



Empirical Study on the Interaction Between Agricultural Insurance Development and Agricultural Economic Growth

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Abstract. Agricultural insurance is a crucial component of agricultural risk management, and the study of agricultural insurance development can help farmers to some extent lower their production risk. The relationship between agricultural insurance and agricultural economy is analyzed empirically by using unit root test, co-integration test and Granger causality test. The results indicate that there is indeed a long-term relationship between agricultural insurance and agricultural economy, and the rising premium income from agricultural insurance can promote the development of agricultural economy, but that increased agricultural insurance coverage is not a direct outcome of increased agricultural economy. Based on the strategy of rural revitalization, relevant departments must accelerate the legislation of agricultural insurance, strengthen the mechanism of subsidies for agricultural insurance, expand the publicity of agricultural insurance, and promote agricultural insurance into the path of high-quality development, with the goal of promote the development of agricultural economy.

Keywords: agricultural insurance · cointegration analysis · agricultural economy

1 Introduction

The mainstay of the Chinese economy is agriculture. But due to the vast territory and complex terrain of our country, natural disasters such as drought and flood occur frequently, which has a great negative impact on agricultural production and farmers' life. According to the National Bureau of Statistics, 11,739 thousand hectares of crops were affected in 2021 because of complex disasters and frequent extreme weather and climate events. As a traditional means of agricultural risk management, agricultural insurance has taken a considerable part of the responsibility in reducing the impact of natural disasters on agricultural productivity and safeguarding farmers' income. It can significantly disperse agricultural risks and ensure that insured farmers can obtain insurance compensation in time when they suffer risks within the scope of insurance liability, so as to reduce farmers' losses to the greatest extent and enable them to resume life and production as soon as possible.

Unlike to conventional commercial insurance, agricultural insurance has the traits of significant social benefit and low rate of return. The high loss rate and business operating expenses make the agricultural insurance products of many commercial insurance companies always in a loss situation, which is difficult to continue operation. The report to the 20th National Congress of the Communist Party of China pointed out that we should comprehensively promote rural revitalization, adhere to the priority of agricultural and rural development, consolidate and expand the achievements of poverty alleviation, and accelerate the construction of an agricultural power. In hope of improving the agricultural guarantee system and accelerating the growth of agricultural insurance at a high level, the Ministry of Finance jointly issued the Guiding Opinions on Accelerating the High-quality Development of Agricultural Insurance with the Ministry of Agriculture and Rural Affairs, China Banking and Insurance Regulatory Commission and the Forestry and Grass Administration. A key factor in advancing the rural rehabilitation strategy is the creation of agricultural insurance. Therefore, we raise the question whether the expansion of crop insurance can encourage the expansion of agricultural economy and whether the development of agricultural economy can stimulate the wider coverage of crop insurance. The relationship between agricultural insurance and the agricultural economy will be examined in this research using the national agricultural insurance and agricultural economic development indicators and other statistical data.

Foreign scholars have studied agricultural insurance and its related contents both theoretically and empirically. Using multivariate and multinomial Probit model statistical methods, Velandia (2004) [1] analyzed the supporting role of agricultural insurance in agricultural development, poverty reduction and production recovery. Hazell, Hess (2010) [2] argue that agricultural index insurance can make a significant, market-based role in speeding up long-term safety nets and fostering agricultural development. Birthal (2022) [3] indicated that agricultural insurance can reduce farmers' exposure to downside risks under certain conditions and stabilize expected agricultural income.

Domestic scholars analyzed how agriculture insurance and agricultural economic development are related with the actual situation of China, and exhibited two different viewpoints. One is that there is no discernible link between agricultural insurance and the expansion of the agricultural economy. Bi Qian (2004) [4] theoretically believed that the development level of agricultural economy could affect the supply and demand of crop insurance, but the empirical findings showed that there was almost no correlation between the rate of increase of agricultural GDP and the rate of rise of farm insurance premiums. Li Chen (2012) [5] selected agricultural insurance premium income and agricultural GDP data from 1985 to 2010 for ordinary least squares method (OLS) parameter estimation, and concluded that agricultural insurance was closely related to agricultural economic development, but there was no direct causal connection between the growth of crop insurance premium income and agricultural GDP growth. The other view is that agricultural insurance can significantly promote agricultural economic growth. Huang Yingjun and Pu Yuecheng (2015) [6] concluded from theoretical analysis that agriculture's economy was boosted by crop insurance through changing farmers' budget constraints and post-disaster disposable income, and empirical research showed that the establishment of agricultural insurance had a positive promoting influence on agricultural economic growth over the long and short terms. Cheng Jing, Hu Yaquan and Li

Chunsheng (2016) [7] concluded that crop insurance have an extremely significant contribution on agricultural economic growth in all four provinces of Hubei, Hunan, Jiangxi and Anhui. Shao Quanquan and Guo Mengying (2020) [8] found that the growth of the agricultural economy may be aided by an increase in compensation for crop insurance.

