



Block Chain Technology, Credit Rationing and SME Financing: Theoretical Basis and Application Scenario

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Abstract

The decentralized advantage of block chain technology helps to improve the credit business model of commercial banks, and also provides an idea to solve the financing difficulties of SME. This paper compares the traditional bank credit model with the credit model embedded in block chain technology from a theoretical perspective, and analyzes the impact on block chain technology on the relationship among banks, enterprises and governments. The analysis shows that the credit model embedded in block chain technology can improve the information asymmetry between banks and enterprises and alleviate the problem of bank credit rationing; The credit platform based on block chain technology effectively solves the financing difficulties faced by small and medium enterprises.

Keywords- *Block chain; Credit rationing; SME financing*

1. INTRODUCTION

The problem of difficult loans SME has plagued the academic community for several years. SME are an important part of China's economic structure. They play an irreplaceable role in increasing employment, improving people's livelihood and promoting economic growth. They are the core driving force of China's economic development. The growth of SME is inseparable from the support of financing, but the ability of SME to obtain credit restricts their growth and development. In China, the financing obstacles faced by SME mainly come from the credit rationing strategy of banks. There are two main reasons for the formation of credit rationing. One is the lack of effective collateral for SME [1], which makes many high-quality and low-risk enterprises unable to prove their credit quality to banks; Second, the information on banks and enterprises is highly asymmetric [2]. The moral hazard and adverse selection brought by information asymmetry make banks have to use credit rationing as a protection mechanism.

With the explosive growth of Internet technologies such as big data and cloud computing, information technology is leading people into the intelligent information age. Block chain technology is essentially a distributed shared ledger and database. It has the characteristics of decentralization, real-time, permanence,

sharing, traceability and tamper ability [3]. It is a new distributed architecture based on consensus algorithm. After several years of development, block chain technology has gone through the "digital cash" stage based on program algorithm and the "digital token" stages based on smart contract, and is moving towards the "digital ticket" stages based on physical asset mapping. Block chain technology shows great application potential [4]. Its application for supply chain finances, big data transaction, cross-border payment, digital currency and other aspects makes people no longer equate block chain technology with the application of bitcoin. Especially in supply chain finance, block chain technology, as an effective, reliable and timely distributed ledger, ensures the safe operation of supply chain finance and effectively reduces costs [5]. The supply chain financial platform involved in block chain technology integrates buyers, sellers, third-party logistics and financial institutions on the same block chain platform through pledge registration of accounts receivable and third-party supervision [6], which provides a new idea of applying block chain technology to solve the problem of information asymmetry between banks and enterprises.

The distributed characteristics of block chain ensuring the independence of information, and the characteristics that cannot be tampered with ensure the authenticity of information on the chain. The placement

of smart contract is convenient for the automatic execution of transactions. Block chain technology lays the foundation for the smooth transaction between the two parties that lack the foundation of trust. Then, can the integration of block chain technology and bank credit business alleviate the phenomenon of bank credit rationing and obtain good benefits? In the process of analyzing the causes of credit rationing and the advantages of block chain technology, this paper finds that the credit business of commercial banks has significant decentralization characteristics, which is very consistent with the decentralization characteristics of block chain technology. The credit platform built by block chain technology connects banks and enterprises in a point-to-point manner. From the perspective of banks, this not only save the human and financial resources spent by banks in collecting information, but also ensures post supervision; From the perspective of enterprises, this will effectively increase the probability of obtaining bank loans.

The rest of this paper is arranged as follows: the second part is to sort out the relevant literature; The third part is the theoretical basis analysis, which mainly introduces the connotation and data structure characteristics of block chain; The fourth part is the application scenario analysis. By comparing the traditional credit model with the credit model embedded in the block chain, and analyzing the effect of the credit model embedded in the block chain, it gives the specific application scheme for commercial banks to provide credit supports; The fifth part is the conclusion.

