The Dynamic Effects of Agricultural Insurance Development on the Optimization of Agricultural Industrial Structure——Generalized Method of Moments Estimation Based on Dynamic Panel Model

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Abstract: As an important tool of agricultural risk diversification, agricultural insurance plays a positive role in the optimization of agricultural industrial structure and is one of the important means to support agriculture and benefit agriculture in China at the present stage. Based on the 2010-2019 panel data of 30 provinces (autonomous regions and municipalities) in China, this paper uses the systematic generalized method of moments to empirically investigate the impact of agricultural insurance development on the optimization of agricultural industrial structure. The research results show that the development of agricultural insurance has a significant role in promoting the optimization and upgrading of the agricultural industrial structure in both the long-term and short-term. In addition, agricultural labor force, economic development level, and agricultural risk level all have a significant positive impact on the optimization of agricultural industrial structure. The fixed asset investment of farmers has a certain negative impact on the optimization of the agricultural industry structure. Finally, relevant countermeasures and suggestions are put forward based on the empirical results. The government should combine the needs of industrial structure upgrading, develop new types of insurance, and take measures to stabilize agricultural production.

1. INTRODUCTION

China is a large agricultural country, and the development of the agricultural industry plays an irreplaceable role in national economy and social stability. The report of the 19th National Congress of the Party pointed out that China’s economy has entered a stage of high-quality development. In this process, the main problem facing China’s agricultural development has changed from insufficient total amount to structural contradiction that has become increasingly prominent. The ‘No. 1 Document of the Central Committee’ in 2021 proposes to strengthen the modernization of agriculture and rural areas, continues to promote high-quality economic development. It thoroughly implements the new development concept, and uses agricultural supply-side structural reforms to promote socialist modernization. Nowadays, in the context of the global economic crisis caused by the new crown epidemic, how to achieve the strategic goals of boosting income, expanding domestic demand, and maintaining growth through the optimization and adjustment of the agricultural industrial structure are issues that should be focused on.

Shao Quanquan (2020) pointed out that China’s agricultural economic growth has long been subject to natural risks and market risks, among which natural disasters are one of the main factors
affecting its development [1]. Agricultural insurance can stabilize agricultural production to a large extent through its economic compensation and risk diversification, it can enhance farmers’ confidence, and promote the market-oriented development of agricultural economy. It plays a positive role in the optimization of the agricultural industry structure and it is also one of the important means of supporting agriculture and benefiting agriculture in at this stage. The ‘Guiding Opinions on Accelerating the High-Quality Development of Agricultural Insurance’ issued in 2019 emphasized that the operation mechanism of agricultural insurance should be continuously promoted to provide increasingly complete risk protection for the construction of agriculture, rural areas and farmers. In 2021, the ‘Guiding Opinions on Promoting the Sustainable Development of Characteristic Industries in Poverty Alleviation Areas’ clearly mentioned that the central government should continue to strengthen financial support for the insurance of characteristic agricultural products in various regions, strengthen the development of characteristic insurance products in poverty alleviation areas, and adapt measures to local conditions. It continuously improves the risk protection level of agricultural insurance. It can be seen that the influence mechanism of agricultural insurance on the optimization and upgrading of agricultural industrial structure is a realistic issue that should be paid attention to in the high-quality transformation of economy, and it is worthy of further study and discussion.

2. LITERATURE REVIEW

With the continuous development of agricultural economy and the increasing emergence of agricultural risk modernization characteristics, the relationship between agricultural insurance and agricultural industrial structure has attracted high attention from scholars at home and abroad.

