Financial Support for Agriculture, Agricultural Mechanization Service and Agricultural Economic Development -- An Empirical Study Based on Provincial Panel Data

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Abstract. With the rapid development of urbanization in China, rural production factors have gradually flowed to urban areas, which has exerted a negative impact on the development of agricultural economy. Government investment in agriculture and agricultural mechanization are key factors to solve the dilemma of agricultural development. Based on China's provincial panel data and PVAR model, this paper explores the relationship between financial support for agriculture (FSA), agricultural mechanization service (AM) and the development of agricultural economy (AE). The results show that that there is a long-term two-way causal and mutually promoting relationship between FSA and AE growth. The government investment in agriculture can increase AE in the short term, however, it is not effective in the long run. The effect of FSA on AE is more significant than that of AM, while the effect of FSA on AM is insufficient. It is suggested to formulate detailed plans for financial support for agriculture, strengthen agricultural land consolidation, build large farms, and optimize subsidy policies for the purchase of agricultural machinery.

Keywords: Financial support for agriculture; Agricultural mechanization; Agricultural economic development; PVAR.

1. Introduction

China is a large agricultural country, and agriculture is an important strategic industry of the country[1]. Agricultural economy accounts for a large proportion in national economy. Since the beginning of the 21st century, China's agricultural economy has been changing from high-speed growth to high-quality development. However, with the accelerating process of industrialization and urbanization, a large number of rural labor force have transferred to cities and towns and non-agricultural industries in rural areas for employment, and the average cost of agricultural labor force is rising rapidly[2], thus China's agricultural development is facing great resistance. Currently in China, traditional agriculture has been gradually transformed to modern agriculture, which still lacks competitiveness in absorbing capital, materials and technology. In this circumstance, the state must support and protect agriculture with effective measures, among which financial support is essential for agriculture and the progress of agricultural science and technology.

China has made great progress in financial support for agriculture and the development of agricultural mechanization. In 2020, the added value of China's primary industry was 704.667 million yuan, the total power of agricultural machinery reached 1027.583 million KW, and the level of agricultural mechanization entered the intermediate stage from the primary stage. Meanwhile, China's financial expenditure on agriculture, forestry and water affairs reached 2233046 million yuan. However, compared with developed countries, China's financial support for agriculture and agricultural mechanization is still at a relatively lower level, and the high-quality development of agricultural economy remains a challenge[3].

Present research mostly focuses on the relationship among agricultural economy, crop planting, labor cost, and the impact of agricultural mechanization on farmers' income[4], whereas the research on the impact of FSA and AM on AE is still in the preliminary development stage. FSA and AM are important driving factors for the development of AE. In order to study the interaction among the three, this paper comprehensively analyzes the endogenous interaction among the three variables

with PVAR model to provide suggestions on policy-making for promoting agricultural economic development and rural sustainable development.

2. Model

2.1 PVAR model

Each variable is regarded as endogenous variable in PVAR model, and the impact of each variable and its lag variable on other variables are analyzed in the model[5]. Compared with the traditional VAR model that requires long time series, PVAR model has the characteristics of large section and short time series. PVAR model can effectively solve the problem of individual heterogeneity panel data, and the individual effect and time effect can be fully considered. The expression formula of PVAR model is as follows:

$$Z_{it} = \Gamma_0 + \sum_{j=1}^{p} \Gamma_j Z_{it-j} + f_i + d_t + \varepsilon_{it} \quad (1)$$

where Z_{it} represents the vector of variables of the i th Province in t th year, followed by FSA, AE and AM, and i represents different individuals, t represents the year, and j represents the lag order of variables, while Γ_0 is the intercept item, Γ_j is the regression coefficient matrix, f_i and d_t represent individual fixed effect and time effect respectively, and ε_{it} is a random perturbation term.

2.2 Panel unit root inspection

LLC test, ADF test and PP test are used to examine the stability of the data (Table 1). The results show that the treated variables are stable, and the PVAR model can be constructed.

