

Research on the Progress of Blockchain Technology Application in Supply Chain Finance

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Abstract: In the era of digital economy, finance will be the most likely scale application scenario for blockchain, and blockchain will be the underlying infrastructure for future financial upgrading. The innovative development of blockchain financial applications is not only the need for efficiency and quality improvement in the finance industry, but also conforms to the trend of financial services for entities and inclusive finance. This paper summarizes the definition and development history of blockchain, and discusses the application of blockchain in empowering the development and innovation of supply chain finance.

1. Introduction

According to the China Blockchain Financial Application and Development Research Report (2020) released by the National Internet Finance Association of China, among the 112 blockchain financial application projects researched by the research group, 29 of them involve supply chain financial scenarios, accounting for 25.9%. Currently, according to the association's statistical analysis of the pilot projects of fintech innovation regulation (also known as the Chinese version of the regulatory sandbox), by the end of 2020, 23 of the 70 selected projects involving blockchain technology accounted for 32.9%. Among these 23 projects, the application scenario involves supply chain finance in 8 projects, accounting for 34.8%. In addition, according to the association's statistics on the current four batches of blockchain information service filing data from the State Internet Information Office, there are 99 service types involving supply chain finance, accounting for 34.3% of finance-related blockchain filing services.^[1] With the continuous development of blockchain technology, the maturity and landing of blockchain technology has promoted the development of supply chain finance.

2. Blockchain Concept and Characteristics

2.1 Concept of Blockchain

First proposed by Satoshi Nakamoto, the concept of blockchain is a decentralized, distributed ledger based on cryptography, mainly represented by Bitcoin. In this decentralized system, traders do not need third-party guarantees to make transactions. Blockchain uses a hash function to record, which maps a string of unlimited length and compresses the output into a string of fixed length,

expressed by the formula $Hash(x)=y$.^[2] The formula is a one-way function, and this mapping relationship determines that y can only be derived from x , but it is difficult to derive x in reverse from y . Each hash value must be calculated based on the result of the previous value, and the next hash value is obtained from that result plus the new content, which can only be derived in a one-way sequence from front to back, and cannot be derived in reverse. Therefore, the blockchain realizes the information cannot be tampered with according to this principle to ensure the security of data and information, forming a chain data structure composed of first and last according to the order of time generation, and the whole blockchain system cannot be forged or tampered with through encryption technology.

In addition, in order to secure the data in the supply chain, blockchain can also use asymmetric encryption algorithms, using public and private keys corresponding to encryption and decryption respectively. The public key is the password that all users on the chain make public to all traders, while the private key is only available to the corresponding users. This can ensure that sensitive business information such as suppliers' quotes and costs can be shared within the chain without being misused, helping to protect privacy and dispel concerns of upstream and downstream companies.

2.2 Characteristics of Blockchain

2.2.1 Decentralization

The core of blockchain technology is decentralization, in which there is no strong central node for rule making and bookkeeping preservation in the blockchain system. Rather, without central control, the consensus mechanism enables individuals without a basis of trust to make rules together. Every node on the blockchain can make records and participate in bookkeeping, as long as they follow the jointly formulated rules for bookkeeping and are confirmed by other members in the system, without the need for a central node to guarantee and confirm.^[3]

2.2.2 Non-tampering

The blockchain is encrypted according to the hash function. According to the aforementioned, the information in the blockchain is logical, and the information on each block contains the information of the previous block, which in turn determines the information of the next block. Therefore, if the information of a block is modified, two blocks near it must be modified at the same time, and so on, and all the information on the blockchain must be changed, which is basically impossible to do. Therefore, as long as the function value of the last block is verified, all the information on the whole blockchain can be checked to ensure that the information has not been modified.^[4]

2.2.3 Smart Contracts

A smart contract is a program that can be executed automatically. The conditions required for the contract are written into the program, and when all the conditions of the contract are met, the smart contract will be executed automatically, and the whole process does not require human involvement. This helps to reduce the labor cost of transactions, improve efficiency, and make the transaction process more transparent.^[5]

3. Development of blockchain

3.1 Blockchain 1.0 era

The birth of Bitcoin is a sign of the arrival of the blockchain 1.0 era. During this period, the development of blockchain technology was closely related to digital currency, and the applications were generally focused on money transfer, exchange, and payment. In a sense, blockchain technology in this period found a solution to the decentralization of currency and payments. Moreover, Bitcoin is defined by Baidu Baike: as a P2P form of digital currency with peer-to-peer transmission means a decentralized payment system. When Satoshi Nakamoto proposed the concept of "Bitcoin" and made it a public issue, it became the blockchain research source. In the blockchain 1.0 era, the main innovation was the creation of a decentralized, open, and transparent ledger of transaction records - a database shared by all network nodes, updated by "miners," and universally maintained, with no one in control of the ledger. The impact of this technology on the financial industry is second to the invention of double-entry bookkeeping.

