Research on Interactive Relationship between Agricultural Insurance and Rural Financial Development in Central and Western Regions

GAO Chun-ling *

South-Central University for Nationalities, Wuhan 430074, China

Abstract By selecting the panel data from 2001 to 2008 in central and western regions, I adopt the methods of covariance analysis test, Hausman test, panel unit root test and co-integration test to conduct empirical research on the interactive relationship between agricultural insurance and rural financial development in central and western regions. The results show that there is a long-term balanced and interactive causal relationship between agricultural insurance and rural financial development in central and western regions. The agricultural insurance in western regions is the cause of rural financial development, while such relationship in central regions is not tenable. There is an interactive promotion relationship between agricultural insurance and rural financial development efficiency in central regions, while the relationship between agricultural insurance and rural financial development efficiency in western regions is mutually inhibitive, but the rural financial efficiency in western regions promotes the development of agricultural insurance. Then corresponding suggestions are put forward in order to give full play to the role of mutual promotion between agricultural insurance and rural financial development as follows: reinforce the support degree for policy finance in central and western regions; increase the inputs of rural financial institutions in serving agriculture, countryside and farmers; expand the types and coverage of policy agricultural insurance.
Key words Agricultural insurance, Rural finance, Co-integration test, China

Since Ministry of Finance allotted 1 billion yuan to subsidize the premium of policy agricultural insurance at selected points in Jilin Province, Inner Mongolia, Xinjiang Uygur Autonomous Region, Jiangsu Province, Sichuan Province, and Hunan Province in the year 2007, the agricultural insurance in central and western regions of China has made remarkable progress. The premium income of agriculture in 2007 was 5.33 billion yuan, 6.3 times that of the previous year. In 2008, the premium income began to break through 10 billion yuan, and the sum of payment of agricultural insurance also increases year by year. In addition, due to the rapid development of rural finance and formation of multi-layered rural financial system, the financial aggregate is growing incessantly, and financial services cover most of the rural areas. The research shows that there is a close relationship between agricultural insurance and rural finance; the agricultural insurance and rural finance play the role of promoting rural economic development. I use panel data model to conduct empirical research on the relationship between agricultural insurance and rural finance, which can provide theoretical reference for how to give full play to the role of agricultural insurance and rural finance in developing rural economy in central and western regions of China from mathematical perspective.

1 Data source, index selection and research method

1.1 Data source The data are from *China Financial Yearbook*, *China Statistical Yearbook*, *China Insurance Yearbook*, and *China Agriculture Yearbook* from 2001 to 2008; Macro China Database; National Bureau of Statistics and the web site of the bureau of statistics in the central and western provinces and autonomous regions in China.

Amid the data of the central regions (Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan, Jilin and Heilongjiang) and the western regions (Inner Mongolia, Guangxi, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Tibet and Chongqing), inasmuch in the yearbook of Jiangxi Province, there is no loan data regarding township and village enterprises, and there is short of corresponding data regarding loan of township and village enterprises in Chongqing, and premium income of agricultural insurance in Tibet and Qinghai, therefore, in the empirical analysis, the central regions exclude Jiangxi Province, and the western regions exclude Chongqing, Tibet and Qinghai.

1.2 Index selection First, we select the measuring index of agricultural insurance. We take insurance depth (*NBFS*) as the measuring index of agricultural insurance developmental level[1].

$NBFS = NYBF/NYGDP$

In the above formula, *NYBF* is premium income of agricultural insurance, *NYGDP* is agricultural GDP.

