

Inventory Financing Model Based on Blockchain Technology

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Abstract—Incorporating blockchain technology, this paper focuses on solving inventory financing difficulties of small and medium-sized enterprises (SMEs). Different from the existing financing model, we provide a new way for SMEs to obtain loan financing services without the involvement of core companies. Related concepts and main characteristics of blockchain are introduced. Data flow model of new inventory financing and its design details about how to apply these blockchain technology are described. Finally, we present its innovative advantages in solving the financing difficulties of SMEs.

Keywords—supply chain finance; blockchain; SMEs' financing; inventory financing

I. INTRODUCTION

Owing to the serious information asymmetry between banks and enterprises, financing difficulties have always been the bottleneck for the growth and development of SMEs. However, SMEs are of great importance for the development of the national economy. As far as China is concerned, SMEs account for more than 99% of the total number of enterprises, which contribute 60% of China's GDP, 50% of tax revenue, and solve 80% of the urban employment. It is an important force in China's economic development [1]. Therefore, solving the financing problems of SMEs is crucial to promote economic development.

To address this challenge, the supply chain finance has developed rapidly. Inventory financing mode, one of the main financing modes in supply chain finance, has become an important financing means to alleviate financing difficulties of SMEs. The inventory financing refers to the enterprises that need financing (i.e., the borrower) to obtain the funds by providing the pledge, the goods in the process of its trade, to the financial institutions (i.e., the lender). At the same time, the pledge is transferred to the logistics enterprise (i.e., a third party) with the legal custody inventory qualification. Generally, under the circumstance that the enterprise has a large inventory or a slow inventory turnover, leading to a large capital turnover

pressure, the enterprise tends to use the existing goods to cash out in advance.

There are still many problems restricting its further development, although the financing difficulties of some SMEs' has been alleviated to a certain extent. On the one hand, when the existing inventory financing service is implemented, the verification of the value of pledge, the review of ownership, and the examination of regulatory agency are usually cumbersome, which are easy to generate moral and operational risks. Issues such as false pledges, unclear responsibilities, and property rights disputes are still exist. On the other hand, the process of bartering in the inventory financing business is very easy to exchange into unsalable goods. Once the market price fluctuates, the threshold of third-party's minimum inventory cannot be timely revised and the real-time update is poor. Moreover, the regulatory authorities need to upload electronic data of in-out storage and inventory to financial institutions, which leads to large amount of data and cumbersome operations.

With the rapid development of the new-generation information technology such as big data, internet of things, cloud computing, intelligent manufacturing and machine learning, blockchain has attracted increasing attention in both academia and industry. Because of the characteristics of decentralization, trustless, autonomy, anonymity, transparency, consensus, traceability, non-tampering and distributed storage, blockchain technology has shown an explosive growth with application ranging from privacy protection [2-3], banking [4], e-Government [5], healthcare [6-8], energy [9], supply chain [10, 11], etc. Pan, et al. revealed that the implementation of blockchain technology has a positive impact on improving asset turnover rate and reducing sales expense rate in [12]. Wang et al. [13] proposed a theoretical model to analyze a new credit pattern of SMEs through the blockchain technology. The results show that the alleviation of information asymmetry and credit rationing problems can be achieved. Chiu [14] established a blockchain record-keeping system. The system can keep track of securities ownership as well as payments

related to securities trades. Therefore, it is commonly believed that the supply chain finance based on blockchain technology will have great potential in solving the above problems.

Enlightened by the above discussions, in this paper, we intend to consider a new inventory financing pattern by blockchain technology. This paper is organized as follows. In Section 2, some preliminaries for blockchain are presented. In Section 3, the design of the new inventory financing process is described. In Section 4, its innovative advantages in SMEs' financing are discussed. Finally, a brief conclusion is summarized.

II. PRELIMINARIES

In this section, the related concepts and main characteristics of the blockchain, which may indicate the way to solve the SMEs' financing difficulties under the supply chain finance, are introduced.

A. Distributed Ledger Technology

The distributed ledger is a distributed database that is shared, replicated, and synchronized between network members. Compared with traditional accounting techniques, data service centers are no longer needed. When the data in the system changes, each participating node can perform accounting. The record of the fastest and best node is written to the ledger and sent to other nodes in the system. Each node also verifies the correctness of the results recorded by other nodes while recording data, and the trading records will be written into the block without any problem. Therefore, each node in the system possesses and maintains a complete ledger, which achieved decentralization or multi-centered effects. Obviously, the records may be tampered when controlling more than 51% of these nodes at the same time, so as to ensure the security of the data and the unavailable data tampering while sharing the data. In addition, the data maintenance cost is also reduced.

