Original Paper

Study on the Effect of Agricultural Supply Chain Finance Empowering Agricultural and Rural Modernization

Jiatong Wang[1*]

[1] Beijing Wuzi University, Beijing, 101149, PR China

[*] Jiatong Wang, E-mail: wangjiatong1998@163.com

Abstract

Based on the data from 2011 to 2020, this paper constructs an index evaluation system of agricultural and rural modernization, and studies the effect and mechanism of agricultural supply chain financial development affecting agricultural and rural modernization. The following conclusions are drawn: First, the development of agricultural supply chain finance can significantly promote the modernization of agriculture and rural areas. Secondly, taking industrial structure adjustment as the threshold variable, there is a single threshold effect in the promotion of agricultural supply chain finance to agricultural and rural modernization: the higher the proportion of tertiary industry, the more significant the positive impact of agricultural supply chain finance on agricultural and rural modernization; Taking urban-rural integration as the threshold variable, its promotion effect has double threshold effect: the higher the level of urban-rural integration, the greater the promotion effect of agricultural supply chain finance on agricultural and rural modernization, but after the level of urban-rural integration rises to a certain extent, the promotion effect decreases slightly. At the same time, the promotion of agricultural supply chain finance to agricultural and rural modernization is more significant in middle and low-economic-level areas.

Keywords

Agricultural supply chain finance, Agricultural and rural modernization, Industrial structure, Urban-rural integration

1. Introduction

At the present stage, the most arduous and burdensome task in comprehensively building a strong modern socialist country remains in the countryside. The report to the 20th National Congress emphasizes the need to comprehensively promote rural revitalization, accelerate the construction of a

powerful agricultural country, ensured the development of agriculture and rural areas as a matter of priority, adhere to the integration of urban and rural development, and promote the circulation of factors between urban and rural areas. Realizing agricultural and rural modernization is the only way to build a strong socialist modernization country. However, in order to realize that modernization, the supporting role of financial system cannot be ignored. The increase of rural residents' income, the construction of infrastructure in rural areas, the optimization of rural ecological environment and the development of agricultural economy cannot be separated from financial support. The Strategic Plan for Rural Revitalization (2018-2022) points out that it is necessary to increase financial support for agriculture, improve the rural financial service system, so that it can adapt to the characteristics of the development of agriculture and rural areas, and allocate more abundant financial resources in the key and weak links of rural development, so as to meet the diversified financial needs of rural areas. Then, will the development of agricultural supply chain finance promote the modernization of agriculture and rural areas? Is the influence nonlinear? Is there any heterogeneity? This paper carries out an in-depth study on these issues to provide a certain theoretical basis for accelerating the development of agricultural and rural modernization.

2. Literature Review

Through literature review, it is found that agricultural supply chain finance can promote the modernization of agriculture and rural areas from the following aspects: First, agricultural supply chain finance can promote the development of rural industries. Supply chain finance can relax credit constraints in rural areas by reducing financing costs, alleviating information asymmetry, credit enhancement mechanism and risk prevention and control mechanism, and then promote industrial modernization in rural areas (Dong Xiaojun et al., 2022). Second, agricultural supply chain finance can increase the income of residents in rural areas. The development of agricultural supply chain finance can indirectly promote residents' employment and capital accumulation (Shen Yun et al., 2019). To a certain extent, it can also solve the problems of credit failure and improper allocation of financial resources in rural areas, and provide more efficient, low-cost and safe financial services for rural small and micro enterprises and farmers (Shen Yun et al., 2018). Shen Yun et al. (2019) constructed the multidimensional poverty index, and found that the greater the probability of farmers obtaining the supply chain financial credit of farmers' cooperatives, the higher the probability of their multidimensional poverty index and order decline, which shows that the development of agricultural supply chain finance has a very positive impact on poverty reduction and income increase of rural residents. Dai Debao et al. (2022) studied according to the upgraded panel data, and found that agricultural supply chain finance can increase the income of rural residents and reduce the Engel coefficient of rural residents, and its poverty reduction effect is more significant in economically backward areas. Jiang Boheng et al. (2022) studied based on CRERFS2021 data, and also found that agricultural supply chain finance significantly promoted the increase of farmers' farming income. Guo

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Jie et al. (2022), from the perspective of enterprises, by studying the financial data of listed agriculture-related enterprises, found that agricultural supply chain finance can effectively alleviate the financing difficulties of agriculture-related enterprises, and this positive role is more significant for enterprises participating in precision poverty alleviation, which can encourage more agriculture-related enterprises to actively build and develop villages.