Second, we select the measuring index of rural financial development. We take financial interrelation ratio (*GM*) as the index of measuring rural financial developmental scale in China. We substitute the summation of rural outstanding of deposits (*NCCK*) and rural loan balance(*NCDK*) for total assets of rural finance. Wherein, *NCCK* is the summation of agricultural outstanding of deposits and farmers' saving deposits; *NCDK* is the

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* Corresponding author. E-mail: 296648199@qq.com

summation of agricultural loan balance and loan balance of township enterprises. Let *NGDP* be rural GDP, the summation of agricultural GDP and added value of township enterprises. We get that:

$$GM = (NCCK + NCDK)/NGDP$$

We use credit conversion rate, namely the ratio of *NCDK* and *NCCK* as the measuring index of rural financial development efficiency in China. We get that:

$$XL = NCDK/NCCK$$

1.3 Research method By covariance analysis test and Hausman test, we are to choose appropriate model; then by panel co-integration test, we are to judge whether there is a long-term stable causality relationship between the two; finally on the basis of co-integration analysis, we get regression results, and conduct analysis on the relationship between the two.

2 Results and analysis

2.1 Selection of panel data model We establish the following model and select the specific form:

$$GM_{it} = \alpha_i + NBFS_{it}\beta_i + \varepsilon_{i,t} \quad (1)$$

$$NBFS_{it} = \alpha_i + GM_{it}\beta_i + \varepsilon_{i,t} \quad (2)$$

$$XL_{it} = \alpha_i + NBFS_{it}\beta_i + \varepsilon_{i,t} \quad (3)$$

$$NBFS_{it} = \alpha_i + XL_{it}\beta_i + \varepsilon_{i,t} \quad (4)$$

By using Eviews software, we can get *F* statistic of covariance analysis test and *W* statistic of Hausman test. *F* test shows that F_1 of four models in the central region is 4.37, 4.29, 22.24 and 17.87 respectively, and F_2 of four models in the central region is 411.5, 5.98, 1 370 and 24.77 respectively. W statistic in the central region is 21.87, 35.8, 7.63 and 49.39 respectively. F_2 of four models in the western region is 125.39, 5.37, 321.08 and 10.19 respectively, and F_1 of four models in the western region is 3.23, 5.16, 7.3 and 6.16. *W* statistic in the western region is 16.78, 29.54, 5.75 and 37.59 respectively. Obviously, these statistics are greater than the critical value at the significance level of 5%.

$$F_1 = \frac{(S_2 - S_1)/[(N-1)k]}{S_1/[N(T-k-1)]},$$

$$F_2 = \frac{(S_3 - S_1)/[(N-1)(k+1)]}{S_1/[N(T-k-1)]},$$

where S_1 is the square sum of residuals of varying coefficient model; S_2 is the square sum of residuals of varying intercept model; S_3 is the square sum of residuals of constant coefficient model under no influence of the individual; *N* is the amount of cross-section member; *k* is the amount of explanation variable in model; *T* is the total amount of observation periods of each cross-section member.

It is obvious that *F* test of the four models in the central and western regions not only rejects Hypothesis H_1, but also rejects Hypothesis H_2 ($H_1: \beta_1 = \beta_2 = \cdots = \beta_N$; $H_2: \alpha_1 = \alpha_2 = \cdots = \alpha_N, \beta_1 = \beta_2 = \cdots = \beta_N$; if it is at significance level of α, the rejection range of H_1 and H_2 is that $F_1 > F_\alpha((N-1)k, N(T-k-1))$ and $F_2 > F_\alpha((N-1)(k+1), N(T-k-1)))$, therefore, we choose varying coefficient model. In the mean time, the test results of Hausman show that it rejects the null hypothesis irrelevant with individual influence and explanation, and all choose fixed effect model.

2.2 Test of model By using the test methods of LLC, IPS and Fisher-ADF, we conduct unit root test on panel sequences *NBFS*, *GM* and *XL*. The results can be seen Table1, 2. The results show that the three variables in the central and western regions are not stationary. The test result of first-order differentiation shows that ΔGM and ΔXL in the central and western regions are stationary at the significance level of 5%. The test result of $\Delta NBFS$ and Fisher-ADF in the central region is stationary at the significance level of 5%, and the other two test results are stationary at the significance level of 15%. The test result of ΔNBFS and IPS in the western region is stationary at the significance level of 15%, and the other two test results are stationary at the significance level of 5%. Therefore, the three variables in the central and western regions are first-order integration.