B. Timestamp

The timestamp is embedded into the block header to facilitate the storage and update the trading records, indicating the writing time of the block data, so as to prove the existence of block data and ensure the authenticity of the transaction. Moreover, each block contains a timestamp as well as the hash value of the previous block, so that a continuous chain of linked data blocks is formed over time. In this way, we can pinpoint and verify the source of the historical transaction information by using the timestamp and blockchain structure. Furthermore, the fast forward and difficulty reverse of hash algorithm also guarantees the anti-tamper of transaction information.

C. Asymmetric Cryptography

Asymmetric cryptography is a basic technology for securing blockchains. It refers to the method of encrypting and decrypting information using two asymmetric keys (public and private keys). Public key is publicly available and can be provided to others. It can unlock the information encrypted by the private key, but cannot reverse the private key. The private key is confidential and held by the data owner. Consequently,

data sharing can be realized on the basis of ensuring that information is not leaked.

D. Consensus Mechanism

Consensus mechanism is an algorithm for achieving consistency among multiple nodes in a blockchain. All participants in a distributed scenario agree on the correct state of data on the blockchain. It ensures the normal operation of the system, and guarantees that the data is the same on all nodes in the network. Applying consensus mechanism to the field of supply chain finance can ensure the authenticity and integrity of the data source. Meanwhile, it is easy to check whether the transaction is credible. To some extent, the problem that the SMEs cannot self-certify the credit level? is solved.

E. Smart Contract

Using the script-programmable function of blockchain technology, each transaction information, chained data, tangible or intangible assets of the blockchain are written into the contract. Once the pre-setting terms are met, the system will be triggered and select contract action will be selected to automatically execute according to preset information. Different from the execution of traditional contract executing, the review of neutral third party institution is not required and external intervention cannot be performed until the contract is completed. Finally, the de-trust is achieved.

Based on these above techniques, some main characteristics of blockchain, which can be used in solving financing difficulties of SMEs, are discussed as follows.

Blockchain is a distributed ledger technology, which is a decentralized and completely autonomous system. It guarantees equality, freedom of participation or withdrawal for each node through peer-to-peer network technology, ensures the collective cooperative storage and maintenance of ledger by each node based on synchronization mechanism, makes sure that data cannot be tampered with the help of hash chain, solves the human intervention problem through the irreversible smart contract, guarantees the consistency, fault tolerance and authenticity of the distributed ledger by the consensus mechanism, solves the information traceability through timestamp, and ensures the privacy and security of block data with the help of privacy and password mechanism.

The timestamp and anti-tamper of the blockchain technology can well solve the problem of trade authenticity. Integrating such data as business flow, material flow, information flow and capital flow, all the participates can form and obtain the first-hand real and effective information in each link of the supply chain through blockchain technology. That guarantees the data safety and business transparency and visuality, thereby breaking the information islands of all links.

The characteristics of smart contract, consensus mechanism, decentralization will greatly reduce manual intervention, realize digital paper operation schemes, improve work efficiency, and largely reduce the error rate caused by manual transactions. To a certain extent, it will solve the transaction lag, fraud and operational risks, which exist in

traditional supply chain finance. On the other hand, the programmable digital tickets, developed by blockchain technology, enables the bills to be split and transferred in an open, transparent, and multi-party witness situation. This makes multi-level credit possible, thus solving the disadvantages of credit cannot be transmitted at multiple levels in traditional supply chain finance. In addition, the financial transactions through the blockchain can greatly reduce transaction costs, and shorten transaction processing time.

III. DESIGN THE INVENTORY FINANCING PROCESS BASED ON BLOCKCHAIN

In this section, a brief introduction to the functions of the participating entities in the inventory financing is given firstly. The data flow model of inventory financing is built. And the structure of the model is described.

A. Financial Institution

Financial institution is the supplier of financial services, as a core link, which controls third-party logistics companies to conduct material auditing and supervision. By launching this business, banks can provide loans to multiple companies at the same time, which broadens the scope of bank's business, makes banks no longer limited to providing financial services to single enterprise, helps banks find new profit growth points in the highly competitive financial industry.

B. Enterprise

Enterprise is the recipient of financial services. Inventory financing provides new financing channels for SMEs financing, which makes the company's capital flow more smooth, improves the efficiency of capital utilization, and provides valuable solutions for SMEs to enjoy financing services.