In foreign literature, in terms of theoretical research, Wu (1999) believed that the propensity of farmers for high-risk crops was affected to a certain extent by the degree of agricultural insurance subsidies, so agricultural insurance promoted the adjustment of agricultural production structure [2]. Turvey (1992)’s research also supported this view [3]. Glauber and Collins (2002) conducted research from the perspective of differentiated policies and found that farmers tend to grow crops with higher agricultural insurance premium subsidies [4]. It shows that agricultural insurance plays a certain guiding role in the adjustment of agricultural production structure. In terms of empirical research, Tronstad and Bool (2010) research based on US county-level panel data and Yu et al.(2018) analysis of annual data on major US crops both showed that there is a certain correlation between agricultural insurance and the adjustment of agricultural industrial structure [5-6]. However, there are still a few foreign scholars who question the impact of agricultural insurance on the structure of the agricultural industry. Young (2001) found that the impact of agricultural insurance subsidies only affects a small part of the main crops, but not significant for other crops [7]. Goodwin (2004) based on the North Plains and Midwestern regions of the United States also showed that there is no obvious correlation between agricultural insurance and agricultural industrial structure [8].

Domestic scholars also have a wealth of research on the relationship between agricultural insurance, agricultural economic growth, and agricultural industrial structure. Tang Yingmei (2010) conducted an empirical study on pig farmers in northern Jiangsu that were transferred out of large counties, and concluded that agricultural insurance subsidies can promote the expansion of the production scale of farmers [9]. Zhang Xiaodong and Sun Rong (2015) showed that except for Beijing, agricultural insurance in all provinces across the country has a significant role in promoting farmers’ operating income, but there are still certain differences between different regions [10]. Zhou Wenhai (2015) conducted an empirical test based on the data of 11 cities in Hebei Province, and used the differential generalized moment estimation method to study that agricultural insurance has a significant role in promoting agricultural production [11]. However, other scholars’ studies have come to quite different
conclusions. For example, Wen Hongfei (2016) based on the 2000-2014 data from LinYi, Shandong Province, showed that there is no significant correlation between agricultural insurance and agricultural production structure adjustment [12].

In summary, in the field of research on the relationship between agricultural insurance and the optimization of agricultural industrial structure, domestic and foreign scholars have achieved certain research results, which can provide certain reference and enlightenment for this article. However, looking at the past research methods and research perspectives, there are still deficiencies in the following aspects. Firstly, the research conclusions from theoretical or empirical aspects are not inconsistent, and there are even completely opposite situations. Secondly, most of the results are based on research conducted on specific industries in certain regions, and there are relatively few empirical studies on the relationship between the two based on national inter-provincial panel data. Thirdly, previous studies on the adjustment of the agricultural industry structure are mostly limited to horizontal adjustments among agriculture, forestry, animal husbandry, and fishery, while ignoring the high value-added industries that extend vertically from agriculture to the secondary and tertiary industries. A large error will occur at the time.

In view of this, this article will make the following innovations and expansions. Firstly, the dynamic panel system GMM model is constructed, which is more accurate than the static model estimation result, because the lag term of the explained variable is included in the model. Secondly, this article considers from the perspective of big agriculture and considers the adjustment of the three agricultural industries in terms of the optimization of agricultural industrial structure. Thirdly, the model introduces control variables such as agricultural labor force, economic development level, agricultural risk level, agricultural investment level, etc., so as to avoid the deviation caused by the omission of important variables.

3. VARIABLE SELECTION AND MODEL BUILDING

3.1 Variable selection

3.1.1 Explained variable

Optimization of the agricultural industry structure \( (X_{ih}) \). The research of Gan Chunhui et al. (2011) showed that the process of industrial structure change can be described from two dimensions. They are rationalization and advancedization [13]. This paper makes a reasonable reference to this method, and incorporates both rationalization and advancedization into the construction of China’s agricultural industrial structure optimization indicators.