Table 1 Unit root test of central regions

Variable	*LLC* value	*IPS* value	Fisher-*ADF* value
NBFS	16.24(1.000)	3.229(0.999)	3.803(0.997)
GM	−0.540(0.295)	0.320(0.626)	15.452(0.349)
XL	6.465(1.000)	4.256(1.000)	3.617(0.997)
Δ*NBFS*	0.666(0.133)	−0.579(0.116)	24.070(0.045)
Δ*GM*	−5.825(0.000)	−1.879(0.030)	28.266(0.013 4)
Δ*XL*	−9.779(0.000)	−1.571(0.042)	24.706(0.021)

Note: Value in brackets is *p*-value in Table 1-4.

Table 2 Unit root test of western regions

Variable	*LLC* value	*IPS* value	Fisher-*ADF* value
NBFS	4.722(1.000)	5.611(1.000)	9.21(0.956)
GM	−0.0128 (0.495)	−1.173(0.121)	12.46(0.823)
XL	−0.556(0.289)	0.472(0.682)	15.452(0.631)
Δ*NBFS*	−2.941(0.002)	−0.647(0.141)	29.932(0.038)
Δ*GM*	−5.511(0.000)	−2.241(0.012 5)	37.598(0.004 2)
Δ*XL*	−3.766(0.001)	−1.869(0.031)	35.184(0.009)

The agricultural insurance in the central and western regions and the rural financial development in the central and western regions are first-order integration, and we can continue to judge whether there is co-integration relationship between the agricultural insurance in the central and western regions and the rural financial development in the central and western regions. We conduct varying coefficient fixed effect regression on the central region and western region respectively. From (1)-(4), we get four residual sequences, denoted as e_{1it}, e_{2it}, e_{3it} and e_{4it} respectively. The unit root test results of all residual sequences can be seen in Table 3, 4.

Table 3 Unit root test result of residual sequence in central regions

Variable	*LLC* value	*IPS* value	Fisher-*ADF* value
e_{1it}	−3.571(0.000 2)	−1.078(0.14)	20.791(0.121 2)
e_{2it}	−2.298 (0.011)	−0.041(0.484)	16.998(0.242)
e_{3it}	−7.658(0.000)	−2.234(0.012)	29.611(0.008)
e_{4it}	−3.729(0.000 1)	−1.796(0.035)	26.543(0.022)

Table 4 Unit root test result of residual sequence in western regions

Variable	*LLC* value	*IPS* value	Fisher-*ADF* value
e_{1it}	−4.667(0.000)	−1.552(0.060)	36.507(0.006)
e_{2it}	−0.299 (0.618)	0.535(0.704)	21.572(0.252)
e_{3it}	−4.101(0.000)	−1.674(0.091)	27.765(0.007)
e_{4it}	−2.848(0.006)	−1.235(0.098)	28.473(0.055)

The results in Table 3 show that Model (3), (4) in the central region are cointegrated, indicating that the interaction between agricultural insurance and rural financial development scale is not significant, but the agricultural insurance is long-term reason of development efficiency of regional rural finance, and the efficiency of rural finance plays a long-term decisive role in promoting the development of agricultural insurance. From Table 4, we know that Model (1), (3) and (4) in western region are cointegrated, indicating that the agricultural insurance is not only the long-term reason of development efficiency of regional rural finance, but also the long-term reason of development scale of rural finance. In addition, the efficiency of rural financial development plays a long-term decisive role in promoting the development of agricultural insurance. We can conduct regression on the interaction of agricultural insurance and rural financial development in the central and western regions, so that we get co-integration equation and conduct further analysis.