C. Third Party Logistics

As an intermediate link, third-party Logistics plays a leading role in financial institutions and lending companies. The inventory financing expands the logistics enterprise's business from the traditional transportation and warehousing services to the financial sector, broadens the business scope of logistics enterprises, and realizes the complementary development of the financial and logistics industry. The logistics enterprise provides services such as the custody, value evaluation, and direction supervision of the collateral, to set up a bridge between the bank and the enterprise. The inventory financing business scenario is presented by a dotted line in the Fig. 1.

Based on the distributed ledger technology, digital signature, asymmetric cryptography, smart contract, token and consensus mechanism of blockchain, data flow model of inventory financing is constructed. The data flow model of inventory financing is presented in Fig. 2. And the processes of inventory financing is designed as follows.

Step 1. Financing enterprises launch loan application to financial institutions, and the financial institutions conduct

credit verification about the financing enterprises and third-party logistics through credit pool. Then, the loan contract is deployed and hash signature confirmation is provided for financing enterprises and financial institutions in loan application module.

Step 2. Deploy inventory supervision contract and provide hash signature confirmation for financing enterprises, financial institutions and third-party logistics in inventory supervision module.

Step 3. The financing enterprises deliver pledge to the third party logistics and perform hash signature confirmation. After receiving the pledge, the third party logistics conduct hash signature confirmation. In the following, the third party logistics evaluate the pledge, issue an evaluation certificate to the financial institutions and perform hash signature confirmation. The financial institutions receive the evaluation certificate and then conduct hash signature confirmation in pledge delivery module.

Step 4. After receiving the application for the inventory pledge loan from the financing enterprises to the financial institutions, the financial institutions deploy and review the inventory pledge loan contract. And carrying out the hash signatures for the financing enterprises and the financial institutions in inventory pledge module.

Step 5. The financial institutions issue the loan to the financing enterprises in the form of token, and conduct hash signature confirmation. After receiving the loan, the financing enterprises perform hash signature confirmation in issuing token module.

Step 6. The financing enterprises return the loan to the financial institutions in the form of token, and perform hash signature confirmation. After receiving the repayment, the financial institutions carry out hash signature confirmation in token repayment module.

Step 7. Financial institutions send shipping instruction to third-party logistics and conduct hash signature confirmation. After receiving the instruction, the third-party logistics and financing enterprise perform the hash signature confirmation in shipping instruction generation module.

Step 8. The third-party logistics issue the pledge to the financing enterprises and conduct hash signature confirmation. After receiving the pledge, the financing enterprises and financial institutions perform the hash signature confirmation in sending confirmation module.

The loan application module, inventory supervision module, pledge delivery module, inventory pledge application module and issuing loan module are respectively located in multiple blocks of the blockchain system. By the means of timestamp, chained structure stores data, traceability and verifiability, the problems such as unclear responsibility and dispute of property rights can be well solved. The detailed structural design of blockchain system and the operation mechanism of contract blockchain will be presented in the following section.

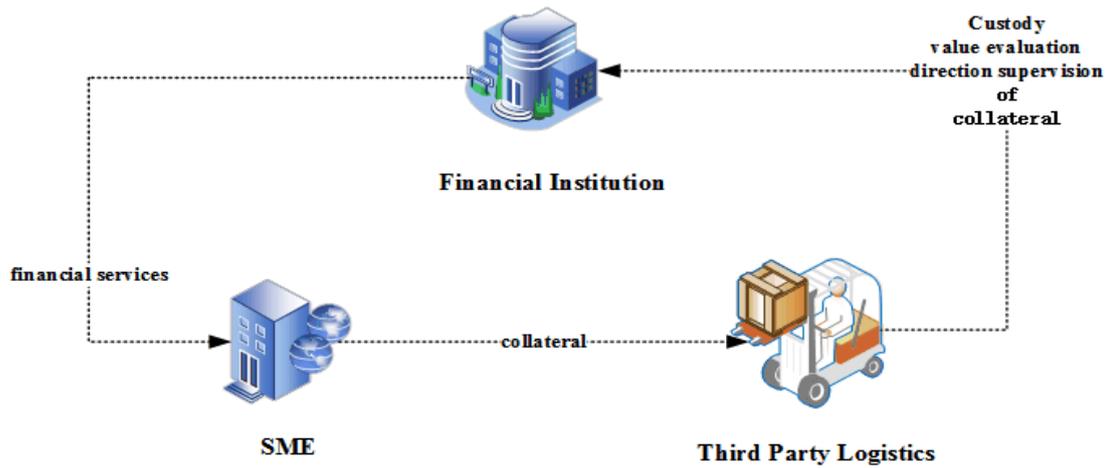


Fig. 1. Inventory financing business scenario.

