Research on Blockchain-Empowered Models for Cash Flow Optimization in Supply Chain Finance

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Abstract. This research investigates the empowerment of supply chain finance (SCF) by blockchain technology to achieve optimized cash flow. By analyzing the critical issues inherent in traditional SCF and leveraging the principles and advantages of blockchain, this paper explores its potential empowering mechanisms. It distills universally applicable pathways for corporate cash flow optimization, thereby offering novel perspectives for SCF development. Validated through a case study of TCL's JDH supply chain financing platform, this research endeavors to construct an integrated theoretical framework encompassing "technology empowerment – scenario adaptation – mechanism innovation." It systematically deconstructs key blockchain features such as distributed ledgers, digital credentials, and smart contracts. Subsequently, it synthesizes generalizable models for trusted data sharing, credit transmission and financing cost optimization, and dynamic risk monitoring and response under high automation, offering a reference for decision-making by enterprises and financial institutions.

Keywords: Blockchain Technology; Supply Chain Finance; Cash Flow Optimization

1   Introduction

Supply chain finance (SCF) is crucial for enhancing inter-enterprise capital liquidity and optimizing cash flow. However, traditional SCF systems often grapple with information asymmetry and fragile credit transmission chains. These barriers impede the efficient flow of core enterprise credit to downstream entities, particularly Small and Medium-sized Enterprises (SMEs), leading to financing constraints and urgent cash flow challenges [1]. Recent national strategic plans, like "China's 14th Five-Year Plan (2021-2025) for Digital Economy Development," emphasize blockchain's innovative application in FinTech and supply chain management. Blockchain's inherent features—decentralization, transparency, immutability, and traceability—offer a new paradigm for building trust and breaking information silos in SCF, thereby enabling optimal capital liquidity and supporting high-quality financial services for the real economy.

Scholarly work has explored blockchain's capacity to empower SCF. Xu (2019) [2] highlighted blockchain's potential (via distributed ledgers and smart contracts) to

enhance supply chain transparency, reduce trust costs, and improve transactional efficiency. Liu (2023) [3] focused on blockchain applications in specific scenarios like accounts receivable financing within BYD's SCF platform, analyzing how trusted data streams improve financing accessibility. Wei (2023) [4] and Chen (2022) [5] examined the link between blockchain and SCF financing model innovations, emphasizing its impact on accelerating settlements and reducing tied-up capital. However, existing literature often focuses on technological merits or specific scenarios, lacking a comprehensive theoretical framework that uncovers the intrinsic mechanisms and universally applicable pathways for blockchain-driven SCF cash flow optimization. This study addresses this gap by constructing an integrated "technology empowerment – scenario adaptation – mechanism innovation" framework. It aims to systematically elucidate how blockchain enhances SCF cash flow and to abstract replicable cash flow optimization models, providing actionable insights for enterprises and financial institutions.

2   Analysis of Core 'pain Points' in Traditional SCF and Blockchain's Applicability

SCF aims to optimize cash flow across supply chains by converting on-chain assets (e.g., accounts receivable) faster and leveraging core enterprise credit [6], thereby increasing capital turnover, reducing financing costs, and expanding SME funding channels. However, traditional SCF faces structural impediments—information asymmetry, trust deficits, and inefficient risk control—hindering its cash flow optimization potential. Blockchain technology offers solutions to these 'pain points'. (Figure 1 illustrates the ideal vs. reality of SCF cash flow optimization.)