2.3 Estimated results and analysis We select varying coefficient fixed effect model to conduct estimation on the aforesaid results, and we get the following regression result:

The central region:

$$\hat{XL}_{it} = 0.593\,2 + \hat{\gamma}^{*}_{1i} + \hat{\eta}_{1i} NBFS_{it}$$
$$t(-55.956)$$
$$\hat{NBFS}_{it} = -0.579\,6 + \hat{\gamma}^{*}_{2i} + \hat{\eta}_{2i} XL_{it}$$
$$t(-8.863\,1)$$

The western region:

$$\hat{GM}_{it} = 0.333\,1 + \hat{\alpha}^{*}_{1i} + \hat{\beta}_{1i} NBFS_{it}$$
$$t(17.037)$$
$$\hat{XL}_{it} = 0.671\,7 + \hat{\alpha}^{*}_{2i} + \hat{\beta}_{2i} NBFS_{it}$$
$$t(24.960\,2)$$
$$\hat{NBFS}_{it} = -0.160\,8 + \hat{\alpha}^{*}_{3i} + \hat{\beta}_{3i} XL_{it}$$
$$t(-2.065)$$

Table 5 Value of coefficient $\hat{\eta}_i$ and $\hat{\beta}_i$ coefficient in central and western regions

Central regions	$\hat{\eta}_{1i}$	$\hat{\eta}_{2i}$	Central regions	$\hat{\beta}_{1i}$	$\hat{\beta}_{2i}$	$\hat{\beta}_{3i}$
Shanxi	1.759 8	2.550 1	Shaanxi	−1.257 8	−3.004 6	0.752 1
Anhui	0.443 3	1.562 5	Inner Mongolia	−0.143 6	−0.240 4	−0.426 7
Henan	0.941 4	1.341 8	Guangxi	−2.181 2	−3.034 8	0.954 2
Hubei	0.500 8	1.879 9	Sichuan	−0.667 3	−0.743 4	0.238
Hunan	0.157 4	1.462 5	Guizhou	−0.365 6	−2.445 3	0.600 7
Jilin	0.082 1	0.697	Yunnan	1.063 0	−0.051 2	0.865 6
Heilongjiang	0.070 1	−2.552	Gansu	2.042 7	−6.342 8	0.489 9
			Ningxia	−1.340 4	−1.508 4	1.314 6
			Xinjiang	−0.146 3	−0.143 6	−1.202 3

Estimated results (Table 5) show that the role of development level of agricultural insurance in all provinces in the central region of China in promoting long-term development efficiency of rural finance is significantly different. The province with the highest value (1.759 8) is Shanxi Province, and the province with the lowest value (0.070 1) is Heilongjiang Province. The role of efficiency of rural financial development in all provinces in promoting long-term development of agricultural insurance is also largely different. The province with the highest value (2.550 1) is Shanxi Province, and Heilongjiang Province doesn't play the role in promoting long-term development of agricultural insurance but play the role in inhibiting long-term development of agricultural insurance.

The development level of agricultural insurance in Yunnan Province and Gansu Province in western regions plays role in promoting rural financial development scale and rural financial development efficiency; the development level of agricultural insurance in other provinces in western regions plays role in inhibiting rural financial development scale and rural financial development efficiency. Among them, the agricultural insurance in Guangxi plays the greatest role in inhibiting rural financial development scale, with the value of 2.181 2; the agricultural insurance in Inner Mongolia plays the smallest role in inhibiting rural financial development scale, with the value of 0.143 6. The agricultural insurance in Gansu Province plays the greatest role in inhibiting rural financial development efficiency, with the value of 6.342 8; the agricultural insurance in Yunnan Province plays the smallest role in inhibiting rural financial development efficiency, with the value of 0.051 2. The rural financial development efficiency in most of provinces in western regions of China plays the role in promoting agricultural insurance, and the rural financial development efficiency in Ningxia plays the greatest role in promoting agricultural insurance, with the value of 1.314 6; only the rural financial development efficiency in Inner Mongolia and Xinjiang plays the role in inhibiting agricultural insurance.

