-poverty effect. Enjolras took France and Italy as examples and found that agricultural insurance has a significant positive impact on farmers' income. Gao found that agricultural insurance mainly promotes income growth through per capita sown area and fixed assets. Xing Li imulated and analyzed 6 agricultural insurance underwriting and subsidy schemes, and the results all showed that improving the level of protection can help increase agricultural income. Liu Wei analyzed the intermediary path of agricultural insurance to increase income from two aspects: breadth and depth of protection. Zhang Xiaodong, Ruan Guilin Wang Baoling, Ma Jiujie Wang Liyong , Fulisa and Chen Yan all concluded that agricultural insurance can Research conclusions on increasing farmers' income. Another view is that the impact of agricultural insurance on farmers' income is not significant. Scholars such as Siamwalla and Glaube found that while agricultural insurance increases agricultural output, it will also shift the crop supply curve to the right. Therefore, the impact of agricultural insurance on agricultural income is uncertain. There is also a view that policy-based agricultural insurance has a negative impact on farmers' income. For example, research by Zhou Wenhai shows that agricultural insurance has a small promotion effect on farmers' income; Jiang Shengzhong also believe that the substantial increase in agricultural insurance premium income will not help increase agricultural output value. Yu Xinping found that agricultural insurance premium income has a negative effect on farmers' income. Shi Wenxiang believe that agricultural insurance has obvious "threshold" characteristics in its impact on farmers' income[3].

From a micro level. One view is that farmers can increase their income by purchasing agricultural insurance. For example, Chen used survey data of 358 herdsmen households in Qinghai and Gansu provinces and found that policy-based livestock insurance has a significant positive impact on herders' income. Guo Jun believe that agricultural insurance exclusion has a significant negative impact on farmers' income. Different from this, another view is that the income-increasing effect of farmers purchasing agricultural insurance is not significant. For example, Han Xudong used data from the "National New Agricultural Business Entity Development Index Survey" and found that agricultural insurance can promote farmers' family business income, but agricultural insurance that "guarantees costs" but does not "guarantee income" has a limited effect[4].

Based on the above points of view, the direction and degree of impact of policy-based agricultural insurance on farmers' welfare is still a question worth exploring. Research on this issue can also help policymakers clarify the effects of existing policies and the direction of future policy efforts.

3. Theoretical Analysis

Agricultural insurance refers to the insurance institution's coverage of property losses caused by agreed natural disasters, accidents, epidemics, diseases and other insurance accidents due to the insured subject matter in planting, forestry, animal husbandry and fishery production in accordance with the agricultural insurance contract, insurance activities that bear the responsibility for compensation of insurance premiums. In practice, whether a region can carry out a certain business will be restricted by the minimum insurance participation rate. Due to the particularity of agricultural insurance, it is difficult for its demand curve and supply curve to intersect under natural circumstances[5]. Countries such as the United States and Japan have lowered the threshold for farmers to participate in policy agricultural insurance and increased the participation rate of policy agricultural insurance through the use of premium subsidies or operating subsidies. After 2007, my country also began to implement policy-based agricultural insurance by subsidizing agricultural insurance premiums from the central government.

As a quasi-public good, policy-based agricultural insurance has positive externalities. On the one hand, agricultural production is a means of obtaining income for farmers. On the other hand, the products produced by agricultural production can increase the overall consumable value of society. Food production also has a decisive impact on social stability and has strong positive externalities. Agricultural premiums transfer the risks of farmers in the agricultural production process to insurance companies by collecting premiums. They are dispersed layer by layer through reinsurance and other methods. Farmers are compensated for agricultural insurance premiums after insurance accidents occur, which can reduce the cost of farmers' agricultural income. Income fluctuations. After farmers obtain stable income expectations, they may further increase agricultural inputs, thereby increasing agricultural income. But at the same time, there may also be moral hazard when farmers participate in agricultural insurance. For example, after participating in the insurance, they reduce their investment in agricultural machinery or risk prevention measures, resulting in a reduction in their agricultural production income. Therefore, we propose the core hypothesis H of this article: Policy agricultural insurance can improve farmers' welfare[6].