Overall, the above literature shows that there is still a large disagreement among academics about the correlation between crop insurance and agricultural economic development. Considering that in recent years national policies have tilted toward agriculture and rural areas, increased support for crop insurance, and helped to agricultural insurance's coverage expansion. This paper will use the time series data of national agricultural insurance premium income and value added of agriculture, forestry, animal husbandry and fishery from 2000 to 2020 to empirically analyze the relationship between agricultural insurance and agricultural economy, which will provide some insights to further understand the interaction between agriculture insurance and economic growth.

2 Analysis of Partial Statistical Data of Chinese Agriculture Industry

2.1 Comparative Analysis of Agricultural Economy and Crop Insurance

Agricultural insurance experiments were involved in the early stage of the founding of the PRC, but they were discontinued for a time due to confusion in business and farmers' lack of insurance habits. It was not until 2003 when the central government proposed to establish "policy-based agricultural insurance" that a new round of agricultural insurance pilots were promoted, leading to the gradual growth of agricultural insurance. In 2007, the Ministry of Finance arranged a special fund of 1 billion yuan to provide agricultural insurance subsidies for 5 major types of grain crops in 6 provinces and autonomous regions, providing guarantee for China's agricultural output. It can be seen from Fig. 1 that 2007 was a turning point in the development of agricultural insurance premium income which jumped from 848 million yuan in 2006 to 5.333 billion yuan in 2007, an increase of 528.89% over the previous year. Since then, agricultural insurance premium income has achieved breakthrough and rapid growth. Meanwhile, we can see from Fig. 1 that the similar trend in changes to agricultural insurance premium income and the value of all agricultural, forestry, animal husbandry, and fishing output from 2000 to 2020, which have positive correlation and both have high development rate. But after the implementation of special subsidies, the development rate of revenue from agriculture insurance premiums is significantly greater than the development pace of total output value of agriculture, forestry, animal husbandry and fishery.

2.2 Comparative Analysis of Affected and Disaster-Forming Situations

One of the nations in the world with the worst natural disasters is China. In the 5,000-year history of farming culture, agricultural production has been attacked by various natural disasters, and its long history of natural disasters, the wide area of disasters, the number of types of disasters and the severity of disasters are rare in the world [9]. Although there are small fluctuations in the level of disaster in the last 20 years, it is in the trend of

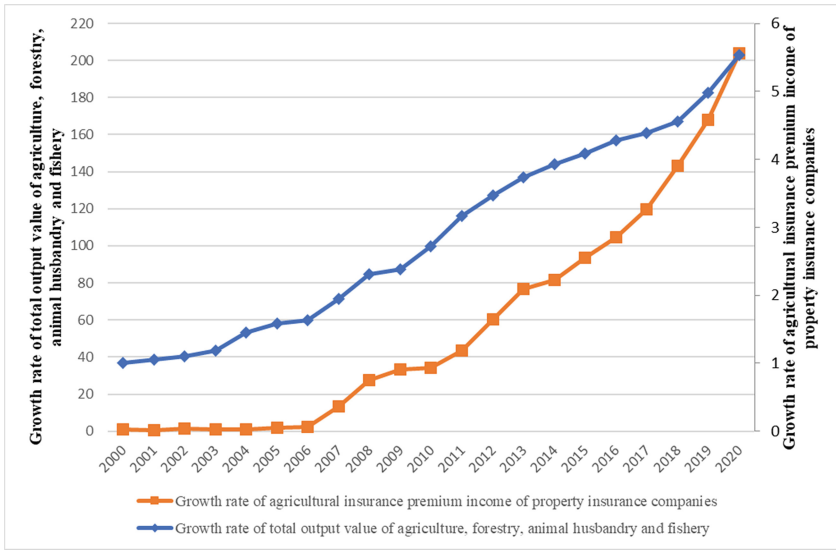


Fig. 1. The development trend of agricultural insurance premium income and the value of all agricultural, forestry, animal husbandry, and fishing output from 2000 to 2020 (Growth rate refers to the proportion of the value of a certain year to the value of the base period in 2000, the data comes from the National Bureau of Statistics)