2. LITERATURE REVIEW

The financing dilemma of SME restricts their survival and development. Many scholars at home and abroad have studied the financing constraints on SME. The research shows that the financing constraints on SME are rooted in the information asymmetry between capital supply and demand. Stiglitz and Weiss [2] believe that the widespread information asymmetry in the financial market is the fundamental reason for the financing constraints of SME, and the adverse selection and moral hazards caused by it [7] will make credit rationing to exist on a long time. Credit rationing mainly has two meanings: one is that the number of loans obtained under the established interest rate is insufficient, and the other is that the subject cannot obtain loans even if it accepts higher interest rate [8] [9]. The small proportion of self-financing funds of SME, the lack of tangible assets as collateral and the relatively non-standard operation make it more difficult for banks to obtain the information on SME, which is one of the reasons for the high degree of information asymmetry between banks and SME [10]. Combined with China's economic situation and under the background of China's large bank oriented financial system, Lin Yifu and Li

Yongjun [11] pointed out from a macroeconomic perspective that most of China's SME are enterprises with more abundant labor force than capital, which are incompatible with China's financing system, resulting in low financing efficiency and expensive financing. It further aggravates the financing problems of SME in China. To solve the problem of information asymmetry, we mainly solve the difficulty of collecting soft information and increase the trust in SME. Increasing the transparency of SMEs information will help to eliminate the financing constraints of banks on SMEs caused by information asymmetry between SMEs and banks [12]. Commercial banks have comparative advantages in obtaining the hard information about SME, but they are in a weak position in obtaining the soft information on SME [13]. Banks can easily obtain hard information such as assets and patents owned by enterprises, but soft information such as the characteristics of borrowers, special local conditions and specific characteristics of companies [14] is difficult to collect. When the information is more opaque and lacks to guarantee, enterprises are more vulnerable to bank credit rationing [15]. A large number of empirical studies at home and abroad also show that there is a positive relationship between close bank enterprise relationship and SME loan availability [16] [17] [18]. Establishing a closer relationship between banks and enterprises can help solve the financing difficulties of SME. However, banks must also pay more time cost and information cost to confirm the authenticity and continuity of enterprise information [19]. Therefore, based on the choice of opportunity cost, banks choose to reduce this part of business volume, smaller banks even choose to withdraw from the SME loan market.

The rapid rise of block chain has attracted extensive attention from many scholars at home and abroad. Based on the technical characteristics of block chain, scholars at home and abroad analyze how the application of block chain technology will change various industries, such as clearing and payment, digital currency, etc. Raskin and yermack [20] discussed how the digital currency derived from block chain technology will change the future of central banks; Zhang Xiaomei [21] believe that the decentralization of block chain technology can fundamentally change the information structure of both financing parties, and point out that the development of this technology will make the direct financing mode dominate the financing market; Wang Sheng [22] analyzed the advantages of the monetary system in the form of block chain currency, and discussed the technical form of block chain currency in the time zone that will assume the function of legal currency in the future. In the follow-up, this paper add how block chain technology will contribute to alleviating the financing difficulties of SME.

3. THEORETICAL BASIS ANALYSIS

3.1. Technical connotation of blockchain

Block chain technology represents people's concept of "shared value chain" in the future. It is a passport to realize digital shared services in the future. The original form of block chain technology is an e-cash system based on cryptography, independent of third-party institutions and completely realized through point-to-point technology. It originated in the period of bitcoin trading. Block chain technology has distinct characteristics of decentralization, strong authentication and tamper resistance [23]. With the continuous development of block chain technology, the technology is not only mature and applied to currency trading platforms such as bitcoin and Ethereum, but also widely used in fields outside the currency system. Since the top-level design of block chain technology is mainly applied to value exchange, this technology has a distributed architecture, which is also called distributed ledger technology [24]. In addition, its unique point-to-point encryption form of "public key + private key" provides convenience for creating an unchangeable database. The transaction data recorded in the block chain is not only difficult to tamper, but also public. Since blocks record transaction data onto chronological order, each distributed node will be stamped with a timestamp, so that block chain technology can verify and create a set of unbreakable data records [25].