4. Variable settings and model settings

4.1 Variable setting

4.1.1 Data source

Taking into account the continuity and availability of data, this article uses data on policy agricultural insurance and agricultural development in 31 provinces across the country from 2000 to 2023. The main sources are the "China Rural Statistical Yearbook 2001-2023", 31 provinces in mainland my country Provincial and municipal "Statistical Yearbooks" from 2001 to 2023, the official website of the Ministry of Finance of the People's Republic of China, etc.

For the pilot years of policy-based agricultural insurance, refer to the notices on the pilot work of policy-based agricultural insurance on the official websites of various provincial governments and other news, and organize them to form point-in-time data for policy implementation. The pilot program began in 2007 by selecting six provinces based on agricultural development conditions, and then added pilot provinces year by year. By 2012, policy-based agricultural insurance will be fully covered nationwide. This paper assigns a value of 1 to the policy implementation dummy variable in each province after the pilot year. After 2012, the implementation dummy variable in all provinces is 1.

Rural per capita disposable income, rural per capita disposable operating income, rural permanent population, rural electricity consumption, total rural mechanical power, effective irrigation area, and total sown area are all from the "China Rural Statistical Yearbook 2001-2023", Agriculture, Forestry and Animal Husbandry The total fishery output value, area affected by natural disasters, number of employees in the primary industry, agricultural product production price index, etc. are all from the "Statistical Yearbook" of each province from 2001 to 2023. The CPI data from 2000 to 2022 are from the National Statistical Yearbook, with 2000 as the year. In the base period, rural per capita disposable income, rural per capita disposable operating income, etc. are deflated. The central government's agricultural insurance premium subsidy data (2017-2022) comes from the official website of the Ministry of Finance of the People's Republic of China, which is compiled and summarized in this article. In order to solve the heteroskedasticity problem caused by large fluctuations in some data, we performed logarithmic processing on some variables. This article did not eliminate missing data, so this article uses a total of 713 provinces and cities for one year. All data processing and empirical work in this article were completed using Stata18.

4.2 Variable setting and statistical analysis

4.2.1 Explanated variable

The empirical part of this article mainly studies whether policy-based agricultural insurance has an impact on farmers' welfare. The core purpose of farmers purchasing policy-based agricultural insurance is to increase and stabilize their income from agricultural operations. Therefore, we use the operational aspect of farmers' disposable income. Income is used as the explained variable to measure farmers' welfare. According to data in the "China Rural Statistical Yearbook 2001-2023", there are four main components of rural residents' disposable income: wage income, operating income, net property income and Transfer net income. The income obtained by rural residents from agricultural production mainly forms operating income. Therefore, it is reasonable for us to use operating income in the disposable income of rural residents as a measure of farmers' welfare. This article conducts macro-level research. There is no bias in the research object in the data on operating income in the disposable income of rural residents in 31 provinces and cities. In addition, since operating income may be affected by inflation and other factors, we use the CPI data published by the National Bureau of Statistics over the years, and use 2000 as the base period to deflate the operating income in farmers' disposable income over the years. After the above data processing, the disposable operating income adjusted for inflation is obtained. Furthermore, we performed logarithmic processing on the data after excluding the inflation factor[7-8].

4.2.2 Core explanatory variables

Since each province did not start piloting policy-based agricultural insurance in the same year, this article uses a multi-period difference-in-difference model for empirical analysis. Policy-based agricultural insurance began piloting in 2007, and by 2012 it had been implemented in all 31 provinces in Chinese mainland (Table 1). Coverage, there is no control group that does not implement policy-based agricultural insurance at all. Referring to the approach of scholars such as Thorsten Beck et al, this article does not set a grouping variable, but only sets the dummy variable Policy as the core explanatory variable describing whether policy-based agricultural insurance is implemented. The years before policy-based agricultural insurance is implemented in a certain province are assigned a value of 0, and the years after the implementation of policy-based agricultural insurance in this province are assigned a value of 1. That is, before province A implements policy-oriented agricultural insurance, Policy=0, and after province A implements policy-oriented agricultural insurance, Policy=1.

