Research on the Application of Blockchain Technology in Financing for Small and Medium-sized Enterprises

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Abstract

This paper focuses on the application of blockchain technology in the field of supply chain finance, with an emphasis on its supportive role in alleviating the financing difficulties of small and medium-sized enterprises. Through theoretical analysis and case study methods, it systematically elaborates how blockchain technology, leveraging its characteristics such as decentralization, traceability, and immutability, enhances the transparency and credibility of supply chain finance, reduces the risks associated with information asymmetry, and thereby improves the availability and efficiency of financing for small and medium-sized enterprises. Taking "Ant Duo-Chain" as an example, the paper analyzes the application effects of blockchain technology in the financing of small and medium-sized enterprises, concluding that this model not only enhances the efficiency of capital circulation but also provides a sustainable path for the stable development and value enhancement of the overall supply chain ecosystem.

Keywords

Blockchain, small and medium-sized enterprises, enterprise financing.

1. Introduction

In China's economic development, the proportion of small and medium-sized enterprises (SMEs) has been increasing year by year. As of September 2025, the number of SMEs nationwide had reached 63.487 million [1]. SMEs serve as an important pillar of China's economic growth. However, due to their relatively simple business models, ownership structures, and management methods, coupled with insufficient collateral and a lack of credit data, banks find it difficult to establish effective credit models and risk prevention measures for SMEs. This has led to persistent challenges for SMEs in accessing financing, often accompanied by high financing costs.

The primary sources of enterprise funds include internal resources such as owners' capital and retained earnings, as well as external financing. External financing for enterprises mainly refers to issuing stocks publicly, issuing corporate bonds, and obtaining bank loans. Given their smaller operational scale and weaker ability to withstand risks, SMEs face relatively greater difficulties in securing external financing. The financial status of SMEs often lacks transparency, and the absence of sufficient asset collateral makes it challenging for banks to accurately assess their profitability, operational capacity, and debt-servicing ability. Moreover, the entry thresholds set by the state for issuing corporate bonds and stocks are relatively stringent, making it difficult for most SMEs to meet the required standards [2]. With the advancement of computer and internet technologies, new models of internet finance have given rise to various financing solutions, providing SMEs with additional channels for raising funds. However, these models also present issues such as unstable funding sources, information asymmetry, and legal compliance risks[3].

It is evident that SMEs face problems including narrow financing channels, high financing costs, and a lack of guarantor institutions. The core cause of these issues is information asymmetry.

Blockchain technology, with its chained data structure, distributed nodes, smart contracts, and asymmetric encryption, has been applied to SME financing to alleviate information silos[4]. This has contributed to enhancing the digitalization level of enterprises, making blockchain-based digital supply chain finance gradually emerge as a more efficient and inclusive means of financial support.

This paper first analyzes the definition and characteristics of blockchain technology, along with relevant theories of supply chain finance. Secondly, it examines the feasibility and necessity of "blockchain + supply chain finance" in facilitating financing for SMEs. Then, using Ant Group's "Double Chain Link" as a case study, it analyzes the effectiveness of "blockchain + supply chain finance" in supporting SME financing.

2. Theoretical Foundations

2.1. Blockchain Technology

Blockchain is a distributed ledger technology first proposed by Satoshi Nakamoto in 2008. Its core architecture includes data structure, consensus mechanisms, cryptographic security, smart contracts, and more[5]. Specifically, blockchain is a chain-like storage data structure similar to a linked list model, consisting of a distributed database where blocks containing transaction records are linked chronologically. Auxiliary information such as transaction history (including the start date of transactions between parties, whether they are invalid, etc.) is also fully preserved within the blocks. Each block header contains information such as a timestamp, a random number (nonce), the identifier of the current block, and the identifier (hash value) of the parent block. Each block, once encapsulated, is linked to the previous block, thereby ensuring the security and integrity of the data on the chain.

Blockchain technology is characterized by decentralization and immutability. As a distributed multi-node structure, multiple nodes collectively maintain the ledger and execute consensus mechanisms. Each node operates with a high degree of autonomy while collectively upholding the integrity of the ledger. The entire system securely and stably transmits data without reliance on centralized servers or management, with each node interconnected and potentially serving as a temporary center[6]. Furthermore, transaction confirmation requires agreement from the majority of nodes, eliminating the control of a single central authority over the data. Once data is stored, modifying it undetected by other nodes would require tampering with all backup copies across the system, making data alteration highly difficult. This technology also exhibits strong autonomy and openness[7].

