Consensus Mechanism and Financial Applications of Blockchain Principles Adoption in Agricultural Value Chain Financing

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Abstract— Blockchain is a new technology based on the interdisciplinary development of cryptography, statistics, economics, and computer science. Its application is a research hotspot under the background of the development of Internet technology. This paper studies the working principle, algorithm and consensus mechanism represented by workload proof of emerging technology blockchain. In addition, this paper expounds the advantages of blockchain technology in promoting and improving agricultural value chain financing. Finally, this paper confirms the positive impact of blockchain and other technologies on rural credit through data.

Keywords-component; blockchain; agricultural value chain financing; credit environment; agricultural revitalization

1 INTRODUCTION

Agricultural value chain financing is the specific application of the concept of value chain in the field of agriculture [1]. In essence, it still belongs to the category of industrial value chain. Under the background of difficult and expensive financing of agriculture related business entities, agricultural supply chain financing has well solved the problems of low efficiency and decentralized production of traditional agriculture. Specifically, agriculture related business entities are naturally weak. Most of them have the problems of low credit ability and asymmetric information. Overall, they lack a good corporate governance mechanism. From the perspective of risk and income management of financial institutions, it is difficult for these business entities to obtain credit funds from banks and other financial institutions. This phenomenon is not only an important issue in the process of rural revitalization, but also a key obstacle to the development of characteristic industries. With the development of science and technology, how to rely on technological progress to solve the problems of difficult and expensive financing of agricultural business entities plays an important role in realizing the value-added of the industrial chain and improving the level of agricultural industrialization.

Based on the relevant literature, this paper introduces the new mode of agricultural value chain financing formed by the combination of Internet Finance and agricultural value chain under the background of scientific and technological progress, introduces the risk control of this mode, and popularizes this mode to promote the development of agriculture.

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2 OVERVIEW OF AGRICULTURAL VALUE CHAIN FINANCING

2.1 Definition and Characteristics

Individuals in the value chain are interconnected, and the production and operation of each participating subject is closely related to other subjects in the value chain. The development between different subjects can be regarded as a community of destiny. Due to the existence of spillover effects within the value chain, the development and operation of everyone is inseparable from the overall benefits of the value chain. In this case, the existence of the agricultural value chain plays an important role in the overall development of the value chain. Agricultural value chain financing refers to the exchange of funds between agricultural producers, processors, sellers, consumers, and financial institutions.

2.2 Specifications

The internal financing of the agricultural value chain refers to the economic exchanges between farmers, agricultural producers, agricultural products processors, agricultural products sellers, and consumers. External financing of the agricultural value chain refers to the capital exchanges between banks and other financial institutions and individuals within the agricultural value chain. When evaluating the value chain, banks and other financial institutions do not individually evaluate one of the individuals but will take ownership of the agricultural value chain. Individuals are evaluated as a whole, and funds are injected into the agricultural value chain based on the overall credit situation of the value chain.

2.3 Problems and Risks

Compared with other industry financing, agricultural industry chain financing has problems such as poor rural financial environment, incomplete financing service system, and low level of commercial security [2].

- Poor rural financial environment: The main participants in the agricultural industry chain, especially the individual farmers, generally have the problems of low learning ability, low management level, and weak production and management concepts. In addition, some farmers have weak legal awareness and breach of contract, which has had a relatively large negative impact on the credit environment.

- Incomplete financing service system: The current policy-based financial institutions oriented towards rural and agricultural development have the problems of uneven development and low overall development level.

- The level of commercial security is low: because financing activities rely on commercial activities, the fragility and instability of commercial activities will affect financing activities. In the case of large fluctuations in my country's agriculture, financing behavior will therefore also be constrained.

3 CREDIT ENHANCEMENT MECHANISM

By establishing a game model that includes agricultural economic stakeholders and capital suppliers, we theoretically analyze the credit-increasing role of the agricultural value chain [3].

3.1 Lending Without A Signal Of Credit Enhancement In The Agricultural Value Chain

3.1.1 Participants in the lending game: agricultural economic stakeholders and capital suppliers.

3.1.2 Assumption:

3.1.2.1 The main body of agricultural economic interest needs to borrow from the fund supplier;

3.1.2.2 The ability of the main body of agricultural economic interest (c) has high or low: c = L (low ability), c = H (high ability). Assuming that the probability of c being high-capacity is q, then the probability of c being low-capacity is 1-q.

