

Research on Credit Risk Prevention in Supply Chain Finance Driven by Blockchain

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Abstract. With the government's emphasis on the blockchain and supply chain industry and increased policy support, the field shows a bright future. Nonetheless, the traditional supply chain finance model faces numerous challenges. This paper aims to explore how blockchain technology can be utilized to mitigate and control credit risk in supply chain finance. It will also detail the principles and characteristics of blockchain technology, including its decentralized architecture, encryption algorithms, resistance to tampering, smart contract functionalities, and more. At the same time, this paper will also analyse the shortcomings of traditional supply chain finance. Distributed ledger technology is utilized through blockchain to ensure the transparency and traceability of information, while smart contracts optimize the credit execution and supervision process, playing a key role in preventing and controlling credit risks. The article concludes by proposing innovative strategies based on blockchain technology, including constructing a credit information sharing platform, improving the credit assessment model, and establishing a risk early warning and monitoring system, with the aim of improving the efficiency and credit level of supply chain management and further promoting the healthy development of supply chain finance.

1 Introduction

In recent years, the Chinese government has placed significant emphasis on the blockchain and supply chain sectors, with numerous policies introduced to foster their growth. For instance, the Guiding Opinions on Accelerating the Promotion of the Application of Blockchain Technology and the Development of the Industry, released in 2021, underscores the importance of integrating blockchain with cutting-edge information technologies like the Internet, big data, and artificial intelligence. The policy aims to establish a robust and advanced blockchain industry framework, driving innovation and development in these fields. These policies create a clear and expansive market outlook for the growth of the blockchain and supply chain industry, in addition to fostering a favorable environment for production and business operations for companies. However, the traditional supply chain finance model has many problems, such as low credit transfer efficiency of core enterprises, poor capital flow, and information asymmetry. It frequently falls short of addressing the financing needs

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of small and medium-sized enterprises (SMEs), which ultimately hinders the overall efficiency of the supply chain. At the same time, it is difficult to verify the authenticity of trade, and fraudulent behaviors such as false transactions and document forgery often occur, which increases credit risk. The emergence of blockchain technology, which has the characteristics of distributed ledger, non-tampering, and encryption algorithms, provides an opportunity to solve these problems.

Most domestic research primarily focuses on the application of blockchain in supply chain management, including areas like traceability, quality control, and supply chain finance. In contrast, countries abroad have a more developed and mature approach to the implementation of blockchain technology, particularly in sectors such as financial services, food safety, and drug traceability. A large number of business cases are used in the study to show how blockchain can solve specific problems in the supply chain, such as anti-tampering and automated processes. In the current literature, the majority of scholars primarily concentrate on studying the model responses, risk assessments, and management strategies related to supply chain finance. In the field of blockchain, most of the research is on the principles of the technology, its role and development under fintech, and other aspects of the problem. However, there are relatively few studies on the integration and systematic research of blockchain technology with credit risk prevention and control mechanisms in supply chain finance, particularly regarding methods for preventing and controlling credit risk in supply chain finance through the use of blockchain technology. There are still many blank spots to be explored. Blockchain is a type of distributed ledger technology where each block includes the encrypted hash of the previous block, timestamps, transaction data, and additional information, all linked in chronological order to create a chain. It is characterized by decentralization, tamper resistance, transparency, and security.

2 Overview of Blockchain Technology and Supply Chain Finance

2.1 Principles and Characteristics of Blockchain Technolog

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2.1.1 Decentralized architecture

Blockchain adopts decentralized distributed ledger technology, where all transaction information in the supply chain is no longer recorded by a single central institution but is jointly maintained by various nodes. This provides an accurate data base for credit risk assessment.

2.1.2 Encryption algorithms and tamperability

Blockchain uses encryption technology to encrypt transaction information, and only authorized nodes can decrypt and view the information. This guarantees the security of business secrets and transaction data and prevents credit risks caused by information leakage. The tamperability is shown by the fact that once the data is recorded in a block, it cannot be modified or deleted after obtaining the consensus of the network [1].

2.1.3 Smart contract mechanism

A smart contract is a program executed on the blockchain that automatically implements the terms of a contract when predetermined conditions are met. In supply chain finance, smart contracts can automatically execute operations such as the transfer of funds and issuance of financing according to preset conditions, such as the delivery of goods and qualified acceptance. This not only improves transaction efficiency but also reduces human error and default risk.

2.2 Supply Chain Finance Business Model and Sources of Credit Risk

2.2.1 Supply chain finance business models

There are three main financial business models for supply chain finance:

Accounts Receivable Financing Model: In this model, upstream enterprises face the problem of long payment cycles from core enterprises, which slows down the return of funds.

Inventory Financing Mode: Businesses seek financing from financial institutions by using their inventory as collateral. Financial institutions focus on factors such as the quality of the inventory, the stability of its market value, and its realizability to determine the amount of financing and the degree of risk.

Prepayment Financing Mode: This model is mainly used by downstream enterprises in the supply chain. When a downstream enterprise needs to make an advance payment to a core enterprise for procurement but has insufficient funds, it can apply to a financial institution for prepayment financing.