Blockchain technology, through its distributed ledger and chain-like storage structure, establishes a transparent and traceable data system[8].Information and operational rules within the system are highly public, allowing any user unrestricted access to query public data (except for personal privacy information, which is encrypted for protection). While ensuring transparency, blockchain also safeguards data privacy and security through technologies such as asymmetric encryption and zero-knowledge proofs[9]. Core transaction metadata (e.g., sender addresses, timestamps) is publicly visible, while specific transaction content can be encrypted, accessible only to authorized parties for decryption and viewing. This "selective transparency" mechanism meets the demands of regulation and traceability while effectively protecting commercial secrets and personal privacy.

Additionally, blockchain's smart contracts are digitally defined commitment agreements characterized by automatic execution and immutability [10]: when predefined conditions are met, the contract automatically executes without the need for any intermediary, and once deployed, its execution process cannot be unilaterally altered. This technology-driven approach to fulfilling agreements not only simplifies transaction steps through automation, reduces

operational and arbitration costs, and mitigates credit risk, but also significantly decreases disputes arising from human intervention or misunderstandings during contract execution.

2.2. Supply Chain Finance Theory

Supply chain finance is a type of commercial bank credit business that differs from the traditional credit model, where financial institutions grant credit based on the creditworthiness of a single enterprise. Instead, it relies on the industrial supply chain to provide financing support not only to core enterprises within the chain but also to small and medium-sized enterprises (SMEs) operating on the chain[11].

Supply chain finance encompasses various models, including accounts receivable financing, advance payment financing, and inventory financing. In accounts receivable financing, SMEs use their outstanding receivables as collateral to secure financing from financial institutions, which helps quickly revitalize the enterprise's working capital and alleviate short-term financial pressure[12]. Advance payment financing refers to the financing support provided by financial institutions to upstream suppliers based on the procurement contracts of core enterprises[13]. Inventory financing, on the other hand, involves using the enterprise's inventory as collateral for financing[14].

Through dynamic management of various stages in the supply chain, supply chain finance achieves efficient fund flow and effective risk control, offering SMEs more convenient and lower-cost financing services.