2.1   The core 'Pain Points' of Cash Flow Optimization in Traditional Supply Chain Finance

Although SCF is set up to improve cash flow, the following 'pain points' in the traditional model seriously restrict the realization of this goal. Figure 1 visualizes the structural dilemma of cash flow optimization in supply chain finance by comparing the ideal with reality. The upper part of the diagram outlines the ideal conditions: seamless data flow is realized through 'information sharing - transaction transparency'. Relying on 'credit conduction - open market information' to promote efficient allocation of credit resources. Establish a dynamic risk control system with the help of 'risk control - strong data, strong credit'. Ultimately, it achieves the triple goals of improving turnover efficiency, reducing financing costs and enhancing cash flow resilience. However, the reality (the lower part of the diagram) shows a significant contrast: cash flow is not forward but continuously backward, a large number of credit resources are in an idle state, and the risk is amplified in the conduction process. This huge gap between ideal and reality is rooted in three mutually reinforcing systemic 'pain points':
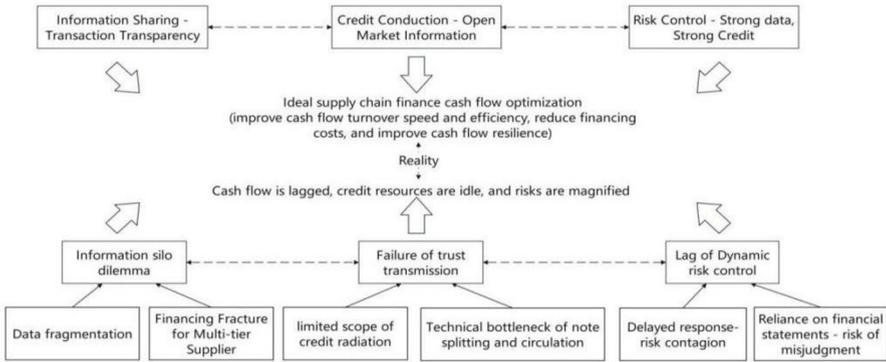
Fig. 1. Ideal and reality of supply chain finance cash flow optimization

2.1.1 Information Silo Dilemma: Blocking Cash Flow Optimization Based on Trade Flow.

SCF relies on verifiable trade flow data to accelerate cash flow [7]. Information silos, however, fragment data, leading to high verification costs and delayed financing. This cost and delay can be critical for SMEs, directly contradicting SCF's goal of accelerating cash flow. Furthermore, information opacity fractures financing availability to N-tier suppliers, as financial institutions struggle to assess their true risk, leading to 'Credit Rationing'. Consequently, cash flow optimization benefits don't reach downstream entities, limiting overall supply chain resilience.

2.1.2 Failure of Trust Transmission: Core Credit can Not be Converted into Universal Cash Flow.

SCF aims to use core enterprise credit as an 'anchor' to reduce overall financing costs and magnify cash flow leverage [8]. Traditionally, this credit transmission often stops at first-tier suppliers due to a lack of efficient mechanisms for verifying deeper transactions, leaving potential credit resources idle. Moreover, technical limitations in splitting and circulating accounts receivable or commercial paper—key cash flow carriers—hinder flexible cash flow allocation. This rigidity prevents dynamic matching with real business needs and obstructs smooth credit flow to downstream entities.

2.1.3 Lag of Dynamic Risk Control: Amplifying the Risk of Cash Flow Fluctuations.

Traditional risk control, overly reliant on delayed financial statements, fails to capture real-time supply chain dynamics (orders, inventory, logistics) impacting short-term solvency. This static perspective can lead to distorted risk assessments, causing institutions to miss supporting healthy cash flows or to tighten credit too late, exacerbating crises. Supply chains are vulnerable to external shocks; an ideal SCF should buffer these [9]. However, traditional risk control's lag hinders early warnings

and interventions, allowing cash flow risks to amplify and spread rapidly, undermining SCF's goal of enhancing supply chain resilience..

2.2   The Potential Empowering Mechanisms Between the Characteristics of Blockchain Technology and the Core 'Pain Points' Of Traditional Supply Chain Finance

The characteristics of blockchain technology such as distributed ledger, smart contract, and non-tampering form a high degree of suitability with the above supply chain finance needs in terms of information, trust, and risk control. At the same time, there exists a precise coupling relationship between such characteristics and the business 'pain points' of traditional supply chain finance, which forms a potential optimization mechanism.

2.2.1 Distributed Ledger: Breaking Information Silos, Reducing 'Friction Costs' of Cash Flow Acquisition.

Distributed ledgers, maintained by multiple nodes, enable real-time synchronization and cross-validation of supply chain transaction data. Each participant holds a data copy, and transactions are confirmed by consensus and immutably stored [10]. This ensures data validity, real-time updates, and consistency, fundamentally addressing information asymmetry and trust deficits, thus reducing information verification costs (transaction costs). Key supply chain participants on an alliance or private chain can record transaction data (orders, logistics, invoices, payments) on a shared, tamper-proof ledger [11]. Financial institutions, as nodes, can directly access trusted, cross-validated trade data, significantly reducing information acquisition costs and improving credit approval efficiency. This diminishes information asymmetry, reducing adverse selection and moral hazard, thereby lowering financing risk premiums and improving cash flow acquisition speed and cost.