3.1.1.1 Rationalization of the industrial structure

This dimension reflects the degree of coordination between different industries. The traditional method of measuring the degree of structural change is difficult to measure the status and importance of different industries in the economy. In addition, the calculation of absolute values also makes the research difficult to a certain extent (Qian Chunhui et al., 2011) [13]. In order to circumvent the shortcomings of this method, this article uses the Theil and Henri (1967) Theil Index (TL) to measure the rationalization of the industrial structure. The calculation formula is as follows [14].

\[
TL = \sum_{i=1}^{n} \left( \frac{Y_i}{Y} \right) \ln \left( \frac{Y_i}{L_i} / \frac{Y}{L} \right)
\]

Among them, \( Y_i \) is the output value of the \( i \)-th industry, and \( L_i \) is the number of employees in the \( i \)-th industry. \( Y/Y \) and \( Y_i/L_i \) represent output structure and output efficiency, respectively. Only when the economy is in a state of equilibrium development, the output efficiency of each industry is the same, that is, \( Y_i / L_i = Y / L \), and \( TL = 0 \) at this time. Due to the particularity of agriculture, it is difficult to accurately measure the number of employees in various industries such as agriculture, forestry, animal husbandry, and fishery. \( Y_i / L_i \) is a reflection of output efficiency. This article refers to the practice of Kuang Yuanpei et al. (2016), and uses the value added (value added/intermediate
consumption) realized by the unit intermediate consumption of agriculture, forestry, animal husbandry, and fishery to measure the production efficiency of each industry [15]. \( Y_i / Y \) is expressed as the ratio of the output value of agriculture, forestry, animal husbandry, and fishery to the total agricultural output value, which is the Theil index of the agricultural industry.

### 3.1.1.2 Advanced industrial structure

This dimension is a measure of the degree of upgrading of the industrial structure. Liu Wei et al. (2008) used the product of the proportional relationship and labor productivity to measure the height of the industrial structure [16]. The research of Gan Chunhui et al. (2011) believes that ‘service economy’ is an important feature of industrial structure upgrading in the information age [13]. Therefore, its research uses the ratio of the output value of the secondary industry to the tertiary industry as the basis for measuring the height of the industrial structure. Considering that in the context of big agriculture, the adjustment of the agricultural industrial structure involves the three agricultural industries, and gradually transitions to the secondary and tertiary agricultural industries with high added value. Therefore, the method that only considers the output value of the secondary industry and the tertiary industry is not well applicable to the measurement of advanced agricultural industrial structure. Therefore, this article draws on the practice of Xu Min and Jiang Yong (2015), and borrows the industrial structure level coefficient (upgrade) to illustrate the level of upgrading of the agricultural industrial structure in each province [17]. The specific formula is as follows.

\[
\text{upgrade} = \sum_{i=1}^{3} (y_i \times \text{upgrade}) = y_1 \times 1 + y_2 \times 2 + y_3 \times 3 \tag{2}
\]

Among them, \( y_i \) represents the proportion of the added value of the \( i \)-th industry, the closer the upgrade value is to 3, the higher the industrial level, and the closer to 1, the lower the industrial level.

Since the optimization of the agricultural industrial structure involves the above two dimensions, this article draws on the practice of Kuang Yuanpei et al. (2016), and combines the agricultural industrial structure optimization index according to the weight of the two indicators each accounting for 50% [15].

\[
X_{yh} = 0.5 \times TL + 0.5 \times \text{upgrade} \tag{3}
\]

### 3.1.2 Core interpretation variable

Agricultural insurance development level (\( Fzsp \)). Research of Zhou Wenhai et al. (2015) showed that agricultural insurance has significantly promoted the development of agricultural production [11]. This article draws on the practice of Dai Ning et al. (2017), using agricultural insurance density to measure the level of agricultural insurance development, and the calculation method is agricultural insurance premium income/number of employees in the primary industry [18]. Since there is a time interval from the payment of premiums to the effect of agricultural insurance, the first-order lag term \( L.\ln Fzsp \) of agricultural insurance density is introduced into the explanatory variables.

### 3.1.3 Controlled variable

1. Agricultural labor force (\( Cyrs \)). The agricultural labor force refers to the employees in the agricultural industry. This article draws on the practice of Kuang Yuanpei et al. (2016) and adopts the number of employees in the primary industry to measure agricultural labor force indicators [15].