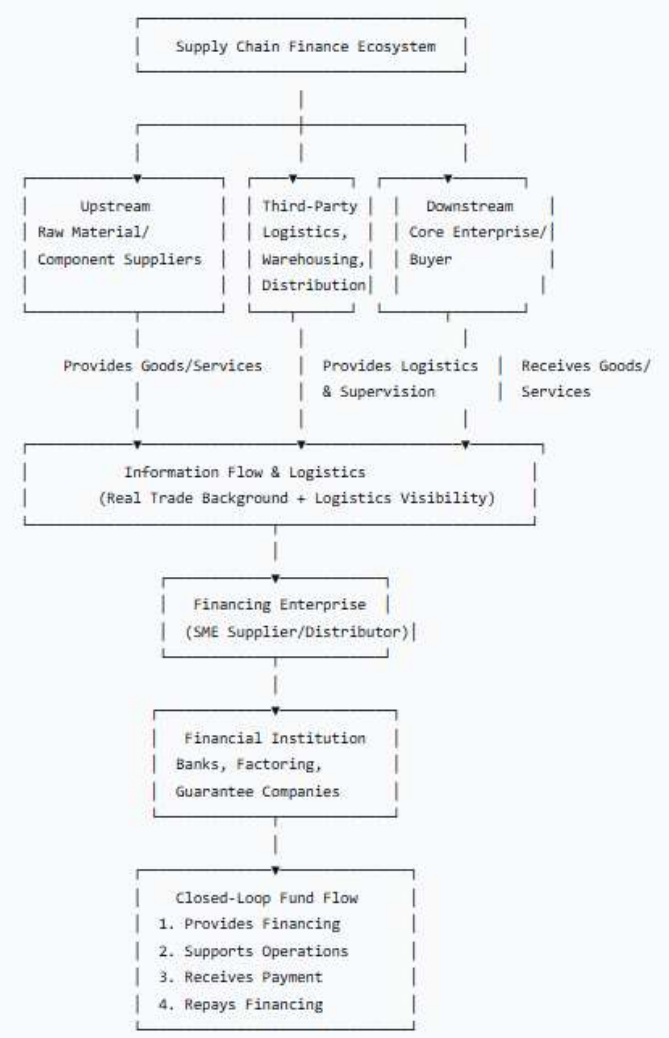

Figure 1. Supply Chain Finance

3. The Necessity of "Blockchain + Supply Chain Finance" in Facilitating Financing for Small and Medium-Sized Enterprises

In traditional supply chains, there are information silos. Each participant in the supply chain manages their business in a decentralized manner through their own systems. The lack of unified standards and norms for information among all parties in the supply chain leads to the inability of all parties to exchange and share information, increasing the credit risks of banks and other financial institutions. In addition, core enterprises in traditional supply chain finance usually only sign agreements with first-level partners and do not have direct business transactions with second-level or lower-level enterprises. This will result in second-level or lower-level enterprises being unable to gain recognition from financial institutions, making it difficult for the credit of core enterprises to be effectively transmitted. In this situation, SMEs that have a lower degree of closeness to their core enterprises or a higher degree of information asymmetry also find it more difficult to obtain financing from financial institutions. Blockchain technology can overcome many problems that hinder the traditional supply chain finance model.

Some scholars have conducted research from the perspective that blockchain technology can reduce the financing costs for small and medium-sized enterprises (SMEs). Qu Shaojian and Li Shuai (2023) constructed a three-level supply chain finance game model involving a capital-constrained SME supplier, an upstream SME manufacturer, and a core enterprise retailer. Their study found that when the cost of blockchain technology meets specific conditions, its adoption can significantly lower the financing costs for SMEs and create higher value for each member of the supply chain, thereby generating greater benefits for the entire supply chain system[15].

Some scholars argue that blockchain technology can enhance the creditworthiness of related links in the supply chain. Zhu Xingxiong, He Qingsu, et al. (2018) theoretically analyzed the feasibility of blockchain technology in helping various parties within the supply chain ecosystem establish a consortium chain and build a transparent, shared information platform. Conducting supply chain finance business based on this platform can simplify cumbersome paper-based processes and promote credit enhancement in relevant links[16]. Liu Silu and Li Huamin (2019) believed that the application of blockchain technology can address issues in the original supply chain finance credit system, such as data barriers, incomplete credit records, data falsification, and low security[17]. Li Chunhua (2021) analyzed the mechanisms through which blockchain technology can prevent bill fraud, achieve trust consensus, enable multi-level credit transfer among enterprises, and improve the financing efficiency of supply chain finance[18].

Some scholars contend that the application of blockchain technology can enhance the risk management level of supply chain finance. Song Hua (2020) argued that real-time data updates via blockchain can help predict the operational status of enterprises, thereby allowing for more reasonable assessments of their risk levels and improving the risk management capabilities of supply chain finance[19]. Wang Xiao (2020), based on the application experience of blockchain technology in promoting supply chain finance business in commercial banks in recent years, suggested that blockchain technology can effectively mitigate risks in supply chain finance by ensuring the authenticity and validity of transactions, reducing transaction costs, providing full-industry-chain financial services, and enhancing risk prevention and control[20].

Additionally, blockchain technology can effectively link a series of responsibility and power relationships, such as financial assets, audit reports, and bank loan reports, into a chain of legal information and release their value across the entire market. By performing simple data calculations on the blockchain, it is possible to roughly assess the credit accumulated by SMEs in their past commercial activities, thereby determining whether transactions can be conducted with them or whether loans can be granted. Leveraging blockchain technology to accumulate

credit can also form a reverse regulatory system, where all participating parties and individuals equally build credit on the chain, consciously maintain the related credit system, and gradually lay the foundation for a credit-based society.

4. Case Study of Ant Group's "Ant Duo-Chain"

4.1. Background of "Ant Duo-Chain"

Ant Financial Services Group was established in October 2014, with the mission of building an open and shared comprehensive financial services platform through technological innovation capabilities. In 2016, it formed a blockchain technology team. In 2020, Ant Blockchain was renamed "AntChain," signaling its future business direction to "make blockchain transform production and life like mobile payments."

The goal of the "Ant Duo-Chain" solution is to connect various participants in the supply chain through blockchain technology and comprehensively and accurately record the entire lifecycle of asset transactions. Leveraging the technological advantages of blockchain, such as immutability, multi-party consensus, and traceability, it ensures the authenticity of on-chain assets, enables credit penetration in supply chain finance, enhances the liquidity of financial assets within the supply chain, reduces financing costs for SMEs, and makes accounts receivable financing under the supply chain model more credible, efficient, and intelligent.