The emergence of block chain technology provides a new idea to solve the problems of easy data tampering, incomplete information and information privacy in the anti-counterfeiting and traceability system in relevant fields. The decentralization of block chain is its core advantage different from other technologies. Block chain technology uses block chain data structure to verify and store data, uses distributed node consensus algorithm to generate and update data, uses cryptography to ensure the security of data transmission and access, and uses intelligent contract composed of automatic script code to program and operate data [1]. In the practical application of bank block chain technology in supplying chain finance, it alleviates the problem of information asymmetry between upstream and downstream members of the supply chain. At the same time, it can make full use of the resources of upstream enterprises and reduce transaction costs. Based on the characteristics of block chain technology, the application of this technology to the credit business of commercial banks will not only effectively alleviate the problem of credit rationing, but also facilitate credit rationing. The bank managed the funds afterwards to effectively control the risk.

3.2. Blockchain data structure features

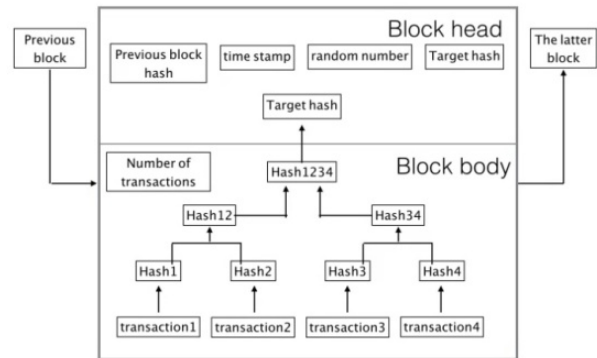


Figure 1. Block chain operation mechanism

Block chain is essentially a peer-to-peer distributed ledger database, named "block + Chain" (as shown in Figure 1) in block chain technology, blocks are data files permanently stored in electronic form, which are generated one by one from the block chain system in chronological order. Each block has a timestamp, named timestamp, while recording value exchange activities. All blocks in the system form a recorded ledger, named block chain system. Although the composition of different block chain systems, it has different structural designs, but the general structure of blocks is basically the same, which is composed of block heads and block bodies. Among them, block heads are mainly used for linking to facilitate information retrieval and verification; block bodies are mainly used to store information, new value exchanges are written into blocks after verification, and a large number of blocks are linked to each other to form a block chain database. The block body mainly applies two technical elements of hash algorithm and Merkle tree to ensure the daily storage of data. Each data block of the block body records a group of tree transaction information composed of hash algorithm, which ensures that the transaction data onto each block can't be tampered with [26]. Merkle tree is a data structure, which can be binary tree or multi tree. Its main function is to quickly summarize and verify the integrity of block chain data. It will group the data in the block chain for hash operation, and continuously recursively operate upward to generate new hash nodes. Finally, only one Merkle root is recorded in the block header [27]. The block header generally includes the hash value (hash pointer) of the previous block, random number, target hash (hash value of this block) and Merkle root. The block chain will also choose to establish a single chain structure or a double chain structure according to different application scenarios. The information recorded by the block chain represents the value exchange with timestamp. With the increase of applications, the new transactions will be saved in the block chain in the form of random sequence after verification, and the increasing new chain is actually a new transaction.

The characteristics of block chain data structure provide good theoretical support and practical application guidance for recording relevant information of SME. If the above characteristics of block chain are used in credit field and risk identification of SME, it will effectively reduce the cost of transaction, shorten transaction processing time and improve transaction security [5]. More specifically, the bank's credit business is characterized by significant decentralization, which makes banks and enterprises enable to connect directly without the intervention of the third-party institutions. On the one hand, it will strengthen the efficiency of credit business, on the other hand, it will help banks understand the dynamics of enterprises at any time and facilitate supervision.

4. APPLICATION SCENARIO ANALYSIS

4.1. Comparative analysis of traditional credit model and blockchain embedded credit model

Under the traditional financing mode (as shown in Figure 2), the enterprise submits its own relevant information to the bank. The risk controlling department of the bank needs to sort out and classify the collected enterprise related information, and then verify the information according to background investigation. If the information is verified correctly and the bank judges that the risk of the enterprise is within the bank's control, it will approve the issuance of loans and complete the loan business. Under the traditional financing channel, the bank can only review the hard information about the enterprise, but can't judge the enterprise risk type through the soft information. Moreover, the cost of manually collecting information is high. A large amount of information to be processed reduces the efficiency of bank loan business, which can't guarantee timeliness and is not convenient for the bank to control risk.