Table 1 Unit Root Test Results of Variables

Var	LLC	ADF	PP	Test Result
FSA	-6.677***	109.543***	222.710***	stable
AE	-6.125***	106.71***	197.893***	stable
AM	-4.733***	132.310***	236.182***	stable

*** p<0.01, ** p<0.05, * p<0.1

2.3 Optimal lag order

The optimal lag order should be determined first to ensure that the lag variable is orthogonal to the transformed variable to form an effective instrumental variable[6]. According to the minimization of AIC, BIC and HQIC, the optimal lag order of the model is determined as 1 (Table 2).

Table 2 Selection Criteria For Lag order of Pvar

Lag	AIC	BIC	HQIC
1	-3.001	-2.1748*	-2.67735*
2	-2.861	-1.920	-2.492
3	-2.732	-1.663	-2.311

* Optimal order

2.4 Granger causality

The optimal lag order of the model is determined as 1, and the model passes the stability test. Granger causality test is carried out for the relationship among various variables (Table 3). The data passes the Granger test[7], indicating that the PVAR model is well set.

Table 3 Granger Causality Test

Equation	Excluded	chi2	df	Prob>Chi2

AE	FSA	6.283	1	0.012
AE	AM	5.623	1	0.018
AE	FSA and AM	10.754	2	0.005
FSA	AE	3.047	1	0.081
FSA	AM	7.628	1	0.006
FSA	AE and AM	11.416	2	0.003
AM	AE	4.628	1	0.031
AM	FSA	9.038	1	0.003
AM	AE and ASA	12.824	2	0.002

*** p<0.01, ** p<0.05, * p<0.1

2.5 Stability test of PVAR

PVAR model stability test is needed to ensure the effectiveness of the results, which show that the model eigenvalues are all within the unit circle, indicating that the model is stable, the measurement results are effective, and there is a long-term stable relationship between the explained variable and the explanatory variable (Figure. 1).

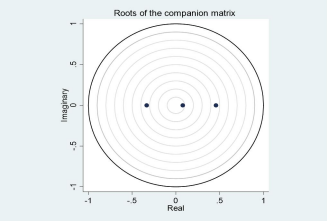

Figure. 1 Stability test of PVAR

3. Results

3.1 Analysis of panel estimation results based on GMM

Based on the data of PVAR model, the optimal lag order is determined as order 1, and GMM Estimation is performed on the panel data (Table 4). As the explained variable, the estimation coefficient of AE is negative, while the estimation coefficient of FSA and AM is positive, and the P value is less than 0.05, which means that FSA and AM have a significant positive impact on AE. When FSA is taken as the explanatory variable, the estimated coefficients of AE, FSA and AM are positive, indicating that FSA can promote the development of AE and AM. The P values of FSA and AM are less than 0.05, thus the regression coefficient is significant. When AM is taken as the explanatory variable, the estimated coefficients of AE, FSA and AM are positive, which means that all three have a significant positive impact on AM.

Table 4 System-Gmm Results

Explained	Explanatory	Coefficient	P	95% confidence interval	
AE	AE	-0.219	0.438	-0.770	0.333
	FSA	0.116	0.012	0.025	0.207
	AM	0.221	0.018	0.038	0.404
FSA	AE	0.149	0.081	-0.018	0.317
	FSA	0.207	0.000	0.101	0.314
	AM	0.488	0.006	0.142	0.834
AM	AE	0.046	0.031	0.004	0.087
	FSA	0.053	0.003	0.018	0.087
	AM	0.256	0.001	0.105	0.406

*** p<0.01, ** p<0.05, * p<0.1

3.2 Analysis of Impulse response results

In this paper, the impulse response function is adopted to analyze the interaction among three variables, describing the impact on the current value and future value of other endogenous variables after applying a forward pulse of standard deviation to one of the endogenous variables. The investigation period is set as 10 periods, and separate forward pulses are set for three variables respectively to observe the long-term trend of response change, and Monte Cario is adopted to simulate 200 times to obtain the impulse response diagram (Figure. 2).