Table 1: Sequence of pilot projects for policy-based agricultural insurance

Year	**Policy-based agricultural insurance implementation provinces (municipalities, autonomous regions)**
Year 2007	Hunan, Jilin, Jiangsu, Inner Mongolia, Sichuan
Year 2008	Anhui, Fujian, Hainan, Henan, Heilongjiang, Hubei, Liaoning, Shandong, Zhejiang
Year 2009	Jiangxi
Year 2010	Gansu, Guangdong, Ningxia, Qinghai, Shanxi, Yunnan
Year 2011	Guangxi, Guizhou, Hebei, Shaanxi, Chongqing
Year 2012	Beijing, Shanghai, Tianjin

4.2.3 Control variables

Omitted variables can lead to endogeneity problems. Considering that rural residents' operational disposable income may also be affected by factors such as natural disasters, agricultural production inputs, and agricultural product prices, this artical uses a variety of control variables to solve endogeneity problem. Referring to the approach of scholars such as Chen Yan et al. (2023),we select natural disasters with Disaster damage rate, rural per capita mechanical power, per capita effective irrigated area, primary industry employment, rural per capita electricity consumption, agricultural product producer price index, etc. as control variables to reduce estimation errors caused by omitted variables (Table 2).

Natural disaster disaster rate: Natural disasters may cause farmers to have poor harvests. Therefore, the natural disaster disaster rate is used as one of the control variables. The measurement method uses the proportion of the natural disaster-stricken area in the total planting area, that is, the province (region, city) The area affected by natural disasters in the current year/the total sown area in the province (autonomous region, city) in the current year, unit %.

Rural mechanical power per capita: The investment in agricultural machinery can improve agricultural efficiency and may also have a certain impact on farmers' income. Therefore, we choose the rural mechanical power per capita as an indicator to measure it. The calculation method is province (city, city, District) The total power of rural machinery divided by the rural population, the unit is kilowatt-hour/person.

Effective irrigation rate: Irrigation conditions are also very important to agricultural management. This article introduces the effective irrigation rate to describe the agricultural irrigation situation. The calculation method is the irrigated area of the province (city, district) divided by the total sown area of the province (city, district). That is, the proportion of effective irrigated area to total sown area.

Number of labor participants: This article uses the number of employees in the primary industry of each (city, district) to characterize the number of labor participants. In order to avoid the heteroscedasticity problem caused by excessive data fluctuations, it is logarithmically processed.

Rural electricity consumption per capita: This article draws on the practice of Chen Yan and others, and uses rural per capita electricity consumption as a control variable for empirical analysis. The calculation method is the rural electricity consumption of the province (city, district) divided by the rural population, and the unit is kilowatt-hour/person.

Agricultural product producer price index: This indicator reflects the trend and amplitude of changes in the price level of agricultural products sold by agricultural product producers within a certain period. Using it as a control variable can eliminate factors that cause fluctuations in farmers' income levels due to market price fluctuations.

Table 2: Variable definition

Variable type	**variable name**	**variable identifier**	**Measurement method**
Explained variable	Rural per capita operating disposable income	LlIncome	Operating income in the disposable income of rural residents is deflated using CPI data from 2000 to 2022, excluding the inflation factor (yuan), and taken as a logarithm
core explanatory variables	Implementation of policy agricultural insurance	Policy	Dummy variable, measuring whether policy-based agricultural insurance has been implemented; in the years when a province or city did not carry out policy-based agricultural insurance pilots, Policy=0, in the years when the province or city carried out policy-based agricultural insurance pilots and subsequent years, Policy=1
control variables	Natural disaster damage rate	DisasterRate	Area affected by natural disasters in each province and city/total sown area in each province and city (%)
	Rural mechanical power per capita	Mechanical Power	Total power of rural machinery in each province and city/rural population in each province and city (kWh/person)
	effective irrigation rate	IrrigationRate	Total irrigated area of each province and city/total sown area of each province and city (%)
	Employment in primary industry	LnEmployment	Number of people employed in the primary industry in each province and city (10,000 people), logarithm
	Rural electricity consumption per capita	LnPowerConsumption	Total rural electricity in each province and city/rural population in each province and city (kWh/person), take the logarithm
	Agricultural Producer Price Index	PriceIndex	Producer price index of agricultural products in various provinces and cities

4.2.4 Statistical analysis

After this article completed the selection of variables and data collection and processing, in order to facilitate the observation of the overall situation of the data, descriptive statistics were performed. The descriptive statistics results are as Table 3.