3.2 Blockchain 2.0 era

Along with the original setup, blockchain technology has evolved from Bitcoin. There are three core ideas in Satoshi Nakamoto's vision: a decentralized public transaction ledger end-to-end direct value transfer system, a powerful scripting system to run any protocol or currency, and so on. Bitcoin achieves the first two, and the third technology is embodied in Ethereum.^[6] It can be said that the emergence of Ethereum is representative of the blockchain 2.0 era, and the development of this period is closely related to the development of contract technology.

Ethereum can be defined as an open-source block underlying system in which all blockchains and protocols can be run. Like Bitcoin, Ethereum is not controlled by anyone and is maintained by all participants on a global scale. This is just like the Android system, which can provide users with a very rich API, allowing many people to develop various blockchain applications on it quickly, and as of now, there are more than 200 applications on Ethereum.

Smart contracts are one of the distinguishing features of Ethereum, which is the basic technology for programmable currency and programmable finance. The concept of "smart contract" was first introduced by cryptographer Nick Szabo in 1995. The concept can be simply understood as a series of promises defined in digital form, and once the contract is established, the principle that smart contracts can be executed automatically on the blockchain system without the participation of third parties fully embodies the "code is law" that programmers have always believed in. Although this theory has been proposed for a long time, smart contracts were not widely used until the emergence of Ethereum, which provides a friendly and programmable base system for smart contracts.

3.3 Blockchain 3.0 era

The blockchain 3.0 era is also the era of comprehensive application of blockchain, thus constructing a large-scale collaborative society. In addition to financial and economic aspects, blockchain is now more widely used in social life, especially in government, health, science, culture, art, etc. Moreover, there are several important concepts in the blockchain 3.0 era: Dapp (Decentralized application), DAC (Decentralized Autonomous Corporation), DAO (Decentralized Autonomous Organization), and DAS (Decentralized Autonomous Society).^[7]

The evolution of blockchain applications can be said to be the history of development from Dapp to DAC and DAO and then to DAS step by step. When blockchain technology is applied to social governance, we also step into the blockchain 3.0 era. It can be imagined that an intelligent

government system constructed on the blockchain can carry out public affairs such as storing citizens' identity information, managing national income, allocating social resources, and resolving disputes. In this system, information related to citizens, such as land deeds, registered enterprises, marriage registration, health records management, etc., can be well preserved and processed. When a baby is born, the doctor will upload the child's birth year and other information to the blockchain citizen electronic identity system, and the system will confirm the child's information and assign an ID to the child; the relevant government departments confirm the ID, the relevant electronic identity information will accompany the child's life, after that, the child's school registration, health, property, title, credit, and other information will be linked to the ID, stored in the blockchain. When he passes away, his testamentary contract will be triggered, his property will be distributed to his heirs, and no new information will be added to his chain of information on the system.

4. Progress of blockchain technology in China's supply chain finance application

4.1 The basic model of supply chain finance

In the research related to supply chain finance, Hofmann (2005) proposes a representative definition that supply chain finance can be understood as a way for two or more organizations, including external service providers, in the supply chain to jointly create value by planning, executing and controlling the flow of financial resources between organizations. The definition given by foreign scholars tends to be in the category of organization management, while the domestic definition of supply chain finance is more inclined to its financial attributes: based on the core customer, with the real trade background as the premise, using self-reimbursement trade financing, through the pledge registration of accounts receivable, third-party supervision and other professional means to close the flow of funds or control the rights in rem, and provide comprehensive financial products and services to the upstream and downstream enterprises in the supply chain. (As shown in figure 1)

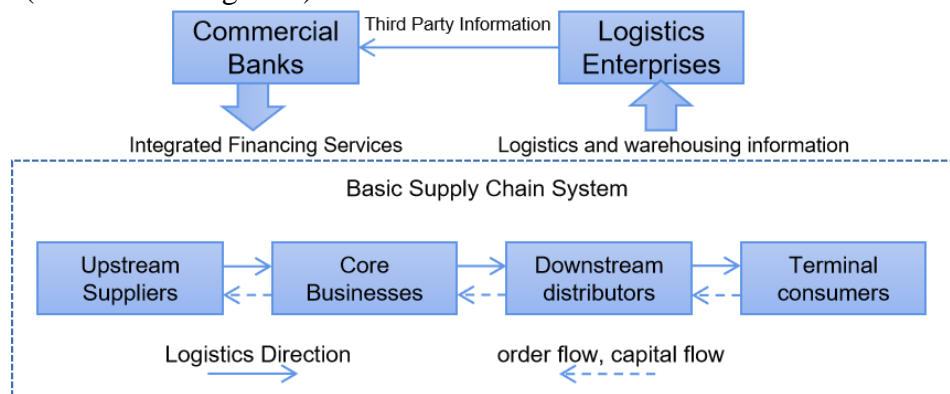


Figure 1: The basic model of supply chain finance^[8]