2.2.2 Sources of credit risk

This paper focuses on the sources of credit risk in terms of both internal factors and supply chain factors.

Internal Factors: The main risks are related to the operating capacity of the enterprise. If the enterprise has problems in production, sales, or financial management, such as poor product quality or inappropriate cost control, it may lead to a tight capital chain, making the enterprise unable to pay its debts on time. This results in financial condition risk, as the poor financial condition of the enterprise is an important factor in credit risk.

Supply Chain Factors: The main risks are related to the credit risk transmission of core enterprises and supply chain partnership risks. Since the core enterprise occupies a dominant position in the supply chain, its credit status significantly impacts the capital flow of the entire supply chain. If the core enterprise faces an operational crisis, such as bankruptcy or a financial scandal, it will lead to uncollectible accounts receivable for upstream suppliers and the loss of important sales channels for downstream enterprises, undermining the stability of the entire supply chain and triggering a chain of credit risks.

2.3 Deficiencies in the Traditional Supply Chain Model

Traditional supply chain management involves horizontal integration, connecting designated suppliers, manufacturers, distributors, retailers, and customers in a linear fashion through a communication medium. This type of supply chain emphasizes internal linkages, making it inflexible and constrained to point-to-point integration. As a result, supply chain management is costly and inefficient, and a broken link in the supply chain will paralyze the entire supply chain operation [2]. Danqing Wang, Hao Chen, and Shuo Zhang (2024) mentioned that the

main problems of traditional supply chain deficiencies today are information silos, communication barriers, data inconsistency, lack of collaboration, and risk proliferation [3].

As traditional supply chain finance evolves, its inherent flaws have become more apparent, especially in areas like prepayment financing and accounts receivable financing, which rely on transactions between upstream and downstream participants. First, in prepayment financing and accounts receivable financing, the core enterprise's upstream and downstream orders are mostly cross-bank, cross-network, and cross-regional, and the main creditors of the supply chain bank are sub-regional, with a strong localized color. Additionally, due to factors such as the long business management process, the lending efficiency of financial institutions is also affected [4]. Secondly, the legal gaps and management loopholes in the traditional supply chain finance model provide the possibility for enterprises to seek their own interests and choose to falsify and cheat. Once there are problems such as price distortion, product counterfeiting, or money laundering, it is difficult for the traditional supply chain finance model to investigate and hold accountable, leading to significant losses for the entire supply chain [5]. At present, although many financial institutions have built up the supply chain finance model, the credit evaluation system has not been specifically established, and the service platform does not have a high degree of specialization, failing to carry out professional data collection and analysis activities with the help of big data, cloud computing, and other technologies [6].

The deficiencies faced by traditional supply chains in their operations have gradually become a major obstacle to their ability to remain competitive in the modern market. These deficiencies not only affect the efficiency of the supply chain but also limit its ability to respond quickly to market changes and consumer demand. They also bring huge credit risks. However, the reasonable use of blockchain's features can effectively improve the deficiencies of traditional supply chains.

3 Strategies for Credit Risk Prevention and Control in Supply Chain Finance Based on Blockchain Technology

Under the basic model of “blockchain+supply chain”, blockchain technology is used as the core technology and organizational structure to reshape the supply chain, digitally upgrade a series of links in the supply chain, coordinate and integrate all activities in the supply chain based on the blockchain platform, and carry out unified bookkeeping, so that all members of the blockchain can query supply chain information; at the same time, they can also release upstream demand and downstream output of the supply chain according to the actual situation of enterprises, and summarize and organize all information of the supply chain to strengthen the connection between enterprises in all links of the supply chain. At the same time, it can also release the upstream demand and downstream output of the supply chain according to the actual situation of enterprises, and summarize and organize the information of the supply chain, so as to strengthen the connection between enterprises in each link of the supply chain, and guarantee the transparency, traceability, automation and intelligence of supply chain management. With multi-level and multi-chain penetration, it can reduce costs and increase efficiency for supply chain, and improve quality and empowerment [7].

3.1 Building a Blockchain Credit Information Sharing Platform

In modern supply chain management, information sharing is a key factor in improving efficiency and reducing risk. To this end, it is important to build a blockchain credit information sharing platform that integrates the information resources of all parties and enables different participants, such as core enterprises, SMEs, financial institutions, and

logistics enterprises, to share and query credit information efficiently and securely. The "blockchain + supply chain" interaction provides trusted data transmission, utilizes the tamper-proof nature of blockchain and the distributed storage of IPFS to achieve data verification, and uploads data transaction records to the chain, making them traceable and auditable. This solves the risks of security, process, and risk control in traditional supply chain finance [8].

