Application and Challenges of Blockchain Technology in Credit Risk Management of Supply Chain Finance

Jing Zhao

School of Economics and Trade, Henan Finance University, Zhengzhou 451464, Henan, China

Abstract: As global economic integration deepens, supply chain finance plays a crucial role in optimizing corporate cash flow and promoting the coordinated development of industrial chains. However, issues such as information asymmetry and credit assessment difficulties in traditional models have hindered its growth. Blockchain technology, with its decentralized nature, data immutability, and automated smart contracts, offers innovative solutions for credit risk management in supply chain finance. This article systematically analyzes the application logic, typical scenarios, and implementation effects of blockchain technology in credit risk management within supply chain finance. It also explores the technical bottlenecks, regulatory challenges, and coordination issues faced by the practical implementation of these technologies, and propose targeted optimization strategies. The aim is to provide theoretical support and practical references for the deep integration of blockchain technology with supply chain finance.

***Keywords*:** Blockchain technology; supply chain finance; credit risk management; smart contracts; decentralization

1. Introduction

In the digital economy, supply chain finance integrates capital flow, information flow, and logistics to effectively address financing challenges for SMEs and enhance the resilience of industrial chains. However, in traditional models, the significant information silo effect between core enterprises and upstream and downstream SMEs makes it difficult for financial institutions to obtain real transaction data. This leads to credit assessments heavily relying on subjective judgments and guarantees from core enterprises, resulting in high financing costs for remote enterprises. Additionally, paper-based transaction processes are prone to data tampering and operational errors, complicating credit management. The distributed ledger and smart contract features of blockchain technology offer the potential to break down information barriers and create a trustworthy trading environment. Studying the application paths and challenges of blockchain technology is crucial for advancing the digital transformation of supply chain finance.

2. Core characteristics of blockchain technology and adaptability to supply chain finance

2.1 Core architecture of blockchain technology

Blockchain utilizes distributed ledger technology, constructing a chain-like data structure through hash algorithms. Nodes achieve data synchronization through consensus mechanisms such as Proof of Work (PoW) and Proof of Stake (PoS). Smart contracts, which are self-executing code protocols, can solidify business rules into programmable logic, ensuring transactions execute automatically according to predefined conditions[1-3], thereby effectively reducing the risk of human intervention.

2.2 Technology features empower credit risk management

Decentralization breaks the reliance on traditional centralized credit systems, ensuring data consistency through multi-node verification. The non-tamperable nature of data, combined with timestamp technology, makes transaction records traceable and reduces the risk of fraudulent transactions. Smart contracts automate the financing process, from confirming accounts receivable to fund disbursement, significantly enhancing business efficiency and risk management accuracy[4-5].

3. Current situation and pain points of credit risk management in supply chain finance

3.1 Traditional credit risk management model

Traditional supply chain finance relies on the credit transmission of core enterprises and controls risks through guarantee methods such as accounts receivable pledge and inventory mortgage. Financial institutions mainly conduct credit

evaluation based on static data such as financial statements and transaction vouchers, and lack real-time monitoring of dynamic information of supply chain[6-7].

3.2 Existing Risks and Challenges

Information asymmetry leads to high costs and low efficiency in credit assessments for small and medium-sized enterprises (SMEs). Financial institutions often impose stringent financing conditions to mitigate risks. Paper-based processes are prone to operational risks, such as data falsification and repeated financing. The excessive concentration of core enterprise credit can easily trigger systemic risks during business crises, thereby hindering the inclusive development of supply chain finance[8-10].

4. Application practice of blockchain technology in credit risk management of supply chain finance

4.1 Construction of information sharing platform

The blockchain-based supply chain finance platform integrates data from core enterprises, suppliers, and logistics providers to create a real-time shared distributed ledger. For example, once suppliers upload delivery information, logistics tracking and quality inspection reports are synchronized to the blockchain. Financial institutions can then automatically verify transaction authenticity through smart contracts, thereby reducing the cost of information verification.

4.2 Typical application scenarios of financing

In accounts receivable financing, suppliers digitize their debt instruments and link them to the blockchain. Once confirmed by the core enterprise, a smart contract is triggered, allowing financial institutions to automatically disburse loans according to predefined rules. In inventory financing scenarios, IoT devices monitor the status of pledged items in real time. When inventory levels fall below the safety threshold, the smart contract automatically alerts and initiates the disposal process, ensuring that the entire process remains risk-controlled.

4.3 Innovation of credit evaluation system

The dynamic credit evaluation model is built by using the multi-dimensional transaction data accumulated by blockchain and machine learning algorithm. The model not only considers the financial indicators of enterprises, but also incorporates the behavioral data such as supply chain participation and transaction performance rate, so as to realize real-time credit rating update and provide data support for differentiated credit granting.

