



Analysis of Coupling Relationship Between Agricultural Industry Chain and Inclusive Finance Development

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Abstract. By analyzing the coupling mechanism between the development of agricultural industrial chain and inclusive finance, the evaluation index system of agricultural industrial chain and inclusive finance development was constructed respectively, and the coupling coordination degree model was used to analyze the development situation and the change process of the coupling relationship between the two in Jiangsu Province from 2010 to 2019. The results show that the development level of agricultural industry chain and inclusive finance in Jiangsu province shows an upward trend, and the coupling coordination degree of the two keeps improving, experiencing the stage of disadjustment—transition—coordination. The two present an alternating change situation of the development of inclusive finance and the development of agricultural industry chain is relatively lagging behind. The research of this paper has certain guiding significance to accelerate the establishment of technological innovation strategic alliance between industrial chain and financial institutions, strengthen the financial literacy education of small and micro enterprises and farmers in agricultural industrial chain, and improve the quality of financial supply of industrial chain relying on financial digitization.

Keywords: Agricultural Industry Chain · Inclusive Finance · Coupling Relationship

1 Introduction

In January 2020, the Central Committee of the Communist Party of China and the State Council pointed out in the “Opinions on Doing a Good Job in the “Three Rural” Areas to Ensure an All-round Well-off Society as Scheduled” and issued that it supports all regions to build distinctive agricultural industrial chains based on their resource advantages. Organic integration is achieved through economic and technological links between agricultural-related industries, so as to achieve the organic combination of horizontal integration and vertical integration in the agricultural industry chain. However, due to the continuous expansion of the development scale of the agricultural industry chain, the demand for funds in the industry chain has increased significantly, and the weak small and micro enterprises and farmers in the industry chain often face the problem

of insufficient loan funds. On October 18, 2017, the Central Rural Work Leading Group pointed out in the National Rural Revitalization Strategic Plan (2018–2022) to increase the loan coverage of small and micro enterprises and farmers to enhance the availability of inclusive financial services. Although my country's rural inclusive financial system has been well developed, it still cannot meet the financial needs of the rural industrial chain. With the continuous expansion of the scale of the agricultural industry chain, the problem of insufficient loan funds supply in the industry chain has become increasingly prominent. According to the China Financial Yearbook, from 2016 to 2018, the ratio of agricultural loans involving the agricultural industry chain to the total loan balance was 1.11%, 1.03%, and 0.91%, respectively, showing a downward trend. Therefore, the China Banking and Insurance Regulatory Commission issued the Notice on Banking and Insurance Services for Rural Revitalization and Helping Poverty Alleviation Work pointed out that all banking financial institutions should maintain the same caliber of continuous growth in the balance of agriculture-related loans, and realize the growth rate of inclusive agriculture-related loans is generally higher than the average growth rate of various loans in 2019. Inclusive finance helps the development of the agricultural industry chain by supporting the loan needs of small and micro enterprises and farmers, and the development of the agricultural industry chain has further promoted the healthy development of inclusive finance. Therefore, studying the coupling relationship between the agricultural industry chain and the development of inclusive finance is necessary to promote the coordinated development of the two.

Focusing on the relationship between the agricultural industry chain and inclusive finance, some scholars have carried out research from the perspective of financial support for the agricultural industry chain. [9] proposed to analyze agriculture from the perspectives of industrial chain, financial market, and third-party credit enhancement. Industry chain financing strategy. [6] found that the “bank + cooperative + farmer” financing model can suppress the moral hazard of members at a lower cost, improve the ability of members to repay loans, and give opportunities for innovation and development of the agricultural industry chain. [4] analysis of 55 agricultural industry chains in Zhejiang Province, it is found that the agricultural industry chain model can widely attract foreign capital to bring opportunities for agricultural financing difficulties and improve the efficiency of inclusive finance implementation. Other scholars have carried out research from the perspective of farmers in the industrial chain. [10] and [8] found through empirical analysis that the increase in the degree of organization of farmers and the increased willingness of farmers to participate in financing can improve the efficiency of industrial chain financing. At present, scholars have studied the internal relationship between the agricultural industry chain and inclusive finance development from the perspective of financial support of the agricultural industry chain and farmers in the industry chain. These research results provide a certain theoretical basis for the empirical research of this article. Using the entropy method and the coupling coordination degree model to conduct empirical research on the coupling relationship between the agricultural industry chain and inclusive finance development in Jiangsu Province, and put forward suggestions to promote the coordinated development of the agricultural industry chain and inclusive finance.