The results show that no immediately response of AE appears in the face of the impact of FSA. A positive response is obtained from AE in the first phase and reaches the peak. The impact of FSA on AE in the second phase decreases sharply, and the impact effect in the third phase is close to 0, indicating that FSA lags behind the development of AE. Meanwhile, the influence of FSA on AE is not sustainable. In the face of the impact of AE, FSA immediately produces positive development, reaching the peak in the first phase, which indicates that the income generated by agricultural development can be immediately used in agricultural development. In addition, the positive impact of AE on FSA continues in four phases, indicating that AE increases the income of financial support for agriculture and has sustainability.

AE does not respond immediately in the face of the impact of AM. In the first phase, AM has a positive impact on AE and reaches the peak. In the second phase, its response coefficient decreases sharply, and the response coefficient in the fourth phase tends to be 0, indicating that the development of AM has a sustained positive impact on AE. AE has an immediately positive impact on AM, reaching its peak in the first phase and approaches zero in the fourth phase. The profits brought by AE also act on the indicators of AM. With the development of AE, farmers can use the profits generated by agriculture to purchase agricultural machinery, and the government can return the profits generated by agricultural development to farmers as subsidies for purchasing agricultural machinery.

As the FSA changes, AM immediately produces the maximum positive response. After the first phase, the response coefficient decreases sharply and tends to be zero in the fourth phase, thus FSA directly affects AM. For Chinese government departments, a large proportion of FSA is used for farmers' machinery purchase subsidies. Therefore, the impact of FSA on AM does not lag, but FSA directly has a positive impact on AM and reaches the peak immediately. On the contrary, the impact of AM on FSA lags, and its response coefficient approaches 0 in the third phase.

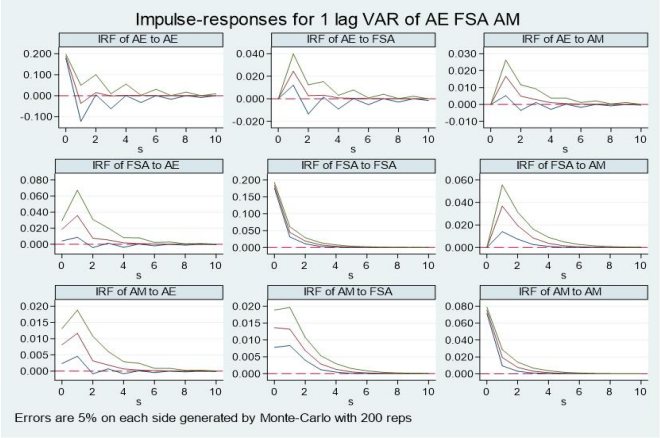

Figure. 2 Impulse response function diagram

3.3 Variance decomposition results

In order to further investigate the interaction degree of the three variables, the contribution degree of each variable is measured by variance decomposition (Table 5), the results of which are set into

eight different observation phases from phase 1 to phase 5, phase 10, phase 20 and phase 30 respectively.

The change of AE in phase 1 only comes from its own impact, and from phase 2 to phase 30, the change of AE still mainly comes from its own impact. In addition, in phase 2, the contribution of FSA remains stable at 1.6%, and in phase 3, the contribution of AE remains stable at 0.8%. The impact of FSA on AE is greater than that of AM. The change of FSA in phase 1 comes from the impact of two variables: AE and FSA. From phase 2 to phase 5, the impact effect of FSA on itself gradually decreases, and the impact effect remains stable at 91.1% after phase 5. In phase 2, the contribution of AE to FSA remains at 4.2%, and gradually tends to be stable after phase 4. In the second phase, the change of FSA is affected by AM. In the fifth phase, the contribution of AM to FSA reaches 4.6%. The change of AM is affected by three variables. After the fourth phase, the contribution of AE to AM maintains at 3.2%, and the contribution of FSA to AM maintains at 6.2%. It can be seen that FSA has a great impact on AM.