2.2.2 Tokenized Credit/Digital Credentials: Realizing the Chain Conduction Model of Credit Penetration and Activating the Precipitated Cash Flow on the Chain.

Blockchain can transform traditionally illiquid core corporate credit (e.g., confirmed accounts payable) into standardized, programmable, and divisible digital assets (Tokens) [12]. This "Tokenized Credit" offers unprecedented liquidity and divisibility. Accounts payable from core enterprises are converted into digital debt certificates on the blockchain. First-tier suppliers can split these vouchers to pay second-tier suppliers, who can further split and pay N-tier suppliers. Each transaction is immutably recorded, ensuring authenticity and traceability. Technologies like Hashed Timelock Contracts (HTLC) can ensure atomic transfer of vouchers and fund settlement upon specific conditions (e.g., delivery confirmation), enhancing flow security. This mechanism enables core enterprise credit to penetrate the entire supply chain, and automation significantly accelerates the Order-to-Cash cycle. The certainty of automated execution also aids in accurate cash flow forecasting and management.

2.2.3 Smart Contract: Building A Collaborative Response Mechanism for Dynamic Risk Control, Accelerating Cash Flow Turnover and Efficiency Improvement.

Smart contracts automate complex business logic (e.g., payment terms, financing conditions), realizing self-enforcement ('code is law') and reducing counterparty risks and performance costs [13]. This automation ensures efficient, transparent cash flow management. Real-time on-chain transaction data (from IoT, ERP interfaces) enables dynamic risk monitoring. Smart contracts can embed risk-control rules, automatically triggering warnings or actions (e.g., freezing a financing line if inventory turnover falls below a threshold). Combined with off-chain big data analysis, this creates a closed-loop system of 'real-time data monitoring + automatic smart contract execution + big data warning,' transforming risk management from static to dynamic. This allows for timely responses to supply chain fluctuations, preventing cash flow disruptions and safeguarding financial assets.
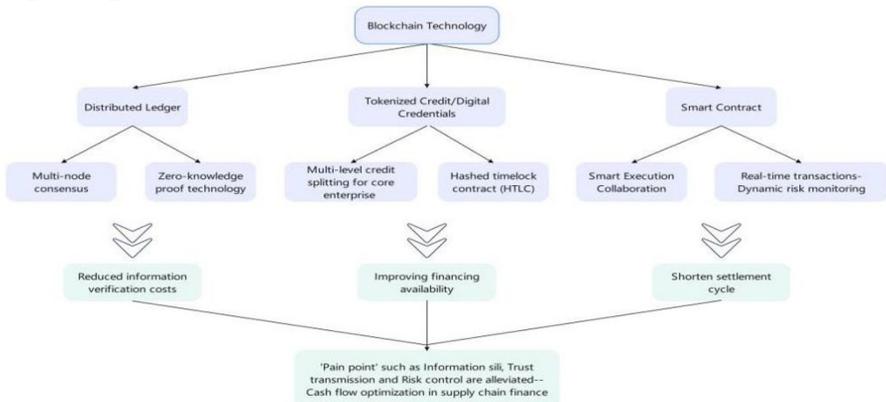

Fig. 2. Coupling mechanism between the enabling characteristics of blockchain technology and the 'pain points' of traditional supply chain finance services

The coupling mechanism between the enabling characteristics of blockchain technology and the 'pain points' of traditional supply chain finance business is shown in Figure 2. Blockchain technology is not a 'panacea', but it shows remarkable applicability and huge application potential in solving the long-standing trust, efficiency and risk control problems in traditional supply chain finance, and thus optimizing cash flow management. Its distributed, untamperable, traceable and programmable characteristics are highly compatible with the information sharing, credit transmission, process automation and risk management needs in supply chain finance scenarios, laying a technical foundation for building a more efficient, inclusive and secure supply chain finance ecosystem.

3 Blockchain Technology Empowerment of Cash Flow Optimization Model

Blockchain technology provides a brand new solution for cash flow optimization in the field of supply chain finance by virtue of its decentralization, non-tampering, traceability and other characteristics. Through the construction of data sharing, credit transmission, and risk monitoring modes, blockchain can significantly improve the efficiency of capital flow, reduce financing costs and enhance the ability of risk control.