2 Analysis on the Coupling Mechanism of Agricultural Industry Chain and Inclusive Finance Development

[2] proposed that the development of agricultural industry chain should analyze its evolution logic from three aspects: agricultural industrial structure, financing model, and community of interests. [5] analyze the development of inclusive finance should focus on analyzing the hematopoietic and sustainability of the funds provided. This article combines existing research to analyze in detail how to achieve a benign interaction between the agricultural industry chain and inclusive finance development. The coupling mechanism analysis between the two is shown in Fig. 1.

First of all, the transformation of the agricultural industry structure is from the initial model of “dispersed farmers directly entering the market” to the model of “farmers + cooperatives/company”, and then to the model of “farmers + cooperatives + companies”. The social relationship network of the agricultural industry structure has gradually changed from homogeneous transformation into an open and diversified network. This relationship from simplification to organized economic relationship makes agricultural capital and company commercial capital closely integrated, and fully mobilize all agricultural production factors to achieve the integration of agricultural product production, processing, logistics, and sales. This modern form of industrial organization is conducive to improving the operating efficiency of the entire industrial chain. The improvement of the operational efficiency of the entire industrial chain makes farmers willing to increase investment in large-scale production, which in turn stimulates effective demand for loans from inclusive finance. As an important part of the agricultural industrial chain, farmers can participate in the industrial chain by signing contracts with agricultural cooperatives or agricultural enterprises, which can not only reduce the market risk of individual farmers, but also enable farmers to achieve economies of scale and obtain more economic benefits, and then form a good cycle of capital, manpower and technology.

Secondly, the financing mode of farmers has gradually changed from the original joint guarantee loan and third-party cooperative economic organization guarantee mode to the industrial chain mode, and the trust mode of its business activities has also changed from an emotional basis to a general trust based on formal contracts. In the industrial

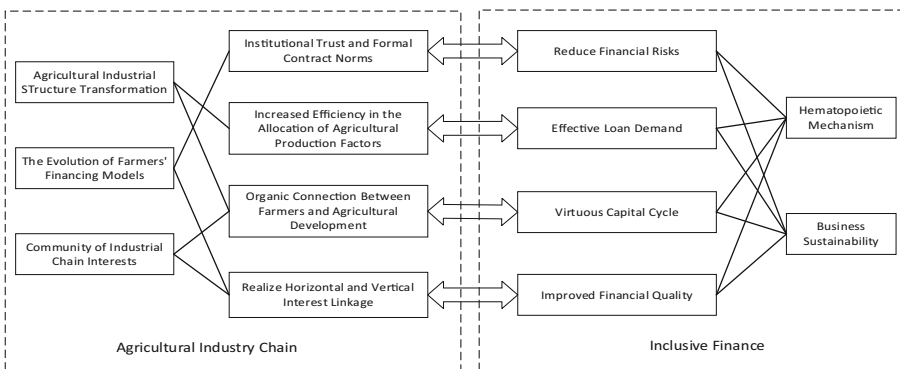


Fig. 1. Coupling Mechanism of Agricultural Industry Chain and Inclusive Finance Development

chain financing model, the economic transactions between the upstream and downstream of the industrial chain that use formal contract connections have strengthened the diversified horizontal and vertical links between the industrial chains. In this case, farmers can not only obtain production technology and market information, but also realize credit funds, precise and effective services to improve the quality of inclusive finance of farmers. At the same time, each link of the industrial chain is closely linked through formal contracts to enable the sharing of information resources between upstream and downstream, enhancing the stability and standardization of the main bodies of the industrial chain, thereby reducing the financial risks of participating members.