Through the above analysis, it is found that there are relatively few empirical studies on the impact of agricultural supply chain finance on agricultural and rural modernization at present. Therefore, this paper selects the data of 30 regions in China from 2011 to 2020 (excluding Tibet, Hong Kong, Macao and Taiwan), constructs the agricultural and rural modernization index, and analyzes the promotion of agricultural supply chain finance to agricultural and rural modernization.

3. Research design

3.1 Variable Selection

This paper measures the index of agricultural and rural modernization of each province based on the provincial panel data of 30 provinces (except Tibet) in mainland China from 2011 to 2020, and studies the impact of agricultural supply chain finance on agricultural and rural modernization. The data come from China Statistical Yearbook, People's Bank of China, Provincial Statistical Yearbook, China Labor Statistical Yearbook and National Bureau of Statistics.

a. Explained variable: Agricultural and rural modernization level (Rur). In this paper, the practice of Chen Huiqing et al. (2022) is used for reference to construct the index evaluation system of agricultural and rural modernization. On the basis of standardizing the original data, the weighting method of Liu Jun et al. (2020) is used to weight each index, and the agricultural and rural modernization level index of different provinces is calculated, and the natural logarithm is taken. Among them, the selection of each index is shown in Table 1.

Table 1. Index Evaluation System of Agricultural and Rural Modernization Level

first-class index	second-class index	attribute
rural agricultural modernization	Proportion of effective irrigated area to total sown area	+
	Per capita grain output	+
	Total power of agricultural machinery	+
	Fiscal expenditure on agriculture, forestry and water affairs	+
rural ecological modernization	Application amount of chemical fertilizer per unit sown area	-
	Forest coverage rate	+
	Harmless treatment rate of domestic garbage	+
	Fiscal expenditure on environmental protection	+
rural cultural	Per capita possession of public library collections	+

modernization	Financial expenditure on culture, sports and media	+
	Fiscal expenditure on science and technology	+
	Telephone penetration rate	+
rural governance modernization	Pension insurance participation rate	+
	Number of village committees per 10,000 people in villages	+
	Finance expenditures on social security and employment	+
	Number of health workers per 10,000 people in villages	+
farmers' life modernization	Engel coefficient	-
	Proportion of administrative villages with centralized water supply	+
	Rural electricity consumption	+
	The proportion of rural residents' education, culture and entertainment consumption to total consumption	+

b. Core explanatory variables: Level of agricultural supply chain financial (Ain). This paper draws lessons from the practice of Dai Debao et al. (2022), and uses the logarithmic value of the balance of local and foreign currency agriculture-related loans of financial institutions to represent the development level of agricultural supply chain finance in different regions.

c. Threshold variables: Industrial structure adjustment (Ais), urban-rural integration (Urb). Among them, industrial structure adjustment is measured by the ratio of the added value of the tertiary industry to the added value of the secondary industry; Urban-rural integration is measured by the proportion of urban population to the total population.

d. control variables: Government intervention (Gov), industrial structure adjustment (Ais), human capital (Hum), population status (Pop), education popularity (Edu). Government intervention is measured by the ratio of general budget expenditure to regional GDP; Industrial structure adjustment is the same as the measurement of threshold variables above; Human capital is measured by the ratio of the number of students in ordinary high schools to the resident population in the region; Population status is measured by the total dependency ratio; Education popularity is measured by the proportion of illiteracy in the population over 15 years old. Table 2 below shows descriptive statistics of relevant data:

Table 2. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Rur	3.612	0.208	2.919	4.036
Ain	4.136	0.861	2.034	6.151
Ais	1.324	0.729	0.527	5.244
Urb	0.590	0.122	0.350	0.896

Gov	0.117	0.032	0.058	0.245
Hum	0.018	0.004	0.006	0.027
Pop	0.374	0.071	0.193	0.578
Edu	4.908	2.757	0.890	16.630

3.2 Model Design

In order to analyze the impact of agricultural supply chain finance development on agricultural and rural modernization, this paper constructs the following model:

$$Rur_{it}=\alpha_1 Ain_{it}+\alpha_z C_{it}+\alpha_0+\mu_i+\sigma_t+\varepsilon_{it} \tag{1}$$

In the above formula, Rur_{it} is the agricultural and rural modernization level of i province in t year, and Ain_{it} is the agricultural supply chain financial development level of i province in t year. C_{it} is the control variable of i province in t year, μ_i is the fixed effect of province, σ_t is the fixed effect of year, ε_{it} is the random disturbance term, and α_1 is the influence coefficient of agricultural supply chain financial development on agricultural and rural modernization.

Because the impact of agricultural supply chain finance development on agricultural and rural modernization may be nonlinear, this paper analyzes the threshold effect. In this paper, Hansen's (1999) method is used for reference to build a panel threshold regression model. Single threshold and double threshold models are as follows:

$$Rur_{it}=\rho_1 Ain_{it}\ I(q_{it}\leq\theta_1)+\rho_2\ Ain_{it}\ I(q_{it}>\theta_1)+\rho_z C_{it}+\rho_0+\mu_i+\sigma_t+\varepsilon_{it} \tag{2}$$

$$Rur_{it}=\delta_1 Ain_{it}I(q_{it}\leq\theta_1)+\delta_2 Ain_{it}I(\theta_1< q_{it}\leq\theta_2)+ \delta_2 Ain_{it}I(q_{it}>\theta_2)+ \delta_z C_{it}+\delta_0+\mu_i+\sigma_t+\varepsilon_{it} \tag{3}$$

Where q_{it} denotes threshold variables, θ_1 and θ_2 denote threshold values, I ($\cdot$) denotes indicative functions.

4. Analysis of Empirical Results

4.1 Benchmark Regression Result Analysis

In this paper, the fixed effect model is taken as the benchmark regression model, and Table 3 shows the benchmark regression results of the impact of agricultural supply chain finance development on agricultural and rural modernization. Columns (1), (2) and (3) in the table are the regression results of gradually adding individual fixed effect, time fixed effect and control variables. It can be seen from the results that the R2 of regression results is constantly rising, which shows that the explanatory ability of the model to the influence effect is constantly improving. The development of agricultural supply chain finance has always promoted the modernization of agriculture and rural areas at a significant level of 1%, which reveals the positive impact of the development of agricultural supply chain finance on agricultural and rural modernization and shows the importance of developing supply chain finance.

Table 3. Benchmark Regression Results

	(1)	(2)	(3)
Ain	0.432***	0.194***	0.199***
	(0.021)	(0.034)	(0.040)
Gov			0.510
			(0.492)
Ais			0.074*
			(0.042)
Hum			3.448
			(4.743)
Pop			-0.493**
			(0.240)
Edu			-0.001
			(0.006)
_cons	1.826***	2.649***	2.604***
	(0.086)	(0.123)	(0.169)
year	No	Yes	Yes
province	Yes	Yes	Yes
R^2	0.867	0.921	0.930

Note. ***, **, * represent the significance at 1%, 5% and 10% levels respectively, and clustering robust standard errors are in brackets, the same below.

4.2 Robustness Tests

4.2.1 Replace the Explained Variable

To verify the stability of the benchmark regression results, the explained variables above are now replaced. In this paper, the entropy method is used to calculate a new level of agricultural and rural modernization (Rur2) to replace the explained variables above, and the two-way fixed effect model is also used for regression. Table 4 (1) is the regression result after replacing the explained variables. It can be seen that the promotion of agricultural supply chain finance to agricultural and rural modernization is still stable, which is consistent with the benchmark regression result.