The credit business module involved in block chain technology will more effectively control credit risk (as shown in Figure 3). SME upload hard information they can provide for the credit platform embedded in block chain, such as asset registration, land use right, use right of houses and buildings, use right and income right of special equipment and machinery, income right of coal, oil and other energy, ownership of stocks and bonds, ownership of patents and commercial marks, etc; Relevant functional departments are under the same cooperation, the soft information about the enterprise, such as the enterprise related transaction information, historical loan information, the evaluation of the enterprise by the relevant enterprise, tax payment, whether the water and electricity rental fee is in arrears, should be recorded in the block chain after verification. The information about the relevant controller, such as the number of enterprises under the personal name of the

enterprise legal person, whether they are in debt, whether they are limited high consumption and whether there is a criminal record can also be recorded in the block chain, which will greatly to reduce the difficulty and workload for banks to obtain information manually. The application platform embedded in the block chain will no longer verify the relevant information about enterprises through the traditional manual way. Through the unique smart contract level of block chain technology, it can automatically approve the loan business, which will greatly improve the efficiency of banks. The efficiency of the bank's loan business will also improve the accuracy of business. At the same time, the timeliness and traceability of block chain technology ensure the bank's supervision of loan funds and further ensure the safety of funds. In addition, the government, enterprises and banks participate in the construction of the platform, which realizes risk sharing on the one hand, and uses the funds of the three parties to accumulate funds on the other hand. The use of tripartite funds to store the capital pool will also alleviate the early construction cost of the platform and enable the platform to land faster.

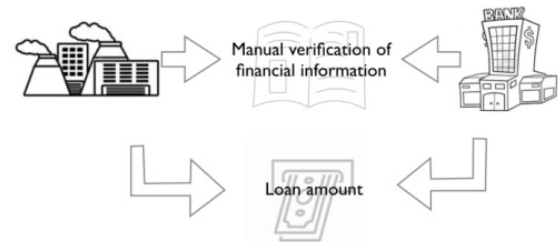


Figure 2. Bank credit business under traditional mode

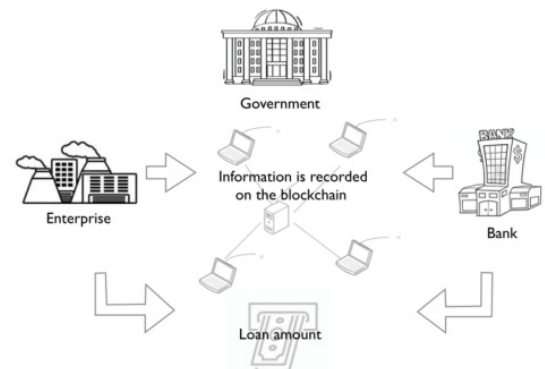


Figure 3. Bank credit business embedded in block chain

4.2. Effect analysis of blockchain technology embedded in credit system

Based on the decentralized and tamper proof characteristics of block chain technology, we believe that block chain technology is very applicable to solve the financing difficulties of SME. The challenge in solving

the financing problems of SME is information asymmetry, and the block chain structure and distributed architecture of block chain helps to coordinate and collect all kinds of information. We attempt to apply block chain technology for the financing difficulties, one is to solve the information asymmetry between banks and enterprises; The other is to make the government as the object of supervision and disclosure, and store a "risk pool" with banks and enterprises to set up a risk sharing mechanism. Specifically, the relationships of the three parties are shown as the following (Figure 4).

1) Between banks and enterprises: The operation of SME is usually not standardized. Except that their own funds account for a relatively small proportion, it is difficult for them to come up with relevant materials to prove the enterprise's repayment ability. Therefore, the enterprise structure, enterprise related transaction information, historical loan information, relevant enterprise's evaluation of the enterprise, tax situation becomes a powerful tool to prove the enterprise's repayment ability. However, in order to obtain the above information and confirm its authenticity, banks need to reach strategic cooperation with other commercial banks and coordinate multiple departments such as tax department, water department and power department. In this way, the manual workload of banks will increase sharply, which also means more costs. In addition, the actual decision-makers of private enterprises, especially SME, are mostly the actual controllers of enterprises. Or the enterprises' legal person and investors usually represent the reputation for the enterprise they operate, so it is equally important to collect the information about enterprises' legal person and investors. Such a large amount of business will not only affect the loan bank's judgment on the risk of loan business, but also prolong the time of loan issuance. The decentralization of block chain solves this problem. On the one hand, putting the enterprises' information on the chain avoids the problem of information distortion and increase work efficiency. On the other hand, it also strengthens relationship between banks and enterprises, which is not only convenient for the bank's post supervision, but more conducive to the growth of SME.