Table 3: Descriptive statistics of variables

variable name	Number of observations	mean	standard deviation	minimum value	maximum value
LlIncome	713	7.743	0.501	6.168	10.58
Policy	713	0.557	0.497	0	1
DisasterRate	713	0.215	0.161	0	0.936
Mechanical Power	713	1.845	11.48	0.039	306.4
IrrigationRate	713	0.433	0.196	0.139	1.234
LnEmployment	713	6.326	1.144	3.045	8.179
LnPowerConsumption	713	6.289	1.281	2.730	11.28
PriceIndex	600	1.057	0.0730	0.864	1.369

Correlation analysis is used to analyze the degree of linear correlation between two variables. Before performing regression analysis, Pearson correlation analysis on different variables can better judge the degree of linear correlation between different variables, thereby determining whether there is multiple Collinearity (Table 4).

Table 4: Correlation coefficient table

	Ln Income	Policy	Disaster Rate	Mechanical Power	Irrigation Rate	LnEmploy ment	LqCy Consumption	Price Index
LlIncome	1							
Policy	0.662***	1						
DisasterRate	0.334***	0.456***	1					
MechanicalPower	0.132***	0.076**	-0.033	1				
IrrigationRate	0.120***	0.122***	0.238***	0.027	1			
LnEmployment	0.083**	-0.062*	0.118***	-0.011	0.555***	1		
LnPowerConsumption	0.281***	0.409***	0.387***	0.165***	0.288***	-0.196***	1	
PriceIndex	0.166***	0.287***	0.193***	-0.037	-0.045	0.080*	-0.140***	1

Note: *** means P<0.01, ** means 0.01≤P<0.05, * means 0.05≤P<0.10.

Through correlation analysis, it can be seen that operating income and policy pilot dummy variables show a significant positive correlation, which is basically consistent with our theoretical analysis. However, in subsequent regression analysis, the coefficient may also change after controlling other variables. This Further verification is required. In addition, operating income also shows a positive correlation with the disaster rate, per capita mechanical power, effective irrigation rate, primary industry employment, agricultural product production price index, etc. Next, we observe the results by conducting quantitative regression on the variables.

4.3 Model construction

4.3.1 Multi-period double difference model

Since the implementation of policy-based agricultural insurance in various provinces (municipalities and autonomous regions) did not start in the same year, the implementation of policy-based agricultural insurance was gradually completed in several batches from 2007 to 2012, and after 2012, 31 provinces (municipalities, municipalities, and autonomous regions) in Chinese mainland has fully realized the coverage of policy-oriented agricultural insurance, so there is no control group without policy-based agricultural insurance at all. We refer to the approach of scholars such as Thorsten Beck et al. [1] and set the model as follows:

$$LnIncome_{i,t} = \alpha_0 + \alpha_1 Policy_{i,t} + \sum \beta_k X_{k,i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

In the above formula, i and t represent the province (city, autonomous region) and year respectively, and k represents the serial number of different control variables, which $LnIncome_{i,t}$ is the explained variable and represents the business viability of rural residents in a certain province (city, autonomous region) in a certain year. The value of disposable income after logarithmic processing $Policy_{i,t}$ is the core explanatory variable, which represents the dummy variable of whether province i (municipality, autonomous region) implements policy-based agricultural insurance in year t, and $X_{k,i,t}$ represents the kth period of province i (municipality, autonomous region) in year t. The specific value of each control variable is mainly used to control the impact of other variables on the explained variable. The control variables used in this article mainly include: natural disaster disaster rate, rural per capita mechanical power, effective irrigation rate, primary industry employment number, rural per capita Electricity consumption, agricultural product producer price index, etc. μ_i represents the individual effect, λ_t represents the time effect, and $\varepsilon_{i,t}$ represents the random disturbance term. α_1 Represents the estimated coefficient of the core explanatory variable. If it α_1 is significantly positive, it means that the implementation of policy-based agricultural insurance can significantly increase farmers' operational disposable income, that is, it improves farmers' welfare. If it is α_1 significantly negative, it means that the implementation of policy-based agricultural insurance has a significant impact. It reduces farmers' operational disposable income, that is, reduces farmers' welfare.

4.3.2 Parallel trend test model

The premise of the double difference model is that the explained variables of the experimental group and the control group have the same development trend before the policy impact, that is, there is no significant difference. Only when this premise is met, the experimental group after the impact of exogenous events is studied Only the difference between the experimental group and the control group is meaningful. Only when parallel trends are met can the difference between the experimental group and the control group after the impact of the event be regarded as the impact of the policy.