Furthermore, the interest linkage mechanism between agricultural core enterprises and farmers can be summarized into four ways: market linkage, contractual linkage, contract constraint, and equity participation linkage. The first type is loose market relations, where farmers sell agricultural products at market prices at market prices; the second type is where farmers sign agricultural order contracts; the third type is for core enterprises or cooperatives to develop and establish industrial bases, and then contract to farmers for operation or provide employment; the fourth is that farmers use land management rights and other methods to buy shares and cooperate. These interest linkage mechanisms increase farmers' horizontal and vertical participation in the industrial chain, and also make farmers and the industrial chain more closely organically connect.

Finally, the development of the agricultural industry chain has brought new opportunities for the development of inclusive finance. In order to meet the needs of the development of the agricultural industry chain, inclusive finance must pay more attention to the hematopoietic nature of funds provided in financial services and accelerate inclusive finance. The financial aid agriculture credit system solves the loan demand of farmers and reduces financial risks in the industrial chain. At the same time, inclusive finance pays attention to the matching of credit supply and the capital demand of the agricultural industry chain, ensuring the sustainability of inclusive financial services for the "three rural" and realizing a virtuous circle of inclusive financial funds. The sound development of the agricultural industry chain system has also strengthened farmers' awareness of compliance, and the use of the agricultural industry chain as a carrier to improve their financial inclusiveness, and farmers' awareness of proactive use of financial tools is conducive to the formation and stability of the agricultural industry chain's cooperative relationship.

3 Construction of the Coupling Coordination Model of the Development of Agricultural Industry Chain and Inclusive Finance

This article uses the coupling coordination degree model to quantitatively analyze the degree of coordinated development of the two. The analysis is based on the data of Jiangsu Province from 2010 to 2019. The agricultural industry chain data mainly comes from the "Jiangsu Statistical Yearbook" and the "China Rural Statistical Yearbook". The inclusive financial data comes from the "Jiangsu Statistical Yearbook" and "China Regional Finance Operation report".

3.1 Index System and Its Weight Formation

At present, the research topics of scholars on the development of the agricultural industry chain mainly focus on strengthening innovative technological capabilities, creating an open innovation environment, and enhancing the capabilities of the industrial chain. [1] proposed that agricultural innovation technology can produce synergy and aggregation quality, and improve the overall development level of the agricultural industry chain through resource aggregation. [3] proposed that an open innovation environment can also effectively promote agricultural technological innovation, and strengthen the development of the agricultural industry chain through the use of foreign capital and other means. [7] pointed out that the ability to improve is also an important indicator to measure the industrial chain development. Based on the actual situation of the industry and drawing on existing research results, this paper constructs an evaluation system for the agricultural industry chain development from the three aspects of innovation technology, innovation environment, and enhancement capabilities, and uses the entropy method to weight indicators, as shown in Table 1.

Regarding the establishment of an evaluation index system for the development level of inclusive finance, we mainly refer to the “Analysis Report on China’s Inclusive Finance Indicators” released by the People’s Bank of China in 2019. In this paper, specific indicators are formed from the three dimensions of the penetration, availability,

Table 1. The Evaluation Index System and Weight of Agricultural Industry Chain Development

Target Layer	Measurement Dimension	Specific Indicators	Weights
Agricultural Industry Chain Development	Innovative Technology	Number of professional and technical personnel per ten thousand agricultural employees	0.1088
		Number of invention patents in agricultural and sideline food processing industry	0.1268
		Number of granted patent applications for agriculture, forestry, animal husbandry and fishery	0.1644
	Innovation Environment	Agricultural fiscal expenditure as a proportion of local fiscal expenditure	0.1146
		Actual use of foreign capital in agriculture, forestry, animal husbandry and fishery	0.1854
	Improving Capability	Agricultural output value	0.0463
		The growth rate of per capita disposable income of rural residents	0.1518
		The ratio of the output value of agricultural and sideline products processing industry to the total agricultural output value	0.1019
	–	Total	1.0000