3.1 Trusted Data Sharing Model

3.1.1 Distributed Ledger-Driven Chain-Wide Data Collaboration.

Blockchain achieves real-time synchronization and cross-validation of transaction data through multi-node consensus mechanism (e.g. PBFT, PoA) [14], breaking the 'information silos' in the traditional supply chain. For example, TCL simple remittance 'golden notes' flow record system: Through the alliance chain architecture, it integrates core enterprises, suppliers and financial institutions into a unified account book, making the entire process of bill issuance, splitting and circulation transparent. Each transaction needs to be verified by more than half of the nodes before it can be uploaded to the chain to ensure data consistency. Thus, this will reduce information asymmetry, contain adverse selection and moral hazard, lower financing risk premiums, and improve capital acquisition efficiency and cost advantages.

In terms of privacy protection, the application of Zero Knowledge Proof (ZKP) technology also meets the requirements of the Personal Information Protection Law. Supply chain platforms use ZKP technology to allow suppliers to prove the authenticity of their accounts receivable to financial institutions without disclosing the details of the specific transaction, which not only protects business confidential information, but also meets the compliance requirements.

Increased efficiency of transaction authenticity verification

The authenticity of trade background is the core risk control point of accounts receivable financing and other businesses. Traditional audit relies on manual checking of a large number of paper documents, which is inefficient and easy to be forged. Blockchain can hash key business documents, such as purchase orders, invoices, logistic documents (bills of lading, transport bills, signing receipts), acceptance certificates, cash flows and other key information onto the chain for verification. Through smart contracts, these data from different sources and different links can be associated and bound. When it is necessary to verify the background of trade, it only needs to query on the chain to verify whether the hash value of the relevant data is consistent and whether the logical relationship matches, so that the authenticity of the transaction can be quickly and accurately judged. Therefore, the verification of the whole process of trade can be penetrated.

An automotive BYD supply chain platform has successfully reduced the risk of accounts receivable forgery through blockchain technology [3]. The platform integrates the order, logistics, invoice and payment information between the host factory

and its multi-level suppliers on the chain. Financial institutions can directly verify the authenticity and continuity of transactions on the chain when carrying out accounts receivable financing approvals, and effectively identify fraudulent behavior such as forged contracts, false invoicing and duplicate financing by comparing the tamper-proof data on the chain. A number of studies have pointed out that blockchain significantly reduces information asymmetry and operational risk and improves the efficiency and accuracy of trade authenticity audits by providing tamper-proof transaction records and associated credentials (Lahkani et al., 2020) [15].

3.2   Credit Transmission and Financing Cost Optimization Model

3.2.1 Multi-level Credit Split from Core Enterprise.

Using the detachable characteristics of blockchain-supported digital vouchers (e.g., accounts receivable vouchers), core enterprise credit can penetrate to multi-level suppliers. For example, a home appliance manufacturer splits a $10 million credit line into 100 $100,000 financing lines through a blockchain platform, and records the transaction history of each level of suppliers through timestamps. The second-tier suppliers can apply for financing from banks based on the credit flow path recorded on the chain. Through the credit splitting mechanism, the 'Ti-RONGYI' platform has increased the approval rate of financing for third-tier suppliers from 35 per cent in the traditional model to 82 per cent [16].

At the same time, it builds the visualization of the credit conduction path, so that the timestamps and transaction clearly records on the blockchain, and shows the whole process of credit certificates from the issuance between the core enterprise and suppliers at all levels. Financial institutions can trace the source of credit accordingly and understand the real transaction history of suppliers at each level, thus assessing risks in more accurately way so that reducing the high premium risk caused by information asymmetry.

3.2.2 Smart Contract-Driven Business Recreation and Efficiency Improvement.

Smart contracts automatically match financing rates: Based on trusted data on the chain (e.g. suppliers' historical transaction records, frequency and stability of transactions with core enterprises, voucher holding time, etc.), financial institutions can achieve differentiated and dynamic risk pricing through smart contracts. Suppliers with better credit performance can automatically obtain lower financing rates. This mechanism has been proven in Ant Financial Services Group (Ant Financial)'s supply chain finance practice, where its dynamic pricing model reduces SME financing rates by an average of 1.8 percentage points by integrating tax and logistics data [17].