Referring to the approach of scholars such as Thorsten Beck, we set up the following parallel trend test model:

$$LnIncome_{i,t} = \alpha_0 + \beta_1 D_{i,t}^{-7} + \beta_2 D_{i,t}^{-6} + \cdots + \beta_{19} D_{i,t}^{11} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

$D_{i,t}^{k}$ is a dummy variable representing the year after the policy was implemented, k represents the year $D_{i,t}^{-7}$ after the policy was implemented, and k represents the dummy variable representing the 7th year before the policy was implemented. If the year in i province (city, autonomous region) is the 7th year before the policy was implemented, then $D_{i,t}^{-7} = 1$, otherwise $D_{i,t}^{-7} = 0$. To avoid multicollinearity, we set a total of 19 dummy variables based on the 8th year before the policy was implemented. μ_i represents the individual effect, λ_t represents the time effect, and $\varepsilon_{i,t}$ is a random disturbance term.

5. Outcome of Practice

5.1 Basic regression

From Table 5, without adding control variables, the regression results after controlling individual effects and time effects respectively, while controlling different factors, the implementation of policy agricultural insurance has a significant impact on rural operational disposable income. After fixing time and individual effects, the adjusted R2 is 0.849, so we use a two-factor fixed model for analysis. From the results, we can see that the impact coefficient of the implementation of policy agricultural insurance on farmers' operational disposable income is 0.1 , the significance level is 5%, that is to say, without considering other factors, the implementation of policy-based agricultural insurance will cause farmers' operational disposable income to increase by 10% on average, which means that the implementation of policy-based agricultural insurance will have an impact on The improvement of farmers' welfare has a promoting effect. Next, we further enter into the control variables for research.

Table 5: Regression results without control variables

variable	LnIncmone	LnIncmone	LnIncmone	LnIncmone
Policy	0.667***	0.620***	0.454***	0.100**
	(-23.52)	(-14.36)	(-11.6)	(-2.49)
Constant	7.371***	7.398***	7.490***	7.687***
	(-348.21)	(-307.82)	(-344.02)	(-326)
Observations	713	713	713	713
Number of Province	-	31	-	31
Number of year	-	-	twenty three	twenty three
R-squared	0.438	0.589	0.064	0.849
individual fixed	NO	YES	NO	YES
fixed time	NO	NO	YES	YES

Note: Standard errors are reported in parentheses, *** means P<0.01, ** means 0.01≤P<0.05, * means 0.05≤P<0.10.

Table 6: Regression results after controlling variables

variable	LlIncome	LlIncome	LlIncome	LlIncome
Policy	0.593***	0.259***	0.333***	0.074*
	(-6.92)	(-4.56)	(-12.29)	(-1.82)
DisasterRate	-0.12	-0.325**	0.216*	-0.079
	(-0.52)	(-2.74)	(-1.83)	(-0.93)
Mechanical Power	0.004***	-0.001	0.003***	0.000
	(-2.77)	(-0.75)	(-3.72)	(-0.26)
IrrigationRate	0.438	0.004	0.536***	-0.343**
	(-1.58)	(-0.01)	(-7.24)	(-2.41)
LnEmployment	0.101	-0.322***	0.130***	0.206***
	(-1.54)	(-3.97)	(-10.93)	(-3.16)
LnPowerConsumption	-0.017	0.152**	-0.035*	0.035*
	(-0.32)	(-2.06)	(-2.03)	(-1.67)
PriceIndex	-0.027	-0.17	-0.278	-0.299
	(-0.19)	(-1.38)	(-0.80)	(-1.51)
Constant	6.755***	8.927***	7.012***	6.723***
	(-16.94)	(-11.1)	(-16.54)	(-14.43)
Observations	600	600	600	600
R-squared	0.415	0.628	0.194	0.844
individual fixed	NO	YES	NO	YES
fixed time	NO	NO	YES	YES

Note: Standard errors are reported in parentheses, *** means P<0.01, ** means 0.01≤P<0.05, * means 0.05≤P<0.10.

From Table 6, after adding control variables and controlling for individual and time effects, the coefficient of policy implementation is still positive, with a value of 0.074, and is significant at the 10% level. In a practical economic sense, the implementation of policy-based agricultural insurance has increased rural operational disposable income by an average of 7.4%. In other words, the implementation of policy-based agricultural insurance has improved farmers' welfare. In addition, the effective irrigation rate, number of employees in the primary industry, and rural per capita electricity consumption also have a significant impact on farmers' operational disposable income.