Table 2. The Evaluation Index System and Weight of Inclusive Finance Development

Target Layer	Measurement Dimension	Specific Indicators	Weights
Inclusive Financial Development	Permeability	Number of financial institutions per 10000 square kilometers	0.1160
		Number of financial institutions owned by every 10000 people	0.1155
		Agricultural loan balance	0.1019
	Availability	Proportion of balance of loans to small and micro enterprises	0.1284
		Insurance density	0.1456
		Agriculture-related loans accounted for the proportion of the added value of agriculture, forestry, animal husbandry and fishery	0.0593
	Utility	Small and micro enterprise loans as a percentage of GDP	0.1489
		Insurance depth	0.1844
	–	Total	1.0000

and utility of financial services to analyze, the entropy method is used to assign weights, as shown in Table 2.

3.2 The Coupling Coordination Model

$$U = \sum_{j=1}^m \omega_j x'_{ij} \tag{1}$$

Formula 1, ω_j is the weight calculated by the above agricultural industry chain and inclusive finance development evaluation system; x'_{ij} expressed as the j standardized index value in the i year; $U_1 U_2$ are the calculated comprehensive index of the agricultural industry chain and inclusive finance.

$$C = 2 \left\{ (U_1 \cdot U_2) / (U_1 + U_2)^2 \right\}^{1/2} \tag{2}$$

$$D = \sqrt{C \cdot T} \tag{3}$$

$$T = \alpha U_1 + \beta U_2 \tag{4}$$

Formula 2, C represents the degree of coordination between the agricultural industry chain and inclusive finance; Formula 3, D represents the degree of coupling coordination

between the agricultural industry chain and inclusive finance; Formula 4, T represents the comprehensive index development degree of the agricultural industry chain and inclusive finance; And $\alpha + \beta = 1$, considering that the agricultural industry chain and inclusive finance are equally important in the research, so $\alpha = \beta = 0.5$ is assigned.

4 Empirical Result Analysis

The comprehensive index of the development of agricultural industry chain and inclusive finance and the degree of coupling coordination are calculated through the coupling coordination degree model. The empirical results are shown in Table 3.

4.1 Comprehensive Index Analysis of the Development of Agricultural Industry Chain and Inclusive Finance from 2010 to 2019

It can be seen from Table 3 that the comprehensive index of the development of the agricultural industry chain increased from 0.46 in 2010 to 0.819 in 2011, and the growth rate of the comprehensive index reached 78.21%, and its development level was significantly improved. This was mainly due to the provincial government's organization

Table 3. The development level and coupling degree of the agricultural industry chain and inclusive finance

Time	U_1	U_2	C	T	D	Coordination Level	Degree of Coupling Coordination	Stage
2010	0.460	0.128	1.000	0.010	0.100	2	Severe imbalance	Dysregulation stage
2011	0.819	0.222	0.746	0.132	0.314	4	Mild disorder	
2012	0.827	0.590	0.993	0.201	0.447	5	On the verge of dysregulation	Transitional stage
2013	0.995	0.867	0.997	0.301	0.547	6	Barely coordinated	
2014	1.075	1.391	0.993	0.419	0.645	7	Primary coordination	Coordination stage
2015	1.242	1.442	1.000	0.477	0.691	7	Primary coordination	
2016	1.444	1.644	1.000	0.573	0.757	8	Intermediate coordination	
2017	1.597	1.907	1.000	0.665	0.816	9	Well coordinated	
2018	1.868	1.897	0.993	0.743	0.859	9	Well coordinated	
2019	2.138	2.825	1.000	0.990	0.995	10	Quality coordination	

and implementation of ten agricultural projects. The action plan pointed out that Jiangsu should give full play to its own advantages, accelerate the transformation of agricultural development mode, guide the entry of leading agricultural enterprises, promote the development of enterprise clusters, and then form an “industrial chain” business model. Under the influence of the policy, from 2012 to 2019, Jiangsu Province’s agricultural fiscal expenditures accounted for the proportion of local fiscal expenditures and agricultural output value and other indicators have been steadily rising, which in turn promoted the continuous improvement of the comprehensive index of Jiangsu’s agricultural industry chain and the agricultural industry. The development level of the chain has been continuously improved and optimized.