Smart contracts can be programmed to automatically execute payment instructions when preset conditions are met (e.g., the logistics node confirms that 'the goods have been signed for' or the quality inspection system uploads the 'acceptance signal' to the blockchain) (Peters & Panayi, 2016) [18]. This 'trigger-and-execute' model is expected to significantly shorten the settlement cycle by bypassing the traditional lengthy manual approval and reconciliation processes. Some research simulations have shown

that the application of smart contracts may reduce settlement time by more than half in specific supply chain scenarios (Chang et al., 2019) [19].

The establishment of an automated process for financing applications is utilized to ensure that when an enterprise applies for financing using on-chain digital credentials, the smart contract can automatically verify the validity of the credentials, the identity of the financing subject, and the relevant transaction history data, and carry out rapid approval and amount calculation based on preset rules. This allows the financing process to be compressed from days of manual review to hourly or even minute levels, greatly improving financing efficiency (Gomber et al., 2018) [20].

3.3   Dynamic Risk Monitoring and Response Model

3.3.1 Risk Warning Mechanism Under Real-Time Data-Driven and Intelligent Disposal Collaborative Response Mechanism.

Inventory dynamic monitoring can be achieved based on IoT and blockchain technologies. For example, in a chattel financing or inventory financing scenario, the quantity, location, status (temperature, humidity) and other information of inventory goods can be collected in real time by deploying IoT devices with sensors (e.g., RFID tags, weight sensors, cameras, etc.) in the warehouse. These data are uploaded to the blockchain through encryption, formed a dynamic inventory record that cannot be tampered with (Lu et al., 2019) [21]. Financial institutions can monitor the status of collateral in real time, and once inventory abnormalities (e.g., sharp decrease in quantity, change in status beyond the threshold) are detected, the system can automatically trigger a risk warning.

In response to risk events triggered by early warning, the blockchain builds a closed loop of 'monitoring-response-disposal': when the early risk warning model (based on the comprehensive judgement of on-chain data and external information) monitors potential risks (such as abnormal operation of the supplier, decline in the credit rating of the core enterprise, and serious delays in the transportation of goods, etc.). Smart contracts can be triggered to execute preset countermeasures. For example, automatically suspending new credit to a supplier, adjusting the financing interest rate, notifying relevant parties (e.g., insurance companies, guarantee institutions), or even initiating the asset disposal process in extreme cases (Xu et al., 2020) [22]. This automated intervention mechanism, combined with the cross-institutional synergy provided by the alliance chain (e.g., rapid notification of all relevant financial institutions, logistics parties, etc.), can achieve a rapid, precise, and synergistic response to a risk event, minimise potential losses, and maintain the stability and security of cash flow.

3.3.2 Cross-Institutional Collaboration Efficiency Improvement.

Under the premise of obtaining authorization, different institutions such as banks, core enterprises, suppliers, logistics companies, customs and government's taxation department can join the same alliance chain network as nodes to achieve secure, real-time sharing and cross-validation of key business data. This breaks down the 'information barriers' between organizations and improves the efficiency of multi-party

collaborative business processing (e.g. trade finance, logistics tracking). By analyzing data from the Guangdong-Hong Kong-Macao Greater Bay Area blockchain platform, Tian et al. (2024) [23] found that the median processing time for documents dropped from 9.7 days to 19.2 hours, and the processing cost fell by 93-95%, strongly supporting the view that costs are reduced and cash flow efficiency is improved.

4 Case Study: TCL Group's Supply Chain Financial Service Platform 'JDH'

TCL Group is a Chinese high-tech enterprise group with international competitive strength.Its business involves intelligent terminal, semiconductor display, new energy photovoltaic and other fields. In order to promote the benign development of ecological supply chain, TCL set up the supply chain finance technology platform 'JDH' in 2015 to solve the problem of financing difficulties of small and medium-sized enterprises by digital means. The platform adopts the model of technology finance + industrial finance, realizes the flow of electronic vouchers of accounts receivable 'golden notes' through blockchain technology, penetrates the credit of the core enterprise to multi-level suppliers, reduces the financing cost, and improves the efficiency of funds. In April 2020, the platform's total transaction volume reached 370.5 billion 'Chinese yuan', covering more than 16,000 enterprises, including Micro and small enterprises with a registered capital of less than 10 million CNY accounted for 78% [24]. Therefore, this paper considers that JDH is representative and has passed the blockchain service filing of the Ministry of Industry and Information Technology, which compounds the research demand of this paper.