Supply chain finance is a way to help finance SMEs by placing capital in the supply chain management, relying on the core enterprises in the supply chain, and providing financing to single or multiple supply chain SMEs to revitalize the capital within the supply chain. Originally considered to be only auxiliary function in the supply chain, capital is transformed into an important factor to solve the bottleneck of capital shortage of SMEs through supply chain finance, and it runs through all actions in the supply chain. The traditional financing model is centered on the core enterprise, with upstream suppliers and downstream distributors as the service targets. Through the higher credit and reputation of the core enterprise, it provides more efficient and lower cost financing services by using the real existing trade transaction documents between upstream and

downstream enterprises and the core enterprise. In this process, core enterprises play an important role, providing banks and other financial institutions with real transaction data and providing guarantees for upstream and downstream enterprises, etc.

4.2 The development of supply chain finance based on blockchain technology

Under the environment of complicated traditional supply chain financing problems and the rapid development of blockchain technology, blockchain-based supply chain finance has become a craze in reality, and its essence is a supply chain finance system using distributed ledger. The supply chain business system based on blockchain technology realizes decentralization, and each business entity is both the provider of information, the regulator of information and the participant of business. On the basis of not changing the basic process of supply chain business, blockchain-based supply chain finance can solve the problem of supply chain information sharing, realize the business coordination and management of supply chain, and further improve the operational efficiency of supply chain. As shown in the table below, blockchain technology can address the problems in the operation of traditional supply chain finance. (As shown in table 1)

Table 1: Blockchain technology solves the problems of traditional supply chain finance

Types of Problems	Problems with traditional supply chain financing	Solutions based on blockchain finance
SME financing	Unable to cover most enterprises in the chain	All enterprises in the chain can be covered
Digitalization level	Uneven across enterprises	Unified management by blockchain platform
Information asymmetry	Serious information silo phenomenon	Smooth information flow among platform users
Credit Delivery	Difficulties in credit delivery to core companies	Ensure core business credit delivery

4.3 Progress of information flow transmission in supply chain finance

In terms of promoting information interconnection, the technical features of blockchain, such as peer-to-peer network and distributed bookkeeping, can help realize information interconnection among many participants, such as core enterprises, financial institutions, government departments, and upstream and downstream enterprises in the supply chain at a relatively low cost. Moreover, in terms of proving the authenticity of transactions, the technical features of blockchain, which are traceable and difficult to tamper with, help to link key data such as logistics, information flow, and capital flow generated in the process of supply chain transactions with timestamps and transaction logic, and form a chain evidence flow after confirmation by multiple parties, thus evidencing the authenticity of transactions. In realizing multi-level credit flow, the tier one suppliers turn the accounts payable of core enterprises into digital debt documents through blockchain, which can be further split and transferred to multi-level suppliers for debt offsetting or transferred to funders for financing, helping to alleviate the problem of difficult and expensive financing for small and micro enterprises. In terms of automatic contract execution, smart contracts, as a special agreement, encapsulate pre-defined rules, trigger conditions, and other elements of financial contracts, which help to enhance the automation of business processes, facilitate the fulfillment of contractual obligations by counterparties and reduce the risk of manual operation.

The blockchain platform integrates all kinds of data in the supply chain, such as logistics data, information flow data and capital flow data, all of which are collected in the blockchain platform

with a unified standard. Each enterprise on the chain can upload and access data in the blockchain platform, which effectively solves the problem of data segmentation in the supply chain system, realizes data and information transparency on the chain, enhances the speed of information access and flow within the supply chain, and thus reduces information audit costs.

4.4 Exploring blockchain integrated innovation applications becomes an important trend

According to the association's research, some institutions uplink production and operation information such as equipment usage and power consumption of micro and small enterprises collected through the Internet of Things and synchronize them to the fund providers to improve post-loan monitoring capabilities; Some institutions use technologies such as secure multi-party computing and zero-knowledge proof to obtain analysis results of encrypted data while protecting data privacy among participants, thus promoting inter-institutional information interconnection and alleviating the problem of multiple over-financing; and some institutions introduce technologies such as big data and artificial intelligence to improve the identification and analysis capability of information on the chain.

5. Conclusion

With the acceleration of modern information technology, blockchain technology will be gradually incorporated into the construction of the supply chain financial system, thus enabling the operation and development of enterprises to efficiently allocate the resources of financial institutions. This paper finds that blockchain technology can realize sharing and common supervision, ensure the reliability of transaction data, and thus can well solve the development obstacles faced by supply chain finance, but the application and testing of financing scenarios need to be further strengthened when it is used in supply chain finance financing.

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