Table 5 Variance Decomposition Results

Var	S	AE	FSA	AM
AE	1.000	1.000	0.000	0.000
FSA	1.000	0.010	0.990	0.000
AM	1.000	0.011	0.031	0.958
AE	2.000	0.977	0.016	0.007
FSA	2.000	0.042	0.923	0.035
AM	2.000	0.030	0.054	0.915
AE	3.000	0.976	0.016	0.008
FSA	3.000	0.042	0.914	0.044
AM	3.000	0.031	0.060	0.908
AE	4.000	0.975	0.016	0.008
FSA	4.000	0.043	0.912	0.045
AM	4.000	0.032	0.062	0.907
AE	5.000	0.975	0.016	0.008
FSA	5.000	0.043	0.911	0.046
AM	5.000	0.032	0.062	0.906
AE	10.000	0.975	0.016	0.008
FSA	10.000	0.043	0.911	0.046
AM	10.000	0.032	0.062	0.906
AE	20.000	0.975	0.016	0.008
FSA	20.000	0.043	0.911	0.046
AM	20.000	0.032	0.062	0.906
AE	30.000	0.975	0.016	0.008
FSA	30.000	0.043	0.911	0.046
AM	30.000	0.032	0.062	0.906

4. Conclusions and policy implications

This paper conducts an empirically study on the basis of China's inter-provincial panel data with PVAR model, and analyzes the interactive mechanism of FSA, AM and AE in 31 provinces and cities in China from 2000 to 2019.

The changes of AE mainly come from its own impact, with a small part coming from the impact of FSA and AM. AE has an immediately positive impact on AM, which reaches its peak in the first phase and approaches 0 in the fourth phase. The profits brought by AE also affect the indicators of

AM. FSA lags behind AE and the impact of FSA on AE is not sustainable. The impact of FSA on AE is greater than that of AM. The contribution of AE to AM maintains at 3.2%, and the contribution of FSA to AM maintains at 6.2%. FSA has a great impact on AM.

More targeted suggestions are proposed based on the research results of this paper, which can be concluded from three aspects: planning and supervision of financial support for agriculture, large-scale farm construction and improving the financial subsidy mechanism. Firstly, a long-term plan for financial support for agriculture should be formulated and the supervision of financial support for agriculture should be strengthened. At present, the role of FSA in promoting agricultural development is weak and unsustainable, thus it is very necessary to formulate a long-term plan for FSA. In accordance with the principle of public finance, the agricultural and financial departments should further optimize the structure and highlight the key points of financial support for agriculture. They should also refine the use of funds and establish a special supervision and management organization for financial support for agriculture. Currently it is difficult for the financial fund from central and provincial governments for supporting agriculture to be transferred directly to farmers. After passing through the financial departments at all levels, the purpose and number of funds for supporting agriculture would be quite different from the original purpose and number of funds allocated by the central government. An independent organization can be established to manage the funds in the financial department or agricultural department, thus it can be ensured that the agricultural support funds can be put in place quickly and accurately. Particularly at the township level, a special management organization can play a strong regulatory role.

Secondly, land consolidation should strengthened and large farms need to be built. AM has a very positive impact on AE, while the contribution of AM to AE is only 0.8%, which shows that the effect agricultural mechanization has not been maximized, and it is still difficult to apply agricultural mechanization in agricultural production. Compared with that in developed countries, China's agricultural mechanization level is relatively low, and the situation of China's cultivated land is also quite complex. China has formed a family based farming model, and China's per capita cultivated land area is small, thus large machinery cannot directly act on narrow cultivated land, which leads to the low efficiency of agricultural mechanization output. Therefore, government departments should build large family farms and encourage farmers to jointly operate farms to improve the efficiency of agricultural mechanization farming. Hence the development of agricultural economy can be promoted.

More importantly, the subsidy policies for agricultural machinery purchase need to be improved by increasing the subsidy amount and lowering the threshold. The current agricultural subsidies are mainly for grain, improved varieties and agricultural machinery, which have promoted the increase of grain production and farmers' income. However, problems still exist in the current purchase subsidy policy, such as insufficient total amount, small scope, unreasonable subsidy structure, scattered funds, low incentive effect. The county-level government should update the list of agricultural machinery subsidies and lower the threshold for farmers to purchase machines. Different subsidy standards should be formulated for agricultural machinery with different power and uses purchased by various types of large agricultural households and farmers. Moreover, the scope of subsidies should be expanded, high-efficiency and high-tech agricultural machinery should be actively introduced. Shared mechanized services can be established by cooperating with agricultural machinery companies.

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