Data for this study faced limitations due to commercial confidentiality and the non-public status of some TCL partners. This section analyzes the JDH supply chain structure, presents a mixed qualitative-quantitative analysis, and considers technological empowerment boundaries.

4.1 TCL Group Supply Chain Finance Structure

The TCL supply chain takes itself as the core enterprise, with upstream suppliers (e.g., electronic components and panel manufacturers), and downstream connections with distributors, forming a hierarchical, multi-level synergistic network (as shown in Figure 1). Financial institutions (e.g. CITIC Bank, ICBC, Agricultural Bank of China) access the 'JDH' platform and issue 'golden notes' through blockchain to provide financing for small and medium-sized suppliers. The specific division for all participants are shown in Figure 3.
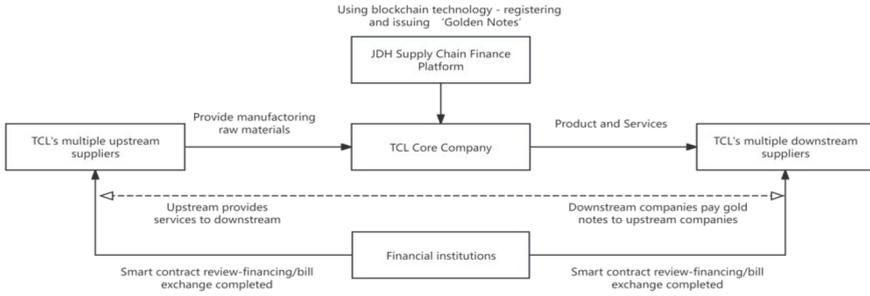
Fig. 3. participants in TCL+JDH supply chain+blockchain Technology

The core enterprise (TCL) issued 'Golden notes' to confirm ownership, transfer credit, and conduct non-face-to-face settlement for 'N-level' suppliers, aiming to optimize enterprise cash flow management. On the supplier side, SMEs split, transfer and finance their accounts receivable through the 'Golden notes', with an average financing amount of 1.13 million CNY per transaction and a comprehensive cost of about 6%. Financial institutions use block link batch verification to drag and drop all transaction instances to reduce risk control costs and complete financing within 2 hours [25].

4.2   Verification of the Effectiveness in Blockchain Technology Empowerment on JDH Platform

Considering that the primary purpose of 'JDH Supply Chain Finance Platform' is to assist the production and operation of TCL Group, and as a listed company, TCL Group needs to disclose the relevant financial and operational data. Therefore, based on the financial data of TCL Group from 2013 to 2023, this paper verifies the supply chain technology empowerment mechanism and models mentioned above. It mainly reflects: 1. whether the financing cost is reduced; 2. whether the turnover efficiency is improved; 3. whether the risk control is optimized.

4.2.1 Reduction of Financing Cost.

The platform tokenises accounts receivable (e.g. 'golden notes') into digital assets on the blockchain. Through cryptographic hashing, each asset is linked to real-world financial data (e.g., invoice amount, due date or next payment date), enabling traceability and partial ownership. This means that multi-tiered suppliers can verify transaction history and minimize arguments about payment terms.

We grab the date from Wind database for TCL Technologies to obtain interest expense and average interest-bearing debt for each year from 2013-2023. Given that:

Average interest bearing debt ratio=(interest bearing debt ratio carried forward + interest bearing debt ratio brought forward)/2   (1)

Average financing cost rate≈Interest expense/Average interest bearing debt   (2)

By comparing it with the average annualized interest value of the one-year monthly quoted loan market rate (LPR) in China and 10 years government bond interest rate. The results are shown as Figure 4 and 5 below:
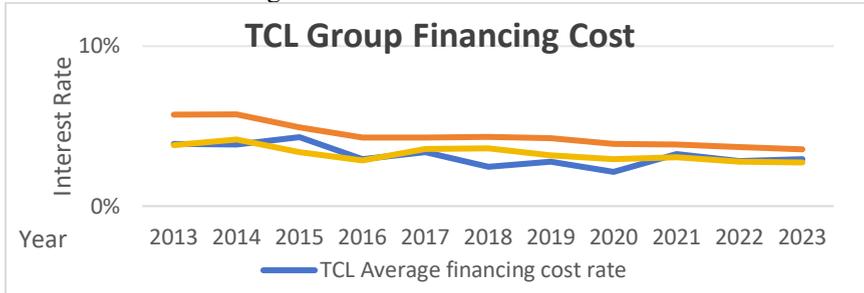