3.1.2.3 The main body of agricultural economic interest uses the funds borrowed from the capital supplier to invest in agricultural production and other activities to generate income R_c, and $R'_c>0$, $R''_c<0$.

3.1.2.4 Agricultural economic stakeholders with high ability can use funds more efficiently, and will obtain higher marginal agricultural output income than those with low ability, that is, $R'_H > R'_L$.

3.1.2.5 The interest rate of the fund supplier is r, and the amount of funds in the credit loan is Q.

3.1.2.6 Then the net income of the main body of agricultural economic interest:

$$y = R_c - (1 + r) Q \tag{1}$$

When y'= 0, the net income Y is maximized, that is, the first derivative of the amount of borrowed funds Q is obtained from Y. When the derivative value is 0, Q is the optimal amount of borrowing.

3.1.2.7 The interest rate for each period is i.

3.1.3 Discuss by situation according to the distribution of information

If the information between the agricultural economic stakeholder and the fund supplier is symmetrically distributed, and the game between the two is an unlimited number of games, since default means that the loan will not be available in the future, and thus the income will not be obtained, so the present value of the future income is Is the opportunity cost of default. Under this circumstance, the default cost of the agricultural economic stakeholders is related to their future earnings. Present value of future earnings is calculated as

$$W_c = [R_c - (1+r)Q] / (1 - i) \tag{2}$$

If there is an agricultural economic interest subject to repay the debt on time to fulfill the loan contract, the prerequisite is that the default cost is large enough and needs to exceed the sum of the principal and interest of the loan funds. Specifically,

$$Wc = [R_c - (1+r)Q] / (1 - i) \geq (1 + r) Q \quad (3)$$

$$R_c=(1+r)(2-i)Q \quad (4)$$

From $R_H = (1+r) (2 - i) Q_H$, $R_L = (1+r) (2 - i) Q_L$, then the optimal borrowing capital scale of agricultural economic stakeholders with high and low capabilities can be obtained respectively.

3.2 Equilibrium under the credit enhancement of the agricultural value chain

Assuming that the agricultural value chain with key enterprises as the core has reached a cooperative relationship with the capital supplier, that is, the key enterprise increases the credit of other economic units in the agricultural value chain, and the capital supplier will make capital supply decisions in accordance with the signal of credit enhancement.

Since the fund supplier cannot observe the types of agricultural economic stakeholders, it can only make judgments based on the credit-increasing signals of the agricultural value chain, determine its repayment ability Sc, and estimate its probability. According to Bayes' theorem, the posterior probability The size is $q'= q'(C/S_C)$, and the strength of the repayment ability of agricultural economic stakeholders is determined from the posterior probability. The larger the S_C, the greater the ability of agricultural economic stakeholders to repay. The agricultural value chain sends a signal S_H to the capital supplier, and high-capacity agricultural economic stakeholders will receive Q_H loans.

Since the information distribution between the agricultural value chain and the agricultural economic stakeholders in the chain, and the information distribution between the agricultural value chain and the fund supplier is relatively symmetric, the risk of the information decision made by the fund supplier according to the obtained signal will be lower.

The agricultural economic stakeholders in the chain need to pay a certain price in order to gain credit in the agricultural value chain. Assuming that the cost of the agricultural economic stakeholders is $C_c(S)$, and $C'_c(S) > 0$, it means that it has high The signal cost of the agricultural economic interest subjects of the ability is lower than that of the lower ability, which means that if the low ability wants to obtain the signal of increasing the credit of the agricultural value chain, it needs to pay a higher price. Therefore, the signal cost that needs to be paid in order to obtain the credit enhancement of the agricultural value chain can be understood as a solution in the refined Bayesian model.