4.2. Main Content of "Ant Duo-Chain"

The essence of "Ant Duo-Chain" is a supply chain collaboration and financing platform built on blockchain technology. It onboards key participants in the supply chain, such as core enterprises, multi-tier suppliers, and financial institutions, transforming critical trade data (orders, contracts, accounts receivable, etc.) into "immutable digital certificates" that are generated, circulated, and stored on the chain.

By digitally transforming the accounts receivable of core enterprises, the platform converts them into standardized credit instruments that can be split and circulated across multiple tiers based on ownership shares. These instruments are created, transferred, financed, and retired on the blockchain, addressing the financing needs of multi-tier suppliers within the supply chain. Simultaneously, the "Ant Duo-Chain" platform leverages third-party social functionalities to connect various financial institutions, including core enterprises, commercial banks, factoring companies, guarantee companies, and credit enhancement institutions. This fosters horizontal integration, forming a supply chain finance ecosystem that not only meets the financing demands of SMEs but also helps them access a broader network of financial business partners.

On this platform, every transaction and each split or transfer of certificates is recorded on the blockchain and witnessed by all participants. This ensures the data's immutability and traceability, preventing data falsification and reducing risks such as fund misappropriation. The original credit of core enterprises is transmitted step-by-step along the actual trade chain as the certificates circulate. Ultimately, even micro and small enterprises at the end of the supply chain can secure financing by holding digital certificates originating from core enterprises, achieving multi-tier credit penetration.

"Ant Duo-Chain" employs TEE (Trusted Execution Environment) privacy protection technology with hardware support, ensuring secure interface access, smart contract execution, and computation. Rules can be pre-set on the certificates without manual intervention, enhancing settlement efficiency and accuracy. Additionally, "Ant Duo-Chain" ensures end-to-end encryption and trustworthiness, providing financial-grade privacy protection for both enterprises and financial institutions.

4.3. Implementation Process of "Ant Duo-Chain"

This paper takes the accounts receivable financing business under the supply chain finance model of "Ant Duo-Chain" as an example to explain its specific process, which is as follows:(1) Credit Enhancement and On-chain Storage: A credit enhancement institution first provides credit enhancement for the core enterprise and stores the payment guarantee on the blockchain. After the core enterprise obtains bank credit, it registers the accounts payable information for its Tier 1 suppliers on the chain for rights confirmation, forming digital assets on the blockchain. Key processes such as the generation, verification, circulation, financing, clearing, and retirement of these digital assets can all be completed on the chain.(2) Splitting and Circulating Receivables: The Tier 1 supplier can split the accounts receivable from the core enterprise on the chain, retain the portion belonging to itself, and circulate the remainder to Tier 2 or multi-tier suppliers.(3) Free Transfer of Receivables: Each supplier can also freely transfer the accounts receivable held on the chain to receive cash payments in advance.(4) Settlement upon Payment: Once the core enterprise makes the payment, the clearing institution partnered with the platform directly settles the received funds to the final holders of the accounts receivable on the chain, such as suppliers and investors.

Under the "Ant Duo-Chain" solution, the entire process of supply chain finance financing is completed on the blockchain, making second-level loan disbursement possible. This not only enhances the liquidity of funds within the supply chain but also reduces operational risks.

5. Analysis of the Application Effectiveness of Ant Group's "Ant Duo-Chain"

5.1. Application Case

This section uses an application example of "Ant Duo-Chain" to compare the financing business processes before and after its implementation, thereby evaluating the practical effectiveness of ""Ant Duo-Chain".

A technology company in Sichuan specializes in providing intelligent service systems for public spaces such as hotels and scenic areas. With nationwide business coverage, the company holds a significant market share. A small household appliance individual business in Sichuan serves as a secondary supplier to this technology company. As a downstream entity in the supply chain, this individual business has no direct contractual relationship with the core company. Due to weak financial standing, it frequently faces cash flow gaps caused by extended payment terms from upstream suppliers. Moreover, despite holding IOUs from upstream purchasers, it struggles to secure loans from banks due to insufficient collateral assets and a low credit rating.In other words, under the traditional supply chain finance model, financing guarantee companies find it difficult to assess the authenticity of transaction data within the supply chain. Coupled with the individual business's low creditworthiness and limited risk resilience, establishing a trust relationship with SMEs becomes challenging for financing guarantee companies. As a result, the individual business cannot leverage the credit spillover effect of the core company to obtain guarantees or financing.