overall reduction. It is assumed that the affected area refers to the reduction in the sown area of crops compared with the normal year, and the disaster area refers to the sown area caused by drought and flood disasters accounting for more than 30% (including 30%) of the crop output in the normal year. The average percentage of affected area in these two decades is 21.02%. It can be seen from Fig. 2 that, taking 2011 as the boundary, the proportion of affected area in 2000–2010 is bigger than the past 20-year average, and the proportion of disaster-affected area in 2011–2020 is lower than that in the past 20 years Average. This is because the central government promulgated the Disaster Reduction Plan of the People’s Republic of China (1998–2010) in 1998. With the continuous progress of agricultural disaster monitoring and extreme weather warning system, the capacity to prevent and reduce agricultural disasters has been consistently improved. Secondly, according to relevant research, the percentage of the disaster area to the affected area can reflect disaster resilience to a certain extent [10]. The proportion of the disaster area to the affected area in the past 20 years is 49.28% on the average. Despite the continuous promotion of Agri-related disaster mitigation and prevention, once the disaster occurs, agricultural output in half of the affected areas has dropped by 30% or more. This phenomenon indicates that China’s agriculture is deeply affected by natural disasters.

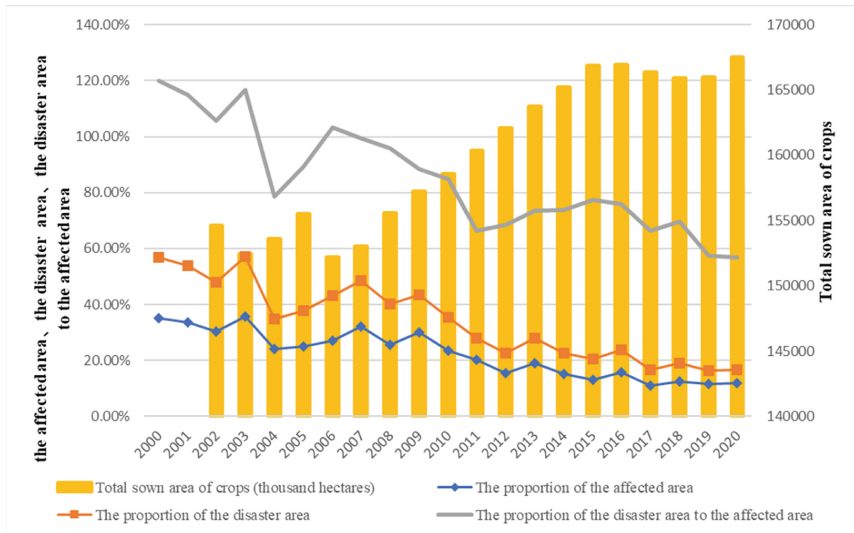


Fig. 2. Statistical data of agricultural affected area and disaster area from 2000 to 2020 (Data from the National Bureau of Statistics)

3 Empirical Analysis

3.1 Data Processing

The added value of agriculture, forestry, animal husbandry, and fishing (GDP) is used in this article to represent the growth of agricultural economy as the explained variable. Revenue from agriculture insurance premiums (INCOME) represents the development of agricultural insurance as an explanatory variable. However, since the agricultural economy is a pillar industry of the national economy and has been subsidized by the state finance for a long time, the state finance for agricultural expenditure (SFAE) was added as a control variable. The Table 1 includes the specific information:

The annual data from 2000–2020 were selected to establish a time series model for the empirical examination of the correlation between agricultural insurance and agricultural economic development. The data were deflated by CPI coefficient and GDP coefficient. All variables were logarithmic in order to exclude the impact of heteroscedasticity on the analysis findings during the model construction process. The model was then subjected to unit root test, cointegration test and Granger causality test using Eviews8.0.

3.2 Unit Root Test

Since most of the economic time series are not stationary, ADF unit root test is performed on the above time series data. The null hypothesis is that the sequence has a unit root, and the test's outcomes are as follows:

It can be seen from the data in Table 2 that according to all three variables the original sequence is not stable, hence the null hypothesis cannot be rejected. After the first-order difference processing, under the significance of 5%, the ADF statistics

Table 1. Statistical data of the added value of agriculture, forestry, animal husbandry and fishery, agricultural insurance premium income and the state finance for agricultural expenditure from 2000 to 2020 (Data from the China Statistical Yearbook and the China Agricultural Statistical Yearbook.)