5.2 Robustness test

5.2.1 Parallel trend test

As shown in the figure, the horizontal axis coordinate represents the number of years before and after the implementation of the policy, and the black dotted line at position 0 represents the current period. It can be seen that in the first 7 years of the implementation of policy-based agricultural insurance, the confidence intervals all passed through 0 points, that is to say, the experimental group and the control group The groups have the same development trend, and the data satisfies the parallel trend test.

5.2.2 Replace the explained variable

In order to further verify the robustness of the regression results, we replace the explained variables for regression, and use rural per capita disposable income after deflation of CPI data to replace rural operating income for regression. The results are as follows, after controlling for individual and time effects. , the explanatory power of the model reaches the highest level, and the adjusted R2 is 0.993. At the same time, the coefficient of the policy-based agricultural insurance implementation dummy variable is significant at the 10% level, and the direction is positive (Table 7). The conclusion of the basic regression still holds, that is, the policy-based agricultural insurance implementation dummy variable Implementation will help increase farmers' income, which means that policy-based agricultural insurance can promote farmers' welfare.

Table 7: Regression results after replacing the explained variables

variable	LnIncome2	LnIncome2	LnIncome2	LnIncome2
Policy	0.566***	0.432***	0.082**	0.012*
	(-20.06)	(-11.14)	(-2.23)	(-1.14)
DisasterRate	-0.729***	-0.423***	-0.327***	-0.047**
	(-4.80)	(-3.79)	(-4.72)	(-2.12)
Mechanical Power	-0.002***	-0.002*	-0.003***	-0.000**
	(-4.70)	(-2.00)	(-14.55)	(-2.06)
IrrigationRate	0.06	0.42	0.178***	-0.129***
	(-0.28)	(-1.69)	(-5.69)	(-3.42)
LnEmployment	-0.101***	-0.638***	-0.062***	0.073***
	(-3.87)	(-5.84)	(-10.97)	(-4.2)
LnPowerConsumption	0.231***	0.215***	0.209***	0.037***
	(-9.28)	(-3.09)	(-21.09)	(-6.59)
PriceIndex	-0.142	-0.223***	-0.292	-0.108**
	(-1.42)	(-3.01)	(-1.16)	(-2.06)
Constant	7.747***	11.174***	7.983***	8.180***
	(-24.91)	(-10.78)	(-27.88)	(-66.2)
Observations	600	600	600	600
R-squared	0.840	0.888	0.715	0.993
individual fixed	NO	YES	NO	YES
fixed time	NO	NO	YES	YES

5.2.3 Placebo test

In order to detect whether the impact of the implementation of policy-based agricultural insurance on farmers' welfare is due to some random factors, this article refers to the practices of Cantoni and Chen Yan to conduct a placebo test. First, from all samples 31 samples were randomly selected as the experimental group, a virtual policy-based agricultural insurance premium subsidy policy implementation variable was constructed, and the basic regression model was re-regressed. This article cycles the above stochastic regression process 500 times, obtains 500 estimated coefficients of virtual policy variables, and draws a probability density distribution diagram, as shown in the figure 1. The density distribution function of the estimated coefficients of virtual policy variables overall presents a normal distribution centered on 0. The estimated coefficients of real policy variables are obviously different from most of the estimated coefficients of virtual policy variables. Almost no blue points fall on the estimated coefficients of real policy variables. Right. This shows that the placebo test is passed and the farmer welfare effect of policy-based agricultural insurance policies is not caused by other unobservable factors.