Therefore, in the process of borrowing and lending funds, agricultural economic interest subjects with different abilities choose different signal costs that they are willing to pay, and the funding providers will judge their types through their own choices. Assuming that the two types of economic interest entities choose to increase the signal of credit is SH, and the low-capacity agricultural economic interest entity’s signal cost for obtaining loan funds will be greater than the financing income, that is,

$$R_L - (1 + r) Q_L - C_L (S_H) <0 \quad (5)$$

while the high-capacity agricultural economic interests are on the contrary, the income obtained is greater than the signal cost, that is,

$$R_H - (1+r)\, Q_H - C_H\,(S_H) > 0 \tag{6}$$

The area value can be obtained from the above two inequalities [S1, S2], relying on this regional value, the fund supplier makes different types of loans to judge, in the regional value [S1, S2] are higher credit agricultural economic stakeholders, lower than S1 is low credit The main body of agricultural economic interest.

This shows that credit enhancement in the agricultural value chain has different signal costs for the agricultural economic stakeholders in the chain. The signal cost of agricultural economic stakeholders with low ability is higher than that of those with higher ability. This is Spence-Mo A sufficient condition for the establishment of Reese's separation equilibrium.

4 THE NEW DEVELOPMENT OF AGRICULTURAL VALUE CHAIN FINANCING IN THE CONTEXT OF INTERNET FINANCE

4.1 Innovate the traditional docking model

Farmers directly cooperate with Internet companies to promote agricultural product sales through online supermarkets.

The agricultural value chain generally cooperates with some large agricultural enterprises or through intermediaries and physical supermarkets, which is the so-called agricultural super docking, which reduces the cost of agricultural products to a certain extent, also reduces the prices of agricultural products, and increases sales. Through the completion of the entire value chain, individuals in the value chain are equivalent to obtaining financing from consumers' consumption, which can also be regarded as internal financing. The sales volume of agricultural products in the value chain has increased, and the evaluation level of the value chain by banks and other related financial institutions may also be improved. As the credit level is improved, the chances of obtaining external financing from banks and other financial institutions will be greater.

4.2 Lower interest rates through agricultural mortgages

In the loan process, farmers use agricultural products as mortgages, and financial institutions conduct credit evaluations on the agricultural value chain. Farmers often obtain more loans in the Internet financial service system than in the traditional financial service system.

4.3 Set up an information network to improve credit awareness

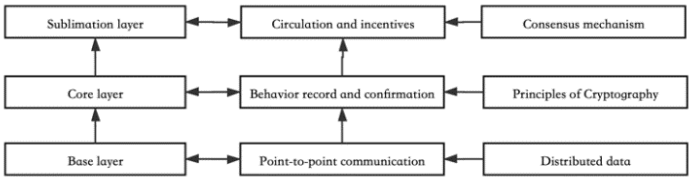
The collection and dissemination of information within the agricultural value chain through the Internet can reduce the loss of agricultural value chain financing due to credit awareness issues. In addition, banks and other financial institutions can grasp the value chain information in real time, reducing the risk of banks, The dissemination of information through the Internet also

reduces the cost of on-site visits, and can also provide a new way for external financing of the agricultural value chain.

5 INTEGRATED DEVELOPMENT OF AGRICULTURAL PRODUCT SUPPLY CHAIN FINANCE AND BLOCKCHAIN

5.1 Principles of Blockchain Technology

Blockchain is a comprehensive technical system integrating multiple technologies. The core technologies include consensus mechanism, cryptography principles, distributed data storage, smart contracts, etc. The system uses distributed node consensus algorithms to form data and relies on cryptography principles It escorts the security of data transmission and access, can realize point-to-point data transmission, and the data is created, maintained, and stored by many scattered nodes, without the need for transaction verification through the original central authorization method, and data can be carried out through the unanimous consent of all nodes verify. The data information in a period will be broken into a block, and each block is arranged in strict time series, thus forming a chain structure. Thanks to the support of the above four core technologies, blockchain technology can effectively reduce the cost of value transmission and realize the mapping of assets in the physical world to the digital domain [4].



Picture 1. The Logic of the Blockchain

5.2 Consensus mechanism

As the core technology of the blockchain, the consensus mechanism can effectively reach a consensus on the data of each node in the blockchain, quickly complete the transaction data processing, and ensure the consistency and reliability of the data. The following is a detailed introduction to the consensus mechanism of proof of work in blockchain technology.