A platform can be established based on blockchain technology, using its decentralized, tamper-proof, and transparent characteristics to provide a secure and trustworthy data exchange environment for all parties. Participants can enter, view, and protect the privacy of information on the platform according to their permissions, thus realizing the effective sharing of credit information. In the field of supply chain management, blockchain technology provides a solution with its non-tamperable characteristics. All supply chain participants can access the same data source, and any update of information about the product will be instantly reflected and seen by all participants. This significantly improves the efficiency of the supply chain and enhances the consumer's trust in the brand [9]. Financial institutions can comprehensively access the enterprise's historical transaction data and credit rating through the platform, combined with big data analysis technology, to more accurately identify potential credit risks. Financial institutions can also develop personalized credit strategies, such as differentiated interest rates and credit limit settings, to achieve appropriate financing for enterprises.

3.2 Improving Blockchain Credit Assessment Models

In the traditional credit assessment system, the credit rating of an enterprise often relies on static information such as financial statements. Although this method can provide a certain reference value, it cannot fully reveal the actual operating conditions and credit risks of enterprises. With the transparency of blockchain technology and the immutability of data, we can improve the credit assessment system by incorporating data from various aspects, making credit assessment more scientific and precise. In the data collection phase, big data technology is utilized to gather various types of information, including network behavior data, transaction data, third-party data, data from cooperative agencies, and preferences of financing enterprise users. In the behavioral modeling phase, we leverage text mining, machine learning, and clustering analysis to enhance the capabilities of natural language processing and predictive algorithms. In the risk pricing segment, we formulate, based on the enterprise customer's credit rating, a behavior monitoring model, anti-fraud model, default model, and debt collection model [10].

Banks and financial institutions can use the improved credit assessment model to provide enterprises with more customized credit solutions and interest rates, improving the efficiency of credit approval. Using a real-time data analysis model, organizations can establish risk warning thresholds to promptly identify potentially risky enterprises and implement appropriate measures in response. Relevant regulatory agencies can also formulate corresponding industry regulatory policies based on the new assessment model to guide enterprises to operate in a compliant manner, thus improving the overall credit level.

3.3 Establishment of a Blockchain Risk Early Warning and Monitoring System

Real-time monitoring of supply chain financial transactions is carried out through blockchain technology, and risk warning indicators are set. The system automatically sends out early warning information when enterprises experience abnormal transactions, tight capital flows, or deteriorating credit indicators. Financial institutions can take timely risk response measures, such as early collection, adjusting credit limits, or requesting additional guarantees,

to effectively reduce credit risk losses. The decentralization, sharing, and traceability of blockchain technology greatly reduce the layers between regulatory agencies and regulatory objects, ensuring that the various operational data of regulatory objects are directly, comprehensively, and in real-time transmitted to the regulatory agencies. This allows regulatory agencies to grasp the dynamic situation of the regulatory objects in real-time, discover and dispose of potential risks in the market in a timely manner, and reduce the accumulation of market speculation and risk [11]. Develop blockchain-based data monitoring and analysis tools to capture data information and analyze it in real-time.

Set warning trigger thresholds so that when the indicator exceeds the threshold, it will automatically generate warning information. At the same time, the system automatically generates a detailed early warning report, including the type of risk, severity, and recommended measures. Early warning information is sent to relevant financial institutions and internal managers in real-time via SMS, email, or application notification.

4 Conclusion

This paper describes the role of blockchain technology in credit risk prevention and control in supply chain finance. Distributed ledger technology ensures the transparency and traceability of information and provides a solid foundation for credit assessment. Smart contracts optimize the execution and supervision process of credit and effectively reduce the risk of default. The article concludes by suggesting a strategy for enhancing the credit risk prevention and control mechanism in supply chain finance through blockchain technology. It emphasizes that blockchain plays a crucial role in facilitating the digital transformation of all supply chain links, enabling coordination and integration of activities. This approach promotes unified bookkeeping and strengthens connections between enterprises, ensuring transparency, traceability, automation, and intelligence in supply chain management. In terms of response strategies, the construction of a blockchain credit information sharing platform facilitates the flow and sharing of information among participants, breaking down information silos and enabling financial institutions to more comprehensively grasp the status of enterprises, so as to formulate more precise credit strategies. Improving the blockchain credit assessment model and integrating multi-dimensional data in combination with big data technology realizes the scientific and refined credit assessment, which helps financial institutions identify potential risks in advance and optimize the allocation of credit resources. Establishing a blockchain risk early warning and monitoring system to monitor transaction dynamics in real-time and issue early warning signals in a timely manner allows financial institutions to quickly take countermeasures to reduce credit risk losses and safeguard the stable operation of supply chain finance.

Although blockchain technology presents considerable benefits for credit risk prevention and control in supply chain finance, it also encounters various challenges and opportunities. Further optimization of blockchain performance is necessary to meet the high concurrency demand in large-scale transaction scenarios, improve the processing speed and throughput of the system, reduce transaction costs, and enhance its practicability and scalability in complex supply chain environments.

At present, the application of blockchain technology in the field of supply chain finance lacks unified standards and specifications, and the compatibility and interoperability between different platforms and systems need to be improved. In the future, it is necessary for industry associations, regulators, and enterprises to make joint efforts to formulate unified technical standards, data formats, and business process specifications to promote the wide application and synergistic development of blockchain technology in the field of supply chain finance. Blockchain technology provides coping solutions and broad development prospects for credit risk prevention and control in supply chain finance.

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