5. Challenges faced by the application of blockchain technology

5.1 Technical bottleneck

Blockchain performance is not yet sufficient to meet the high-frequency transaction demands of supply chain finance. Some consortium chains can only process a few hundred transactions per second (TPS), which is insufficient to support the concurrent operations required by large supply chains. Additionally, the lack of cross-chain interoperability hinders data flow between different platforms, creating new 'on-chain islands.' Security issues, such as vulnerabilities in smart contracts and risks associated with private key management, also need urgent attention.

5.2 Regulatory and Legal Dilemmas

The existing legal system has not yet clarified the legal effect of blockchain data, and there is a lack of judicial precedents for disputes over smart contracts. At the regulatory level, the decentralized architecture makes the transaction subjects anonymous, making it difficult to effectively implement anti-money laundering (AML) and anti-terrorist financing (CFT) measures. Therefore, it is urgent to establish a regulatory framework that adapts to the characteristics of blockchain.

5.3 Ecological synergy problem

Due to issues such as data privacy and profit distribution, all parties involved in the supply chain have concerns about data sharing and system docking. In addition, the scarcity of compound talents who are both familiar with blockchain technology and supply chain finance business restricts the implementation process of technology.

6. Optimization Strategies To Promote The Application Of Blockchain Technology

6.1 Technological innovation and standard construction

Increase investment in research and development of performance optimization schemes such as sharding technology and side chain mechanism, and promote the standardization of cross-chain protocols. Establish a blockchain security audit mechanism to reduce the risk of smart contract vulnerabilities through formal verification technology.

6.2 Improvement of supervision and legal system

The government should speed up the formulation of relevant regulations on blockchain data ownership and smart contract execution, explore the "regulatory sandbox" model, and carry out innovation pilot projects within a controllable scope. Regulatory agencies can use blockchain technology to build a penetrating regulatory platform to realize real-time tracking of transaction data and risk warning.

6.3 Ecological co-construction and talent training

Core enterprises can lead the establishment of supply chain alliances, promoting data sharing through incentive mechanisms. Universities and companies should collaborate to cultivate blockchain finance professionals, set up industry-university-research cooperation bases, and accelerate the transformation of technological achievements. Additionally, a fair profit-sharing mechanism should be established to ensure that all participants achieve mutual benefits in blockchain applications.

7. Conclusion

Blockchain technology offers a revolutionary solution for credit risk management in supply chain finance. By creating a trustworthy data environment and automating processes, it significantly enhances risk control efficiency and financing accessibility. However, challenges remain in areas such as technological maturity, regulatory compliance, and ecosystem collaboration. To promote the deep integration of blockchain technology with supply chain finance and support the high-quality development of the real economy, future efforts should focus on technological innovation, institutional improvements, and ecosystem collaboration. Further research could explore the integration of blockchain with IoT and AI technologies to expand the innovative boundaries of credit risk management in supply chain finance.

References

[1] Fan Y. Financial Volatility Prediction Model Based On Denoising Autoencoder and Unstable Attention Mechanism[J]. Procedia Computer Science, 2025, 261: 45-52.

[2] Zhao, Yunpeng "Research on Interpretable Machine Learning Models for Identifying Corporate Bond Default Risk."Population, Resources & Environmental Economics (2025), 6(1): 38-45.

[3] Guo Y. Research on Investment Bank Risk Monitoring and Early Warning Model Combining Factor Analysis and Artificial Neural Network[J]. Procedia Computer Science, 2025, 262: 878-886.

[4] Pan Y. Research on the Design of a Real-Time E-Commerce Recommendation System Based on Spark in the Context of Big Data[C]//2025 IEEE International Conference on Electronics, Energy Systems and Power Engineering (EESPE). IEEE, 2025: 1028-1033.

[5] Wei Z. Design and Implementation of Financial Derivatives Trading Platform Based on Blockchain Technology[J]. Financial Economics Insights, 2025, 2(1): 29-35.

[6] Guo Y. Technology Application and Focus in Financial Investment Banking[J]. European Journal of Business, Economics & Management, 2025, 1(1): 104-110.

[7] Wang C. Application of Data Analysis in Bank Mortgage Loan Risk Assessment[J]. Financial Economics Insights, 2025, 2(1): 23-28.

[8] Jing X. Real-Time Risk Assessment and Market Response Mechanism Driven by Financial Technology[J]. Economics and Management Innovation, 2025, 2(3): 14-20.

[9] Guo, Xingwen. “The Impact of Financial System Reform on the Investment and Financing Behavior of Enterprises.” Frontiers in Business, Economics and Management (2024): 17(13),279-282.

[10] Zhu P. Construction and Experimental Verification of Automatic Classification Process Based on K-Mer Frequency Statistics[C]//The International Conference on Cyber Security Intelligence and Analytics. Cham: Springer Nature Switzerland, 2024: 391-400.