However, under the "Ant Duo-Chain" model, relying on accounts payable from the core company, the authentic trade documents of all supply chain participants are digitized. This enables the core company's credit to circulate step-by-step on the blockchain.The technology company confirms these accounts payable on the "Ant Duo-Chain" platform, generating a digital certificate that is passed to suppliers at various levels of the supply chain. As the holder of this certificate, the individual business initiates a financing application through the platform to a connected financing guarantee company. Based on this information, the financing guarantee company can assess the credit ratings of the relevant SMEs.Furthermore, by clearly tracing the

complete circulation history of this certificate on the blockchain, the guarantee company can verify that it originates from a creditworthy core company and that the trade background is authentic. Consequently, the guarantee institution can swiftly approve the application and disburse the loan to the individual business. Upon the certificate's maturity, the core company settles the payment with the bank, and the smart contract automatically completes the clearing process for all parties involved.Since all information throughout the circulation process is immutable, and any rights confirmation certificates issued or held by parties in the supply chain, as well as the actual allocation of each credit disbursement on the blockchain, are mutually visible, operational risks such as fund misappropriation are effectively mitigated. This ensures the authenticity of trades (assets). The entire financing process-from application to disbursement-takes only a few minutes, enabling previously underserved small and micro suppliers at the end of the supply chain to access low-cost working capital.

5.2. Analysis of Application Effectiveness

The innovative accounts receivable financing model supported by the "Ant Duo-Chain" solution can provide benefits to all parties involved in supply chain finance. It enhances the authenticity of trades (assets) and, to a certain extent, addresses the concerns of fund providers regarding the authenticity of assets due to information asymmetry. On the "Ant Duo-Chain" supply chain finance service platform, each accounts receivable is transparent in amount and supports multi-dimensional verification. Through electronic certificate technology, these digital assets can be split into multiple levels and circulated accordingly. Suppliers at each level can receive corresponding accounts receivable certificates based on their contractual shares. This enables SMEs holding the rights-confirmed certificates to obtain guarantees and authorizations from credit enhancement institutions, thereby securing financing from banks and achieving true multi-tier credit penetration across the chain.

Table 1. Analysis of the Application Effectiveness and Value of "Ant Duo-Chain"

Dimension	Traditional Financing Model	Ant Duo-Chain	Value
Inclusiveness	SMEs and micro-enterprises have difficulty obtaining loans.	No registered capital restrictions; even micro-enterprises can access loans.	Embodies the inclusive nature of supply chain finance.
Trust Mechanism	Manual, paper-based, point-to-point verification through offline bank branches.	Fully online application; based on blockchain's machine consensus and immutability.	Establishes a genuine and credible trading environment.
Credit Reach	Limited to core enterprise and primary suppliers.	Extends to N-tier suppliers.	Achieves multi-tier credit penetration; core enterprise's creditworthiness can benefit end-tier companies.
Financial Risk	Opaque information, difficulty verifying transaction and document authenticity; higher risk.	Full-link transparency and traceability	Enhances the security of financing.
Loan Cycle	Typical cycle of 1 to 6 months.	Instant approval and disbursement; on-demand borrowing and repayment.	Dramatically improves financing efficiency and liquidity.

This approach breaks down information silos among enterprises and enhances communication and collaboration between the core enterprise and other entities at various levels within the

supply chain. More importantly, “Ant Duo-Chain”helps SMEs precisely connect with core enterprises, commercial banks, credit enhancement institutions, and other financial service providers, offering a one-stop service for financing needs, including credit lines, assessments, factoring, credit, payment, and settlement. This reduces the communication costs between SMEs and the various parties involved in financing operations.

Meanwhile, the full digitalization of business processes and the standardized contracting supported by smart contracts significantly improve the efficiency of financing operations, enabling SMEs on the chain to achieve timely and rapid financing. The solution streamlines the financing process for SMEs, improves their financing efficiency, and reduces financing costs. Compared to traditional supply chain finance, the effects and value generated by "Ant Duo-Chain “are illustrated in Table 1 below.

6. Conclusion

This paper comprehensively employs inductive-deductive methods and case analysis. First, it discusses the feasibility and necessity of "blockchain + supply chain finance" in supporting financing for SMEs. Second, it conducts an in-depth analysis and effectiveness evaluation of the "Ant Duo-Chain" case, a practical application of blockchain-enabled supply chain finance. The findings indicate that supply chain finance leveraging blockchain technology can alleviate the financing challenges faced by SMEs under traditional models. It also facilitates efficient capital flow within the supply chain, enhances the overall strength of the supply chain, and adds value to the supply chain ecosystem.

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