Time \ Indicator	The Added Value of Agriculture, Forestry, Animal husbandry and Fishery (billion yuan)	Agricultural Insurance Premium Income (billion yuan)	the State Finance for Agricultural Expenditure (billion yuan)
2000	14943.6	4	1231.5
2001	15780	3	1456.7
2002	16535.7	5	1580.8
2003	17380.6	4.64	1754.5
2004	21410.7	4	2337.6
2005	22416.2	7	2450.3
2006	24036.4	8.48	3173.0
2007	28483.7	53.33	4318.3
2008	33428.1	110.68	4544
2009	34659.7	133.9	6720.4
2010	39619	135.9	8129.6
2011	46122.6	174.03	9937.6
2012	50581.2	240.6	11974
2013	54692.4	306.59	13350
2014	57472.2	325.78	14174
2015	59852.6	374.9	17380
2016	62451	417.71	18587
2017	64660	478.9	19089
2018	67558.7	572.74	21086
2019	73576.9	672.48	22863
2020	81396.5	814.93	23948

of $\ln\text{GDP}$, $\ln\text{INCOME}$, and $\ln\text{FEA}$ are all below the critical value, rejecting the null hypothesis. Therefore, the three variables are all first-order integrated $I(1)$ time series, which can be tested for cointegration.

3.3 Cointegration Test

This paper will develop a VAR model to investigate whether there is a cointegration relationship between the explanatory variables and the explanatory variables through Johansen co-integration test. The optimal lag interval was chosen to be 3 by combining

Table 2. ADF unit root test results

Variable	Inspection Type (c,t,k)	ADF statistics	Critical Value (5%)	Conclusion
lnGDP	(c, 0, 0)	4.011209	-1.607456	nonstationary
Δ lnGDP	(c, 1, 1)	-4.065876	-3.690814	Stationary
lnINCOME	(c, 0, 0)	-0.826086	-2.650413	nonstationary
Δ lnINCOME	(c, 1, 0)	-3.892467	-3.673616	Stationary
lnFEA	(c, 1, 2)	0.573812	-3.690814	nonstationary
Δ lnFEA	(c, 1, 7)	-4.241357	-3.875302	Stationary

Table 3. Criteria for selecting lag intervals for VAR models

Lag	LogL	LR	FPE	AIC	SC	HQ
1	40.85765	NA	5.88e-06	-3.539739	-3.094553	-3.478354
2	57.36816	22.01401*	2.74e-06	-4.374240	-3.483868	-4.251469
3	70.80400	13.43584	2.08e-06*	-4.867111*	-3.531553*	-4.682955*

Table 4. Johansen co-integration test results

Number of Zero hypothesis Covariance Equations	Eigenvalue	Trace Statistics	5% Significance Lower Critical Value	p-value
None *	0.714679	39.53247	29.79707	0.0028
At most 1 *	0.475406	16.95793	15.49471	0.0299
At most 2 *	0.256939	5.345594	3.841466	0.0208

the information criteria of LR, FPE, AIC, SC, and HQ, and then the lag interval in Johansen co-integration test was 2 (Table 3).

The table 4 displays the cointegration test results, indicating the existence of three long-run cointegration relationships among the three variables.

3.4 Granger Causality Test

The cointegration test findings demonstrate that the model has a long-term correlation relationship. The specific causality test of the added value of agriculture, forestry, animal husbandry and fishery, agricultural insurance premium income and the state finance for agricultural expenditure is shown in the Table 5:

The outcomes in Table 5 reveal that LNINCOME is the Granger cause of LNGDP with a lag of 4, but LNGDP is not the Granger cause of LNINCOME, and the two show a one-way causality. It shows that in the long run, agriculture insurance's expansion can

Table 5. Results of the Granger causality test

	Lag	1	2	3	4
LNINCOME is not a Granger cause for LNGDP	F-statistic	1.81494	1.04831	0.82792	4.58091
	P-value	0.1956	0.3765	0.5057	0.0323
LNGDP is not LNINCOME for Granger reasons	F-statistic	1.74551	1.05503	2.43891	2.23929
	P-value	0.2039	0.3743	0.1194	0.1542

promote the growth of the agricultural economy, whereas it is not clear how agricultural economic development contributes to the growth of agricultural insurance.

4 Conclusions

4.1 Empirical Conclusions

In this study, the empirical analysis of ADF smoothness test, co-integration test and Granger causality test was conducted on the data of value added of agriculture, forestry, animal husbandry and fishery, revenue from agricultural insurance premium of property insurance companies and state financial expenditure on agriculture from 2000 to 2020, and the following two conclusions were drawn.

Firstly, the empirical results of Johansen test demonstrate that income from agriculture insurance has a long-term, positive association with the agricultural economy, and each unit increase of agricultural insurance premium income will pull up the value added of agriculture, forestry, animal husbandry and fishery by 1.108619 units. This is because agricultural insurance can play the role of risk management for agricultural economy, which can efficiently cut down agricultural losses and disperse the consequences of various disasters on agricultural economy.