2) Between banks and the government: As the credit platform built by block chain technology requires a huge amount of calculation, block chain, as an infrastructure construction, will require a large amount of capital investment. Enterprises need to pay a certain fee for using the credit platform, and banks, as the developers and maintainers of the credit platform, need to invest a certain fee. The government, as a policy supporter, provides financial subsidies to the platform. As the main participants, the three parties store the risk capital pool together. On the one hand, the fund of the capital pool can share the cost of platform construction; on the other hand, the fund can be used for increasing the debt of banks. As a policy supporter, the government can invest

in the bank and increase favorable policies on the use of credit platforms; As a supervisor, the government should first improve the relevant laws and regulations on block chain technology platforms, and then do a good job of guiding and supervising bank's credit business so as to avoid banks blindly developing the credit business of SME in order to obtain policy dividends. The integration of block chain and credit business will balance the information asymmetry between banks and enterprises. With the solution to the financing problems of SME, the situation of moral hazard and adverse selection will be greatly alleviated, enterprises will continue to increase their trust in banks, and the bank's loan market for SME will also enter in a virtuous circle. This will benefit on China's financial supply side reform and glow the vitality of the Non-Public Sectors of the Economy.

3) Between enterprises and government: In the traditional credit theory, each lender only focuses on the borrowers' credit history. With the help of a trusted third-party institution (such as credit rating agency), some large borrowers can provide a true and credible credit history, or use the way of providing collateral to reduce the problem of information asymmetry [28]. However, these two methods are too expensive for SME that is still in the initial stage or have not yet formed a scale, and the credit platform based on block chain technology solves the problem of borrowing cost. To solve the problem of difficult loans for SME, except the government's policy support for banks, the government also needs to formulate policies to support SME. The government subsidizes the cost of SME participating in credit platform, which will attract more high-quality and low-risk enterprises to participate in the credit platform. With the increase of the proportion of government investment, more SME and banks will participate in credit platform, which will form a scale effect on the platform, reduce the participation cost and disperse consensus and information effectively. The block chain technology in alleviating information asymmetry and credit rationing will be more obvious [1].