2. The level of economic development (\( Gdp \)). Regional economic development will increase residents’ demand for high-end industries, which in turn will force the optimization of the regional industrial structure. This article draws on the practice of Li Yingjie and Han Ping (2021), and uses regional per capita GDP (per capita gross domestic product) to measure the level of regional economic development [19]. Since the impact of economic growth on the optimization of agricultural industrial structure requires a long process, this paper uses the first-order lag term \( L.\ln Gdp \) of per capita GDP to estimate the model.

3. Agricultural risk level (\( Pfl \)). Agricultural risk refers to various uncertain factors that have an impact on agricultural production, which affect the income and loss of agricultural producers and
operators to a certain extent (Zhao Haiyan, 2008) [20]. This paper draws on the practice of Zhou Wenhai et al. (2015) and adopts the agricultural insurance payout ratio to measure the level of agricultural risk [11]. The calculation method is the agricultural insurance payout/agricultural insurance premium income. In view of the lag in the response and adjustment of farmers to agricultural risks, this paper adopts the first-order lag term \(\text{L.ln}Pfl\) of the agricultural insurance compensation rate for model estimation.

(4) Agricultural investment level (\(Gdtz\)). This variable represents the investment of farmers in fixed assets, such as repairing buildings, purchasing equipment and durable goods (Li Yongbin, 2019), which will affect the consumption of rural residents to a certain extent, and then affect the optimization of the agricultural industry structure [22]. This paper uses the amount of rural fixed asset investment to measure the level of agricultural investment. Since the impact of fixed asset investment on the optimization of agricultural industrial structure requires a long process, this paper uses the first-order lag term \(\text{L.ln}Gdtz\) of the completion of rural fixed asset investment to estimate the model.

| Table 1. Summary Description of the Variables |
|-----------------------------------------------|
| Variable properties | Variable Name | Measurement measures | Variable symbol |
| Explained variable | Optimization of agricultural industrial structure | Agricultural industrial structure optimization index | \(X_{yh}\) |
| Core interpretation variable | Development level of agricultural insurance | Agricultural insurance density | \(F_{zsp}\) |
| Controlled variable | Agricultural labor force | Number of primary industry practitioners | \(C_{yrs}\) |
| | Economic development level | GDP per capita | \(Gdp\) |
| | Agricultural risk level | Agricultural insurance compensation rate | \(Pfl\) |
| | Agricultural investment level | Completion amount of rural fixed asset investment | \(Gdtz\) |

3.2 Model building

3.2.1 Static panel metering model

This paper establishes a static panel measurement model with agricultural industrial structure optimization index (\(X_{yh}\)) as the interpreted variable, agricultural insurance density (\(F_{zsp}\)) as the key explanatory variable representing the level of agricultural insurance development, and adding model control variables of primary industry practitioners (\(Cyrs\)), GDP per capita (\(Gdp\)), agricultural insurance compensation rate (\(Pfl\)) and rural fixed asset investment completion amount (\(Gdtz\)). The static panel measurement model is set as follows.

\[
\ln X_{yh_i} = c + \beta_1 \ln X_{yh_i} + \beta_2 \ln F_{zsp_i} + \beta_3 L \ln F_{zsp_i} + \beta_4 \ln Cyrs_i + \beta_5 L \ln Gdp_i + \beta_6 L \ln Pfl_i + \beta_7 L \ln Gdtz_i + \zeta_i + \theta_i + \nu_i \tag{4}
\]

Among them, \(i\) is a province, with a value of 1-30. \(t\) is the year, and the value is 2010–2019. \(\ln X_{yh_i}\) represents the optimization index of agricultural industrial structure in the \(i\)-th province in year \(t\). \(\ln F_{zsp_i}\) represents the density of agricultural insurance. \(L \ln F_{zsp_i}\) represents the first-order lag term of agricultural insurance density. \(\ln Cyrs_i\) represents the number of employees in the primary industry. \(L \ln Gdp_i\) represents the first-order lag term of GDP per capita. \(L \ln Pfl_i\) represents the first-order lag term of the agricultural insurance payout ratio. \(L \ln Gdtz_i\) represents the first-order lag term of the completion of rural fixed asset investment. \(c\) represents a constant term. \(\zeta_i\) represents the disturbance term that changes with individual time. \(\theta_i\) represents the intercept term of individual heterogeneity, and \(\nu_i\) represents the interference term.
3.2.2 Dynamic panel metering model