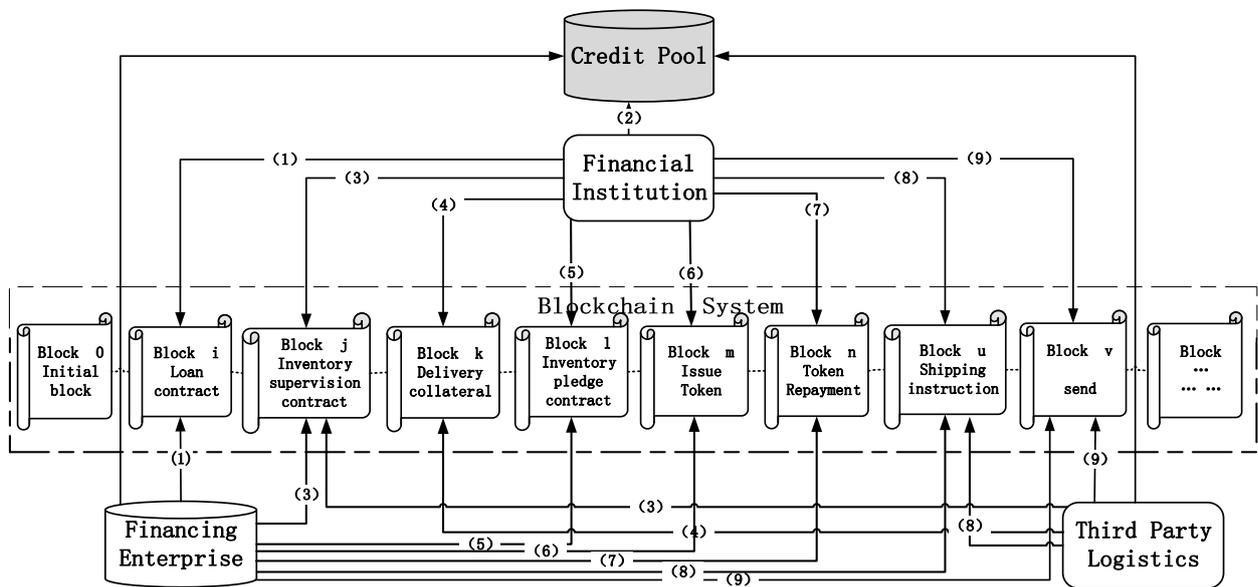


Fig. 2. Data flow model of inventory financing.

IV. ADVANTAGES IN SOLVING FINANCING DIFFICULTIES OF SMES

Based on the data flow model of inventory financing, we will further indicate its advantages in solving financing difficulties of SMEs.

Firstly, the information of loan application, pledge delivery and token repayment for financing enterprises, the information of pledge value verification, issuing token and shipping instruction for financial institutions, the sending information of third-party logistics, and the inventory supervision information signed by the three parties are all recorded in the block. Each participating entity has a complete set of ledger, which can be publicly queried and cannot be tampered. The hash signature and time-stamped chain block structure are highly traceable, verifiable, and can be used to

solve unclear responsibilities, the disputes of property rights. And Fig. 3 shows the structural design of blockchain system.

Secondly, the external party's business information flow is checked based on the real-time updated data information in the blockchain. Once the pre-setting terms are met, the smart contract is triggered and automatically executed according to the preset rules, which not only improves efficiency but also eliminates artificial falsehood. The operation mechanism of contract blockchain is described in Fig. 4.

In addition, the asymmetric cryptography technology unique to blockchain also makes information safe, reliable and difficult to be tampered. Finally, loans issued by financial institutions and loans repayment by financing companies are circulated in the form of token, which improves the efficiency of capital turnover.