Secondly, according to the Granger causality test, in the long run, the increase of agricultural insurance income can encourage the growth of agricultural economy, but the development of agricultural economy has no obvious boosting effect on agricultural insurance. This is because the growth of agricultural insurance in China is still at a preliminary stage for the time being, and there are problems such as unsound agricultural insurance provisions and low participation rate of farmers. Vigorously promoting agricultural insurance can guarantee the safety of agricultural production, minimize how calamities affect agriculture activities, and contribute to the high-quality rise of the agricultural economy. Studies have shown that the availability and demand for agricultural insurance are influenced by the state of the agricultural economy.. Only when the agricultural economy has reached a certain level of development and farmers are able to produce on a large scale and pay for agricultural insurance premiums, will they consider the risks involved in agricultural production and increase the amount of insurance coverage.

4.2 Suggestions for the Sustainable Expansion of Agricultural Insurance in China

Expedite the Legislation of Agricultural Insurance

Although China enacted the Agricultural Insurance Regulations in 2012, it initially regulated agricultural insurance activities and made the operation of agricultural insurance more legal. However, agricultural insurance is different from other commercial insurance, and the content provisions should be formulated separately according to the characteristics of agricultural insurance in the legislation. The regulations are broadly expressed, without specific refinement of agricultural insurance supervision, subsidies, taxation and other issues, and some of the regulations are delegated to other laws to undertake, resulting in more general provisions of the Agricultural Insurance Regulations, which lack feasibility in practice. Therefore, the corresponding legislature in China should learn from the experience of developed countries such as the United States and Japan in enacting agricultural insurance laws, and put agricultural insurance legislation on the agenda as soon as possible, and introduce relevant laws and regulations in a timely manner, and continuously revise and improve them in practice according to China's agricultural conditions. The law is the foundation for the rapid development of agricultural insurance. In order to thoroughly solve the Three Rural Issues, help the agricultural insurance business and steadily improve farmers' earnings, we must speed up the process of crop insurance legislation.

Strengthen Policy Support and Differentiated Financial Subsidies

Due to the late development of China's agricultural insurance, subsidies for agricultural insurance premiums are relatively single, mainly for food crops and livestock, etc. The United States can insure 47 kinds of crops, the number of which far exceeds the number of existing agricultural insurance coverage in China. Meanwhile, the United States has a comprehensive agricultural insurance system with differentiated financial subsidy measures based on different types of insurance, insurance units and coverage levels. The Measures for the Administration of Agricultural Insurance Premium Subsidies by the Central Government, which was revised in 2022, put forward the principles of agricultural insurance premium subsidies for the first time, clearly stipulating that the central, provincial and local governments are "hierarchically responsible" for the subsidies, which provided a more complete explanation of the premium subsidy system in each region, but the differential subsidies for each insurance type were not clear. Higher premium subsidies should be provided for agricultural products with high production risks and high insurance payout rates based on crop characteristics. Considering China's limited financial subsidy capacity and the inability to provide uniform premium subsidies for all agricultural insurance types, a higher premium subsidy rate should be provided for essential crops such as food crops to spread the risk of catastrophes and ensure China's food security.

Expand Publicity to Increase the Likelihood that Farmers will Get Insurance

China is a large agricultural nation with a sizable farming population, and agricultural insurance has a broad market prospect. However, most of the farmers in China are middle-aged and elderly, with low education level and shallow understanding of agricultural

insurance: they are not clear about the operation mechanism of crop insurance, have misunderstanding about the payment of agricultural insurance premiums, and do not understand that agricultural insurance can reduce the loss of agricultural production and operation due to disasters to a certain extent. Therefore, these cognitive biases lead to the low insurance rate of farmers. Rural grassroots personnel should work with insurance company staff to visit the field, record the farmers' current circumstances and help them choose the right type of insurance. In the meantime, agricultural insurance lectures should be held regularly to improve farmers' understanding of agricultural insurance by popularizing relevant insurance terms and explaining the compensation mechanism, thereby increasing farmers' enthusiasm for insurance.

4.3 Summary

All in all, there is still much work to be done before agriculture insurance is fully developed to reach a perfect agricultural protection system in China. To Accelerate agricultural insurance legislation, strengthen agricultural insurance policy support mechanism and expand publicity can all enable agricultural insurance to embark on a high-quality development path. Solving the problem of agricultural insurance is the driving force for the advancement of the agricultural economy, which will support rural revitalization broadly and build a strong agricultural country.

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