Because the static panel model lacks the consideration of the dynamic influence of the explanatory variable itself, the optimization of the agricultural industry structure is a long-term dynamic process, which has larger errors compared with the dynamic panel measurement model. In order to overcome its shortcomings, this paper establishes a dynamic panel model, and introduces the first-order lag term \( L.\ln X_{iyh} \) of the agricultural industry structure optimization index into the explanatory variables. This paper uses the system GMM model to estimate, and the specific settings are as follows.

\[
\ln X_{yhi} = c + \beta_1 L.\ln X_{yhi} + \beta_2 \ln X_{yhi} + \beta_3 \ln F_{zsp} + \beta_4 L.\ln F_{zsp} + \beta_5 L.\ln Gdp + \beta_6 L.\ln Pf + \beta_7 L.\ln Gdtz + \zeta_i + \theta_i + v_i \quad (5)
\]

Among them, \( i \) represents a province, and the value is 1-30. \( t \) represents the year, and the value is 2010~2019. \( L.\ln X_{yhi} \) represents the first-order lag term of the agricultural industrial structure optimization index in the \( i \)-th province in year \( t \). \( \ln X_{yhi} \) represents the optimization index of the agricultural industry structure. \( L.\ln F_{zsp} \) represents the first-order lag term of the density of agricultural insurance. \( \ln F_{zsp} \) represents the density of agricultural insurance. \( L.\ln Gdp \) represents the first-order lag term of GDP per capita. \( \ln Gdp \) represents the first-order lag term of agricultural insurance payout ratio. \( L.\ln Gdtz \) represents the number of employees in the primary industry. \( \ln Gdtz \) represents the first-order lag term of the completion of rural fixed asset investment. \( c \) represents a constant term. \( \zeta_i \) represents the disturbance term that changes with individual time. \( \theta_i \) represents the intercept term of individual heterogeneity. \( v_i \) stands for interference items.

4. DATA ACQUISITION AND PROCESSING

Due to the serious lack of some indicator data in the Tibet Autonomous Region, this study selected the panel data of 30 provinces (autonomous regions and municipalities) in China excluding the Tibet Autonomous Region from 2010 to 2019. Among them, the data of the agricultural industry structure optimization index is taken from the China Rural Statistical Yearbook for each year. The data on agricultural insurance premium income and agricultural insurance compensation expenditure are all taken from the China Insurance Statistical Yearbook for each year. The number of employees in the primary industry is taken from the China Statistical Yearbook for each year. Data on per capita GDP and rural fixed asset investment completed are taken from the National Bureau of Statistics. According to the calculation method of the third part, the original data is processed to obtain the index data required by this research.

In this study, the data is smoothed by taking the natural logarithm of each variable to reduce the influence of heteroscedasticity in time series data. The descriptive statistical analysis of the variables is shown in table 2. The measurement software used in this article is STATA 15.1.

| Variable name | Sample number | Mean value | Maximum | Minimum | Standard deviation |
|---------------|---------------|------------|---------|---------|-------------------|
| \( \ln X_{yh} \) | 300 | 0.1841 | 0.0505 | 0.0815 | 0.3546 |
| \( \ln F_{zsp} \) | 300 | 8.7925 | 0.8513 | 6.4283 | 10.5429 |
| \( \ln Cyrs \) | 300 | 6.4400 | 1.0590 | 3.6133 | 7.9054 |
| \( \ln Gdp \) | 300 | 10.7633 | 0.4594 | 9.4818 | 12.0090 |
| \( \ln Pf \) | 300 | -8.2166 | 1.1954 | -10.1843 | -4.6697 |
| \( \ln Gdtz \) | 300 | 5.3721 | 1.1570 | 0.6932 | 6.8739 |