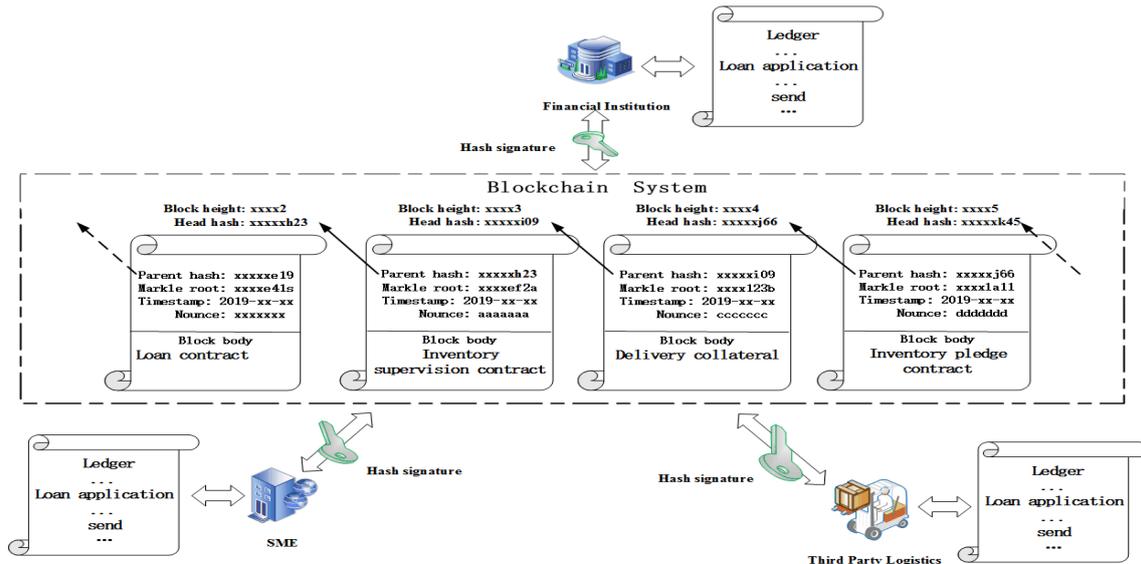


Fig. 3. The structural design of blockchain system..

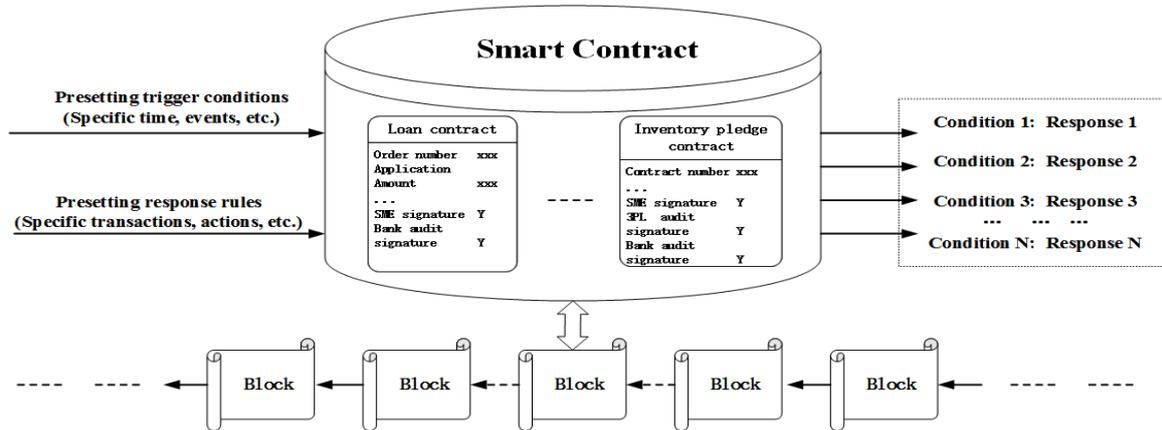


Fig. 4. The operation mechanism of contract blockchain.

V. CONCLUSION

This paper presents a new inventory financing model based on blockchain technology. Related transaction information are all recorded in blockchain, which can be publicly queried and cannot be tampered, enhancing mutual trust and reducing credit costs. Hash signature and time-stamped chain block structure ensure the authenticity and traceability of trade, solving unclear responsibilities and the disputes of property rights. Using smart contract, the transaction efficiency is improved and the possibility of artificial false operations is eliminated because the processes are automated. These make it possible for SMEs to get financing without the involvement of core companies. However, there still are some deficiencies in the current system, such as credit evaluation is not considered. Credit evaluation methods can be added in future studies to credit evaluation of enterprises on the chain. For example, a

blockchain-based credit evaluation system is provided in literature [15]. The system is used to strengthen the effectiveness of supervision and management in the food supply chain.

ACKNOWLEDGMENT

This research is supported by National Natural Science Fund of China (Project No. 71871090) , National Natural Science Fund of China for Emergency Management Project (Project No. 71850012) and Hunan Provincial Science & Technology Major Project (Project No. 2018GK1020).

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