4.2.2 Winsorization

From the descriptive statistics of variables in Table 2 above, it can be seen that there are great differences in the level of agricultural and rural modernization as well as the agricultural supply chain finance among different regions. Hence, these two subjects are treated with winsorization to avoid the interference caused by outliers. In this paper, the level of agricultural and rural modernization and the level of agricultural supply chain finance are simultaneously reduced by 5% on both sides, and the

fixed effect model is also used for regression analysis. Table 4 (2) is the regression result after the winsorization. The results show that the development of agricultural supply chain finance still significantly promotes the level of agricultural and rural modernization, and it is significant at the level of 1%.

4.2.3 Instrumental Variable Method

In order to alleviate endogeneity, this paper uses instrumental variable method to carry out regression analysis, and selects the lagging period of agricultural supply chain financial level as instrumental variable, and then carries out 2SLS regression. Table 4 (3) shows the regression results after using instrumental variables. It can be seen from the results that the positive impact of the agricultural supply chain finance development on agricultural and rural modernization is still significant, which is significant at the level of 1%. In addition, the P-value of Kleibergen-Paap rk LM is significant at the 1% level; the Wald F-value of Kleibergen-Paap rk is larger than the critical value at the 10% level in the Stock-Yogo test, which shows that the setting of this instrumental variable is reasonable.

Table 4. Robustness Tests

	(1)	(2)	(3)
	Replace the explained variable	Winsorization	Instrumental variable method
Ain	0.146^{***}	0.199^{***}	0.200^{***}
	(0.040)	(0.030)	(0.026)
Control	Yes	Yes	Yes
year	Yes	Yes	Yes
province	Yes	Yes	Yes
R^2	0.935	0.925	0.964
Kleibergen-Paap rk LM			61.897 [0.000]
Kleibergen-Paap rk Wald F			497.704{16.38}

Note. [] is the P value and {} is the critical value at the 10% level of the Stock-Yogo test.

4.3 Threshold Effect Analysis

Firstly, the significance of threshold effect and the number of thresholds is tested by Bootstrap method 300 times, and the P-value and F-statistics are obtained. Table 5 shows the results of threshold effect test. It can be seen from the table that when industrial structure adjustment is taken as threshold variable, there is a single threshold, which is significant at 10% level; When urban-rural integration is taken as the threshold variable, there are double thresholds, which are significant at 5% level.

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Table 5 Threshold Effect Analysis

		Threshold value	F	P	Critical value		
					10%	5%	1%
Industrial structure adjustment	Single	1.4594	26.63	0.0767	24.9467	28.8095	35.0718
	Double	—	16.05	0.1933	20.2311	23.0585	35.9394
Urban-rural integration	Single	0.3999	60.70	0.0000	23.7973	27.9886	44.8242
	Double	0.7415	41.18	0.0233	27.7534	33.2070	44.4604
	Triple	—	15.31	0.5400	56.3801	74.6068	97.5619

Table 6 shows the threshold regression results of this paper. Table 6 (1) shows the regression results with industrial structure adjustment as the threshold variable. From the table, it can be seen that the positive impact of agricultural supply chain finance on agricultural and rural modernization is significant at the 1% level regardless of which interval the industrial structure adjustment is in. When the industrial structure adjustment is lower than the threshold value of 1.4594, the impact coefficient of agricultural supply chain finance on agricultural and rural modernization is 0.200; When the industrial structure adjustment is higher than the threshold value of 1.4594, the impact coefficient of agricultural supply chain finance on agricultural rural modernization rises to 0.214, and its promotion effect is enhanced. This result reflects the positive impact of the development of the tertiary industry.