5. EMPIICAL TEST RESULTS

5.1 Empirical empirical results

In order to test the direction and intensity of agricultural insurance for the optimization of agricultural industrial structure, this paper uses the agricultural industrial structure optimization index \( \ln X_{yh} \) as the explained variable, and the current agricultural insurance density \( \ln F_{zsp} \) and the first-order lag term of agricultural insurance density
(L.InFzsp) as the core explanatory variables, with the number of employees in the primary industry (lnCyrs), the first-order lag term of per capita GDP (L.InGdp), the first-order lag term of agricultural insurance compensation ratio (L.InPfl), and rural fixed asset investment. The first-order lag term of the completion amount (L.InGdtz) is used as a control variable for static and dynamic empirical analysis.

### TABLE 3. COMPARISON RESULTS BETWEEN STATIC AND DYNAMIC MODELS

| Variable       | A Static model | B Dynamic model |
|----------------|----------------|-----------------|
|               | FE             | GMM             |
| L.InXyh       | -              | 0.806*** (32.52)|
| lnFzsp        | 0.00491 (0.85) | 0.00625*** (6.75)|
| L.InFzsp      | 0.0186*** (2.30)| 0.0106*** (5.14)|
| lnCyrs        | -0.0152 (-0.77)| 0.00508** (2.21)|
| L.InGdp       | 0.0793*** (11.38)| 0.0276*** (13.43)|
| L.InPfl       | 0.0501*** (4.82)| 0.00669*** (3.37)|
| L.InGdtz      | -0.0221*** (-4.34)| -0.00377*** (-6.10)|
| _cons         | -0.241 (-1.30) | -0.361*** (-14.28)|
| N             | 270            | 270             |
| R²             | 0.6931         | -               |
| AR (2) P      | 0.6931         | -               |
| Sargan χ² (d) | -              | 25.91247 (46)   |
| Sargan P      | -              | 0.9927          |
| Hausman χ² (P)| 24.00 (0.0005) | -              |
| Number of provinces | 30             | 30              |

Note: (1) ***, **, * are significant at the 1%, 5%, and 10% levels respectively, and the t value is the value in parentheses. (2) Sargan χ² is the overidentification test for the rationality of tool variables from Sargan statistical quantity. Progressive card distribution, degrees of freedom in parentheses and corresponding P value of Sargan P. (3) AR(2) P value represents the P value obtained by the second-order serial correlation test after the first-order difference of the residual. The original statistics gradually obey the N(0,1) distribution, and the null hypothesis is that the model does not have second-order autocorrelation. (4) Hausman χ²(P) is the χ² value with random or fixed effect test for the static model, the corresponding P value is used in parentheses.

In Table 3, column A and column B are the estimation results of the static model and the dynamic model, respectively. The results of Hausman’s test reject the assumption that the optimization of the agricultural industry structure has nothing to do with the explanatory variables. Therefore, this article will use the fixed effects (FE) method to estimate static panels. Because the first-order lag term (L.InXyh) of the optimization index of agricultural industry structure has neglected its own dynamic impact, there is a large error between the estimated result and the actual value. Knowing from the AR(2) P value, the interference term estimated by the system GMM has no second-order autocorrelation. According to the Sargan χ² (d) and Sargan P values, there is no over-identification problem in the system GMM, that is, the selected instrument variables are more reasonable and the estimated results are more accurate. Therefore, this article will analyze the results of the system generalized moment estimation method.