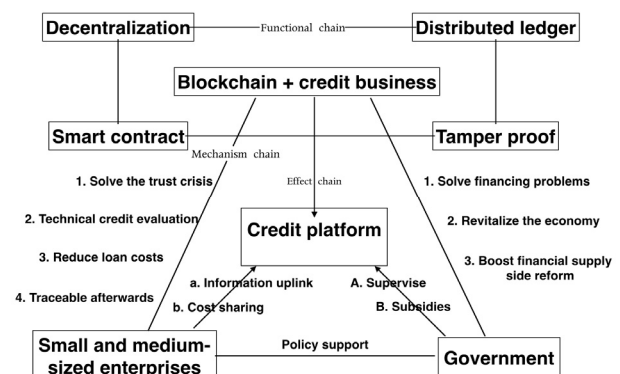


Figure 4. Relationship among banks, enterprises and governments in the platform

4.3. Specific application scenarios for commercial banks to provide credit support

With the development of block chain technology to today's digital ticket stage, it can effectively solve the problem of ownership confirmation of physical assets, be traceable, anti-counterfeiting and auditable, truly empower the real economy, meet the actual needs of various industries and promote transactions. The credit platform embedded in block chain technology will mainly provide three functions (as shown in Figure 5): one is to manage and maintain the information provided by enterprises, the other is to form a relationship network with relevant functional departments to verify the information, and the third is to match the reasonable loan needs of SME. The enterprise data server will provide technical support for the credit platform. It assigns a unique code to each enterprise in the platform, and ensures the storage of traceability data and reported data. At the contract level, the bank writes the relevant standards for issuing loans into the smart contract, which can realize the automatic operation of the loan business. After obtaining the unique identification code provided by the enterprise, the commercial bank enters the enterprise code in the system, automatically judges the enterprise's credit rating through the smart contract, and decides accept or reject the request. When the loan demand is met, the enterprise also needs to send back use details of the loan funds to ensure that the bank can supervise the loan funds in time, and avoid the risks caused by moral hazard and adverse selection. After the enterprise completes the repayment, the bank will also use the smart contract to record the complete business process of the enterprise into the credit platform. The smart contract has the following advantages: Firstly, it provides intelligent credit rating judgment, which avoids the subjective factors involved in the classification of enterprise credit rating; Secondly, smart contracts can automatically complete the issuance and settlement of loans. Compared with traditional channels, the credit platform based on block chain technology greatly reduces the approval and clearing time, but also reduces the cost; Thirdly, the smart contract can automatically execute the transaction and automatically deduct the remaining funds in the designated account when the borrower defaults; When the borrower fails to perform the contract, the default will be automatically recorded on the platform, affecting the credit rating of the enterprise and making it difficult for the enterprise to obtain the loan again.

The credit platform will help the SME loan business of commercial banks. When the risk is controllable, commercial banks will be more willing to provide loan services for SME. At the same time, the credit platform will also act as a screening mechanism. Due to the tamper ability of the platform, every default or information distortion of the enterprise will be recorded

in the server. Dishonesty will not only affect the platform's credit evaluation of enterprises, but also all affiliated institutions can view the enterprise's breach of contract on the platform. The enterprise may affect its business dealings with affiliated enterprises due to dishonesty. Even the enterprise legal person, as the joint and several liability of the enterprise, will be restricted from consumption and even included in the list of dishonest persons. The huge default cost discourages low-quality and high-risk enterprises, and the credit platform solves the financing dilemma for high-quality and low-risk enterprises.

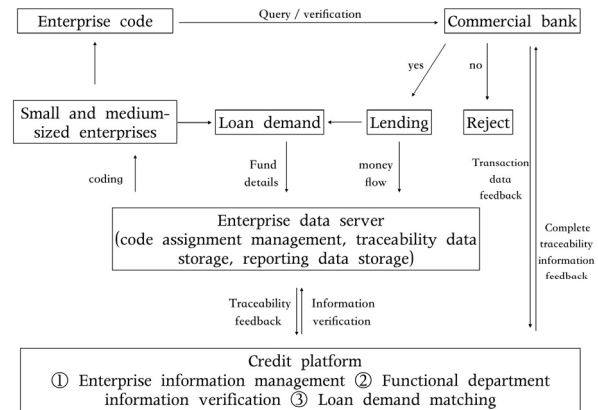


Figure 5. Operation mechanism of credit platform embedded in block chain technology

5. CONCLUSION

We hold that credit rationing is the main reason for the financing difficulties of SME, and the "block + Chain" distributed architecture, decentralized characteristics and tamper proof characteristics of block chain technology are very consistent with solving the contradiction of information asymmetry between banks and enterprises. Theoretical analysis shows that, the credit platform embedded in block chain technology proposed in this paper can help solve the current situation of bank credit rationing. It provides the basis of the information verification of the credit platform by linking the hard information and soft information related to enterprises and enterprise legal persons together, as well as the joint cooperation of multiple functional departments; It will improve the efficiency of bank loan approval and fund security through the built-in smart contract with the credit platform for risk prompt, settlement business and fund tracking, it also greatly reduces the default risk faced by banks when providing loan business for SME. The construction of the theoretical framework mainly includes the following practical significance. Firstly, the decentralization of block chain technology facilitates the point-to-point cooperation between banks and enterprises, so that the idea of solving the financing problems of SME is no longer confined to relying on third-party institutions.

Secondly, the risk sharing mechanism formed by the government, banks and enterprises based on the credit platform, makes SME needn't to worry about collateral. Even without collateral, under the support of government policies, as long as enterprises are in great value, they can obtain banks' trust and loans through the credit platform. Thirdly, with the continuous development of the banking industry, interbank competition will become more intense. The credit platform established by applying block chain technology will enhance the core competitiveness of banks and help to broaden banking business channels.

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