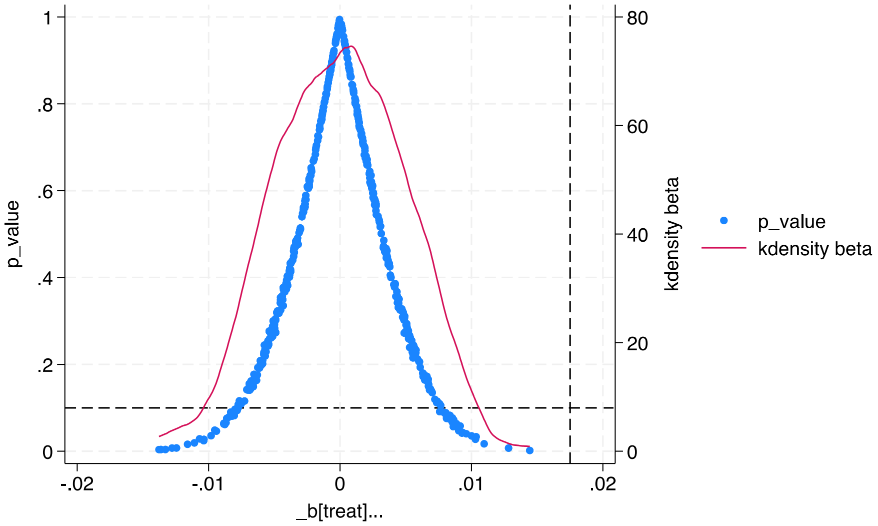

Figure 1: The blue points fall on the estimated coefficients of real policy variables

6. Conclusion

As an important measure to support agriculture and benefit farmers, policy-oriented agricultural insurance has a complex mechanism among three parties including farmers, government, and insurance companies during its implementation. It has had a certain impact on the welfare of the three parties involved. We focus on a large group of farmers, and study the impact of the implementation of policy-based agricultural insurance on their welfare.

Regarding the impact of policy-oriented agricultural insurance on farmers' welfare, this paper adopts a multi-period difference-in-difference model, takes the per capita operational disposable income of rural residents as the main indicator to measure farmers' welfare and constructs the policy implementation dummy variable as the core explanatory variable. At the same time, we add a variety of control variables such as the natural disaster disaster rate, rural per capita mechanical power, effective irrigation rate, primary industry employment, rural per capita electricity consumption, and agricultural product producer price index.Finally, it was found that the implementation of policy-oriented agricultural insurance will increase the per capita operating disposable income of rural residents at a significant level. The implementation of policy agricultural insurance can increase the operating disposable income of rural residents by an average of 7.4%. The implementation of policy agricultural insurance can improve farmers' welfare.

Through the previous research, it can be found that for farmers, the implementation of policy agricultural insurance can help farmers cope with natural disasters, market fluctuations and other risks, improve the stability and sustainability of agricultural production, and help improve farmers' welfare. This enlightens the government that in the process of promoting policy-based agricultural insurance, it can pay attention to subsidizing policy-based agricultural insurance within a reasonable range, increase the participation rate of policy-based agricultural insurance, spread risks, and transfer risks in agricultural production, so that the supply and demand of agricultural insurance are well matched, thereby enhancing the overall welfare of society.

At the same time, we need to pay attention to the problem of excessive government intervention in the implementation of policy agricultural insurance, and use laws and regulations to regulate the government's behavior in the implementation of policy agricultural insurance to prevent the occurrence of incidents such as intervention in claims settlement.

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References

[1] Beck T, Levine R, Levkov A. Big bad banks? The winners and losers from bank deregulation in the United States[J]. The journal of finance, 2010, 65(5): 1637-1667.

[2] Fu Lisha, Wang Sangui, Qin Tao. The income-increasing effect and mechanism of agricultural insurance [J]. China Population ·Resources and Environment, 2022, 32(12): 153-165.

[3] Huang Yalin. Research on the coordination of interests of various subjects in policy-based agricultural insurance [D]. Hunan Agricultural University, 2013

[4] Li Qinying, Cui Yi, Chen Lipeng. The impact of policy-based agricultural insurance on the income of rural residents - an empirical analysis based on provincial panel data from 2006 to 2015 [J]. Journal of Zhengzhou University (Philosophy and Social Sciences Edition), 2018, 51(5): 72-78.

[5] Li Yinan. Research on the interest relationship of agricultural insurance in China[D]. Shandong University, 2012

[6] Long Heng. Research on the poverty alleviation effect and income distribution effect of policy agricultural insurance subsidies [D]. Southwestern University of Finance and Economics, 2022

[7] Sun Xiangyu, Zhong Funing. Welfare economics analysis of agricultural insurance subsidies[J]. Agricultural Economic Issues, 2008, No. 338(2): 4-11,110.

[8] Zhu Zhongkun. Policy-based agricultural insurance: welfare effect and supply efficiency[D]. Huazhong Agricultural University, 2015