From the empirical results, it is found that the estimated coefficient value of the first-order lag term (L.InXyh) of the agricultural industry structure optimization index is 0.806>0, and it is significant at the 1% confidence level. It shows that the agricultural industry structure optimization index has a certain inertial influence on itself. This is because the optimization of the agricultural industrial structure is a long-term and gradual process, and the degree of optimization of the agricultural
industrial structure in the early stage will significantly promote the results of the current period. The estimated coefficient values of the current agricultural insurance density ($\ln Fzsp$) and the first-order lag term of agricultural insurance density ($L\ln Fzsp$) are 0.00625>0 and 0.0106>0, respectively, and both are significant at the 1% confidence level. This shows that the level of agricultural insurance development has a significant role in promoting the optimization of agricultural industrial structure in both the long-term and short-term perspectives. This is because in the short term, purchasing agricultural insurance stabilizes farmers’ production expectations and increases farmers’ willingness to invest in advanced production technologies and high-profit crops, thereby promoting the improvement of agricultural production. In the long run, the compensation mechanism of agricultural insurance enables farmers to quickly resume production, thereby improving agricultural output in the next cycle, thereby promoting the adjustment of agricultural industrial structure.

The estimated coefficient value of the number of employees in the primary industry ($\ln Cyrs$) is 0.00508>0, and it is significant at the 5% confidence level. This shows that the increase of agricultural labor force has a positive effect on the optimization of agricultural industrial structure. This is because under the background of rural revitalization in recent years, some people returning to their hometowns for employment and entrepreneurship can effectively promote rural industrial development and economic restructuring, thereby promoting the rational allocation of rural production resources.

The estimated coefficient of the first-order lag term ($L\ln Gdp$) of per capita GDP is 0.0276>0, and it is significant at the 1% confidence level. This shows that economic development has a significant role in promoting the optimization of agricultural industrial structure, which is consistent with the previous expectations.

The estimated coefficient of the first-order lag term ($L\ln Pfl$) of the agricultural insurance payout ratio is 0.00669>0, and it is significant at the 1% confidence level. This shows that the level of agricultural risk is significantly positively correlated with the level of agricultural industrial structure optimization. This is because the increase in agricultural risks reflects, to a certain extent, the increasing propensity of farmers for high value-added cash crops, which is conducive to promoting the optimization of the agricultural industry structure.

The estimated coefficient of the first-order lag ($L\ln Gdtz$) of the rural fixed asset investment completion is -0.00377<0, and is significant at the 1% confidence level. This shows that investment in fixed assets has a certain inhibitory effect on the optimization of agricultural industrial structure. This is because the increase in investment in fixed assets has reduced the disposable income of rural households and reduced demand for high-end consumption, leading to a slowdown in the upgrading of the industrial structure.

5.2 Robustness test

This article examines the robustness of the measurement model by eliminating sample extremes. In the test, the 2010-2019 values of the core explanatory variable agricultural insurance density ($\ln Fzsp$) of each province are added together, and the largest province is Henan, and the smallest province is Qinghai. Columns (2)-(4) in table 4 are the empirical results of excluding Henan and Qinghai, excluding Henan, and excluding Qinghai, respectively. It can be seen from the AR(2)P value that there is no second-order autocorrelation in the estimated interference term. According to the Sargan $\chi^2$ (d) and Sargan P values. The model does not have the problem of over-identification, that is, it meets the two conditions of using the system GMM method. By comparing with the estimated results of the full sample, it can be seen that the estimated coefficient values of the current agricultural insurance density ($\ln Fzsp$) and the first-order lag term of agricultural insurance density ($L\ln Fzsp$) of the empirical results of each sub-sample are all positive. The direction and magnitude of the coefficients of the other four control variables are also similar, and their significance is basically the same. This shows that the empirical results of the econometric model adopted in this article have not changed significantly with sample changes, that is, the model is robust.
TABLE 4. ROBUSTNESS TEST AND EMPIRICAL RESULTS