In order to compare easily, we conduct simple weighted average on the estimated coefficient value of interaction between agricultural insurance and rural financial development efficiency in the central and western regions, and we get that the coefficient of impact of agricultural insurance on the rural financial development efficiency in the central region is 0.565, and the coefficient of impact of agricultural insurance on the rural financial development efficiency in the western region is −1.946 1; the coefficient of the impact of rural financial development efficiency on agricultural insurance development level is 0.991 7 in the

central region, and the coefficient of the impact of rural financial development efficiency on agricultural insurance development level is 0.398 3 in the western region. Clearly, the agricultural insurance plays a more significant role in promoting rural financial development efficiency in the central region, and the rural financial development efficiency also plays a more significant role in promoting the agricultural insurance in the central region. The rural financial development efficiency will promote the development level of agricultural insurance in western region, but its influence is relatively small, and the development level of agricultural insurance in western region will not promote rural financial development efficiency but will inhibit rural financial development efficiency. This shows that it forms mutual-promotion and mutual-development virtuous cycle between agricultural insurance and rural financial development efficiency in the central region, while the western region has not yet formed mutual-promotion and mutual-development virtuous cycle between agricultural insurance and rural financial development efficiency. However, the level of development of agricultural insurance in the western region is a long-term reason of scale of development of rural finance, but for the central region, there is no such causal relationship.

3 Conclusion and suggestions

3.1 Conclusion Empirical studies have shown that there is a long-term balanced relationship between agricultural insurance and rural financial development efficiency in the central and western regions of China, and it is a mutual causal relationship, but the relationship between the two has prominent regional difference. The level of development of agricultural insurance in the western region is one-way reason of the scale of development of rural finance, while in the central region, there is no such relationship. From the regression results, the agricultural insurance plays significant role in promoting rural financial development efficiency in the central region, and the rural financial development efficiency also plays significant role in promoting the agricultural insurance in the central region; the development of agricultural insurance in the western region inhibits the expansion of rural financial scale and improvement of rural financial efficiency, but the rural financial efficiency in the west region promotes the development of agricultural insurance in the western region.

3.2 Suggestions We should strengthen support for policy finance in the central and western regions, give full play to the functional role of the government's intervention, and increase inputs of the rural financial institutions in serving agriculture, farmer and countryside, so that we connect the fiscal policy and monetary policy in rural areas more effectively, guide more credit funds to flow into the development of agriculture, farmer and countryside, and solve the problems of difficult rural financing. We should use the new deposits absorbed by the financial institutions, such as county bank reasonably and improve the policy of loan lending policies in local areas.

The main body of supply of rural insurance and service network need to be further developed, and we should increase the types of policy agricultural insurance and expand the coverage of policy agricultural insurance. Insurance companies should strengthen research on agricultural insurance market, and develop the insurance products that are consistent with the characteristics of agricultural production and meet the demand of farmers. In view of the realities that the insurance outlets in the vast rural areas are scanty and it is difficult for farmers to go through insurance business, all insurance sectors should actively set up insurance agency in towns, so as to meet the needs of farmers. In the mean time, we should foster a number of interdisciplinary talents who not only understand the insurance, but also understand the credit, reduce the inhibitory effect of agricultural insurance on rural finance and gradually strengthen the role of agricultural insurance in promoting rural finance.

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assumed by rural financial institutions, increase the new deposits of financial institutions in rural areas to support agriculture, farmer and countryside, and ensure that the financial system in rural areas serves agriculture, farmer and countryside. Finally, the government should vigorously promote and foster awareness of rural financial integrity; the rural financial institutions should comply with vocational ethical norm, and achieve their own development by integrity; the farmers and enterprises should also develop good character of honesty and trust, so as to promote trust and favorable cooperative relationship between rural financial institutions and clients. At the same time, the government should accelerate the honesty construction of the government, and set itself an example to others, in order to foster good atmosphere of integrity, and provide orderly and good social environment for healthy development of multiplex rural financial system.

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