The comprehensive index for the development of inclusive finance in Jiangsu has undergone a process of “slow improvement-rapid development”. The level of inclusive finance development has been slow to increase from 2010 to 2015, mainly due to the slowdown in domestic economic growth, increased inflationary pressure, and macro-control policies and other factors have caused changes in the overall financial situation. Later, at the end of 2016, the state promulgated the “Promoting Inclusive Finance Development Plan (2016–2020)”, which greatly improved the development level of inclusive finance from 2016 to 2019, and significantly improved the penetration, availability and utility of inclusive finance.

4.2 Analysis of the Coupling and Coordination Degree of the Agricultural Industry Chain and the Development of Inclusive Finance from 2010 to 2019

The degree of coordination between the agricultural industry chain and inclusive finance in Jiangsu Province from 2010 to 2019 increased from 0.100 to 0.995. From the imbalance stage to the transition stage to the coordination stage, the level of coordination between the two continues to improve.

In the first stage (2010–2011), the degree of coupling and coordination was 0.100 and 0.314 respectively. It was in a phase of imbalance. The agricultural industry chain and inclusive finance developed at a relatively low level. At the same time, the development gap between the two is relatively obvious, which belongs to the relatively lagging development of inclusive finance. The degree of coupling and coordination between the two is relatively low. In the second stage (2012–2013), the gap between the entire agricultural industry chain and the development of inclusive finance has gradually narrowed, and the degree of coupling and coordination between the two has increased, from 0.314 to 0.547, but it is still relatively lagging behind the development of inclusive finance. In the third stage (2014–2019), as the agricultural industry chain and the development level of inclusive finance have improved, the coupling and coordination between the two have increased significantly and a certain benign interaction has been achieved. At the same time, affected by national policies, the level of development of inclusive finance exceeds the level of development of the agricultural industry chain, and the development of the agricultural industry chain is relatively lagging. By 2019, the development gap between the two has gradually increased. The reason is that although the current development of inclusive finance is rapid, it is mainly concentrated on the development of “quantity”, the use of funds is not efficient, and the development of inclusive finance funds is not

closely related to the development of the agricultural industry chain. It is easy to affect the development speed and quality of the agricultural industry chain.

5 Conclusions

The above research based on the coupling coordination degree model found that the current stage of the development of the agricultural industry chain is relatively lagging, which is not conducive to the continuation of the coordinated development of the two. Therefore, the interaction mechanism between the agricultural industry chain and the development of inclusive finance still needs to be strengthened.

5.1 Establish a Strategic Alliance of Technological Innovation Between the Agricultural Industry Chain and Financial Institutions

Strengthen the construction of scientific and technological innovation talents in the agricultural industry chain, gather technical talents in the agricultural industry chain and financial institutions, and jointly innovate the scientific and technological problems of the agricultural industry chain and loan demand, so as to improve the overall level of the agricultural industry chain.

5.2 Strengthen the Financial Literacy Education of Small and Micro Enterprises and Farmers in the Agricultural Industry Chain

On the one hand, by positioning core enterprises, including leading enterprises in the agricultural industry chain, sellers or suppliers with close supply relationships with upstream and downstream, etc., popularize agricultural financial knowledge to them, so that they can fully understand various agricultural industry financing models. It also encourages small and micro enterprises and farmers in the organizational system to access new financing channels and obtain financing; on the other hand, through inclusive financial lectures and financial community activities to strengthen the cultivation of financial literacy of small and micro enterprises and farmers in the industry chain, and improve their financial awareness, thus forming an effective financial service demand in the agricultural industry chain.

5.3 Relying on Financial Digitization to Improve the Quality of Financial Supply in the Industrial Chain

Using big data to analyze the transaction behavior and habits of farmers in the agricultural industry chain to accurately grasp the differentiated and personalized needs of farmers for financial services, and to design more targeted financial products for farmers. At the same time, an Internet credit investigation system related to the agricultural industry chain is established, and the transaction data of the industry chain is sorted and analyzed through big data to provide effective solutions to the difficult situation of agricultural credit evaluation, and then achieve inclusive financial precision drip irrigation.

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