| Variables | GMM | (1) Full sample | (2) Excluding Henan and Qinghai | (3) Excluding Henan | (4) Excluding Qinghai |
|-----------|-----|----------------|-------------------------------|-------------------|--------------------|
| L.lnXyh   |     | 0.806*** (32.52) | 0.806*** (27.01) | 0.806*** (36.33) | 0.798*** (30.03) |
| lnFzsp    |     | 0.00625*** (6.75) | 0.00578*** (4.73) | 0.00568*** (5.76) | 0.00607*** (6.15) |
| L.InFzsp  |     | 0.0106*** (5.14)  | 0.00654*** (4.18) | 0.00766*** (5.68) | 0.00969*** (4.35) |
| lnCyrs    |     | 0.00508*** (2.21) | 0.00443 (1.41)    | 0.00646*** (2.77) | 0.00383 (1.41)    |
| L.InGdp   |     | 0.0276*** (13.43) | 0.0287*** (11.16) | 0.0287*** (20.57) | 0.02283*** (12.09) |
| L.InP/I   |     | 0.00669*** (3.37) | 0.00455*** (1.99) | 0.00647*** (3.74) | 0.00574*** (2.61) |
| L.InGdz   |     | -0.00377*** (-6.10) | -0.00312*** (-3.42) | -0.00347*** (-3.55) | -0.00345*** (-5.55) |
| _cons     |     | -0.361*** (-14.28) | -0.350*** (-18.56) | -0.355*** (-22.48) | -0.359*** (-13.49) |
| N         |     | 270             | 252                         | 261               | 261               |
| AR (2) P  |     | 0.7060          | 0.6371                      | 0.6328            | 0.7012            |
| Sargan χ2 (d) | 25.91247(46) | 22.23454(46) | 24.42668 (46) | 25.66079 (46) |
| Sargan P  |     | 0.9927          | 0.9988                      | 0.9962            | 0.9934            |
| Number of provinces |     | 30             | 28                          | 29               | 29               |

Note: The meanings are the same in table 3.

6. Conclusion

This paper samples the panel data of 30 provinces (autonomous regions and municipalities) except Tibet Autonomous Region from 2010-2019, and empirically analyses the influence of agricultural insurance development on the optimization of agricultural industrial structure by using the systematic generalized moment estimation model. This paper creatively considers from the perspective of "big agriculture" and analyzes the correlation between agricultural insurance and the optimization of agricultural industrial structure, which is of great significance for China's future policy formulation and agricultural insurance operation mechanism construction. Considering the vast territory of China and the great differences in physical geographical environment between different regions, future studies can discuss the heterogeneity by region.

Based on the above empirical results, the following conclusions and enlightenment can obtained.

1. The development of agricultural insurance has a significant positive effect on the optimization of the agricultural industry structure in both the short and long term, and has promoted the optimization of the agricultural industry structure as a whole. Therefore, the government has actively strengthened its support for policy-based agricultural insurance and increased subsidies for agricultural insurance products, thereby reducing the economic burden of farmers. According to the current economic development and natural geographic characteristics of different regions, targeted insurance policies are formulated in accordance with local conditions. Combining with the needs of upgrading the industrial structure, introduce new types of insurance, and implement multi-faceted policies to stabilize agricultural production. In addition, farmers’ traditional concepts should be changed, the promotion of agricultural insurance concepts should be strengthened, and insurance and disaster prevention awareness should be generally improved.

2. The agricultural labor force, the level of economic development, and the level of agricultural risk all have a significant positive impact on the optimization of agricultural industrial structure. Therefore, the government should strengthen the education of the rural labor force and adopt policies to actively attract labor to return to their hometowns for employment, improve the overall quality of the labor force in primary industry, and promote rural revitalization. It can actively promote the development of economy, realize the strategic adjustment of the agricultural industry structure, and accelerate the high-quality transformation of economy. At the same time, the protection level and strength of agricultural insurance should be improved to enable farmers to actively try high value-added crops. It can also work with the meteorological department and other forces to jointly strengthen the prediction and management of agricultural risks, so as to effectively avoid its adverse effects.
(3) The investment in fixed assets of rural households has a certain negative impact on the optimization of agricultural industrial structure. Therefore, the government should strengthen the construction of rural infrastructure, effectively improve the equipment conditions for agricultural production, and adopt certain financial support and preferential policies for the fixed asset investment of farmers to improve the efficiency of agricultural production and promote the optimization and adjustment of agricultural industrial structure.

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