Column (2) is the regression result with the level of urban-rural integration as the threshold variable. It can also be seen from the table that agricultural supply chain finance has always played a significant role in promoting agricultural and rural modernization. Further analysis shows that when the level of urban-rural integration is lower than the threshold value of 0.3999, the impact coefficient of agricultural supply chain finance on agricultural and rural modernization is 0.1462; When the level of urban-rural integration is between 0.3999 and 0.7415, the impact coefficient of agricultural supply chain finance on agricultural and rural modernization rises to 0.1773; When the level of urban-rural integration is higher than the threshold value of 0.7415, the impact coefficient decreases slightly to 0.1771. After the above analysis, it is found that when the level of urban-rural integration rises, the promotion of agricultural supply chain finance to agricultural and rural modernization increases, but after the level of urban-rural integration rises to a certain extent, its promotion is slightly weakened and still plays a positive role.

Table 6. Threshold Effect Regression Results

	(1)	(2)
	Industrial structure adjustment	Urban-rural integration

Low threshold interval	0.200^{***}		0.1462^{***}
	(0.036)		(0.033)
Middle threshold interval			0.1773^{***}
			(0.033)
High threshold interval	0.214^{***}		0.1771^{***}
	(0.038)		(0.032)
Control	Yes		Yes
year	Yes		Yes
province	Yes		Yes
R^2	0.935		0.937

4.4 Heterogeneity Analysis

In order to further explore the internal relationship between agricultural supply chain finance and agricultural and rural modernization, this paper analyzes the heterogeneity of agricultural supply chain finance in promoting agricultural and rural modernization by means of grouping regression.

In order to explore the promotion degree of agricultural supply chain finance to agricultural and rural modernization in different economic levels, this paper takes the regional per capita GDP as the grouping basis for grouping regression, and Table 7 is the regression result. The results show that the promotion of agricultural supply chain finance to agricultural and rural modernization is more significant in samples with low economic level and medium economic level; It is not significant in the sample with high economic level. And with the gradual transition of economic level from low level to high level, the impact coefficient of agricultural supply chain finance on agricultural and rural modernization is decreasing. It shows that the promotion effect of agricultural supply chain finance on agricultural and rural modernization is more obvious in regions with relatively backward economic level.

Table 7. Grouping Regression Results

	(1)	(2)	(3)
	Low economic level	Medium economic level	High economic level
Ain	0.233^{***}	0.120^{***}	0.056
	(0.073)	(0.044)	(0.039)
Control	Yes	Yes	Yes
year	Yes	Yes	Yes
province	Yes	Yes	Yes
R^2	0.980	0.987	0.967

5. Conclusions and Suggestions

Based on the data of 30 provinces in China from 2011 to 2020, this paper constructs an index evaluation system of agricultural and rural modernization, and studies the effect and mechanism of agricultural supply chain financial development on agricultural and rural modernization. The research draws the following conclusions: First, the development of agricultural supply chain finance can significantly promote the modernization of agriculture and rural areas. Secondly, taking industrial structure adjustment as the threshold variable, there is a single threshold effect in the promotion of agricultural supply chain finance to agricultural and rural modernization: the higher the proportion of tertiary industry, the more significant the positive impact of agricultural supply chain finance on agricultural and rural modernization; Taking urban-rural integration as the threshold variable, there are double threshold effects in its promotion: the higher the level of urban-rural integration, the greater the promotion of agricultural supply chain finance to agricultural and rural modernization, but after the level of urban-rural integration rises to a certain extent, the promotion of agricultural supply chain finance decreases slightly. At the same time, the promotion of agricultural supply chain finance to agricultural and rural modernization is more significant in middle and low economic level areas.

Based on the above conclusions, the following suggestions are put forward: First, we should actively develop agricultural supply chain finance, improve the financial service system in rural areas, and launch innovative and diversified financial products to meet the financial needs of rural residents. At the same time, financial institutions should actively publicize relevant financial knowledge and improve rural residents' financial awareness. The government should provide corresponding policy support for agricultural supply chain finance and actively promote the development of agricultural supply chain finance. Second, we should actively promote the upgrading of industrial structure in rural areas, expand the scale of tertiary industry and broaden the income channels of rural residents. Third, we should promote the integration of urban and rural development, narrow the development gap between urban and rural areas, and accelerate the flow of production factors between urban and rural areas, so that agricultural supply chain finance can better promote the modernization of agriculture and rural areas.

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