The mining process in Bitcoin. "Miners" obtain certain bitcoin rewards by constantly trying to calculate a random number N that meets the difficulty of mining.

$$H(\text{BlockHeader}) \leq \text{target} \tag{7}$$

The difficulty value belongs to a very small part of the target value range in the 2^{256} input spaces.

$$Target = target * \frac{actualtime}{e^{expectedtime}} \tag{8}$$

In the blockchain system, the block will dynamically adjust the difficulty of the threshold within a certain period (every 2016 blocks, about two weeks).

$$Difficulty = \frac{difficulty||target}{Target} \quad (9)$$

Among them, *actualtime* and *expectedtime* are the actual mining difficulty and expected mining difficulty respectively; *Target* and *difficulty* are the target threshold difficulty and mining difficulty of the system respectively; *difficulty* || *target* is the actual mining difficulty value set by the system, the minimum is 1, and target is the target threshold.

When the system mining difficulty (target) remains unchanged, the actual mining difficulty is greater than the expected mining difficulty. If it is greater than 1 on the right of the equal sign, the target threshold increases, and the mining difficulty decreases. The mining difficulty is directly proportional to the target threshold difficulty.

5.3 Hash Algorithm

Hash function is a function that maps variable length data to a fixed length summary. Any change to the input data will lead to unpredictable changes in the hash column. The *SHA-256 Hash function* is used in the blockchain to hash the transaction data of any length, that is, the source data is processed to obtain a string of 256 characters for unified data management and storage, and then the characters in a unified format are packaged and stored in the block to reduce the storage space and ensure the data security to the greatest extent.

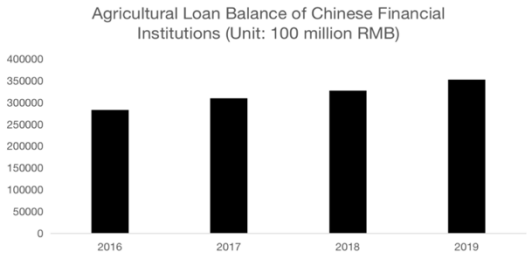
5.4 Blockchain and supply chain finance integration model

How to construct a flat operating organization in the financial operation of agricultural product supply chain is an important means to solve the problem of information in the financial operation of agricultural product supply chain. In this regard, relying on blockchain technology can build a point-to-point systematic transaction and communication platform. Various types of nodes on the chain, regardless of core or non-core enterprises, financial institutions or farmers, can achieve joint participation in data This greatly improves the authenticity and transmission of financial transaction information in the agricultural product supply chain, and can achieve the decentralization of information transmission, thereby effectively preventing transaction information from being tampered with, and further improving the agricultural product supply chain The efficiency of finance reduces the financing cost of agricultural product supply chain finance [5].

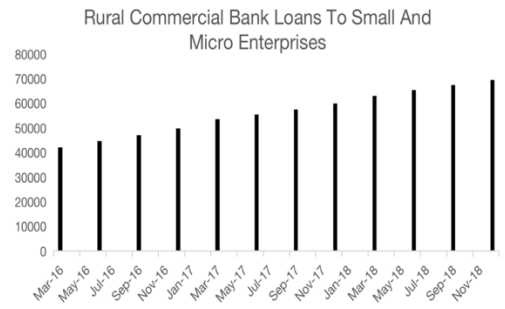
6 THE DEVELOPMENT OF AGRICULTURAL LOANS UNDER THE BACKGROUND OF THE INTERNET

Through the above analysis, the value chain can promote the agricultural credit environment. In the context of the continuous development of the Internet in recent years, scientific and technological progress has objectively promoted the improvement of financing in the agricultural sector. The following data comes from Wind.

The growth of different agricultural loan indicators shows that after the release of the “Internet+” policy, the financing environment related to agriculture has improved, and the financing level of the agricultural industry chain has also increased significantly.



Picture 2. Agricultural Loan Balance



Picture 3. Rual Commercial Bank Loans

7 CONCLUSIONS AND CONTRIBUTIONS

This paper mainly introduces the algorithm, working principle and consensus mechanism represented by positive workload of blockchain, a distributed account book technology based on peer-to-peer virtual network. Based on this, this paper further analyzes the impact of blockchain technology and other emerging storage technologies on agricultural financing.

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