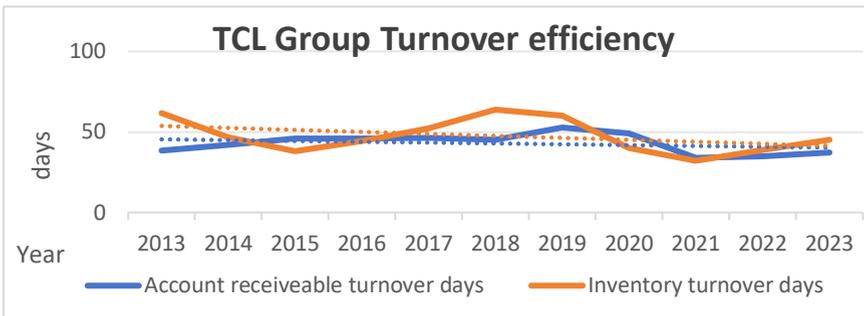**Fig. 4.** TCL Group Average Financing Cost rate from 2013 to 2015

Fig. 5. TCL Turnover efficiency days and trend from 2013 to 2023. Data Source: Wind date-base

The chart shows that on the blockchain platform JDH (which went live in 2015 and was further developed in 2020), the TCL Group has seen a significant reduction in its financing costs, which are generally lower than 1-year LPRs over the 10-year period. and lower than 10-year treasury bonds between 2016- and 2021. This demonstrates that blockchain technology effectively conveys core corporate credit and reduces financing costs.

4.2.2 Increased Turnover Efficiency.

The traditional supply chain finance process involves a large number of manual audits, paper document circulation which caused low efficiency. The automated and disintermediated nature of blockchain can significantly reduce the process time. An analysis of the data (chart 4-3) on accounts receivable turnover days and inventory turnover days from 2013-2019 shows an overall downward trend in accounts receivable turnover days and inventory turnover days. One of the main attributing factors may be: automated verification (automatic completion of order/invoice authenticity verification based on trusted transaction/logistics data on the blockchain); smart contracts (auto-matic execution of financing contract terms and lending instructions); and process

streamlining (reduction of repetitive review and confirmation links between multiple parties).

4.2.3 Risk Control Optimization.

Leveraging blockchain's immutability and transparency helps reduce the risk of fraud (e.g., duplicate financing, false trade backgrounds) and improves risk identification. The platform aggregates different levels of transactional data from Enterprise Resource Planning (ERP) systems and IoT devices and shares cash flow trajectories within the supply chain layer in a visual way. Suppliers can access dashboards showing payment status and liquidity risk to proactively plan their financial position. By collecting bad debt reserves for accounts receivable from 2013-2023, we find that around 2020, when the JDH platform is heavily developed, reserves drop significantly by about 45% vs. a peak in 2019. And it reaches its lowest point in 2021 (Figure 6).
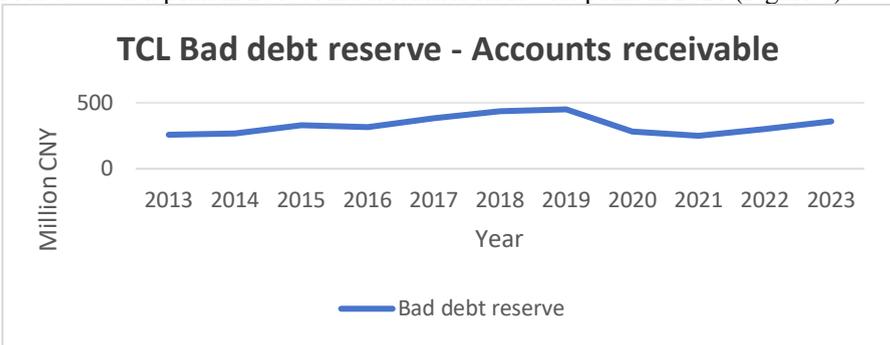

Fig. 6. TCL Group Bad debt reserve - Accounts receivable from 2013 to 2023. Data Source: Wind date-base

4.3   Boundary Conditions for Technology Enablement

Despite the significant benefits of blockchain, its application in supply chain finance is still full of constraints and challenges.

4.3.1 Compliance Constraints of Alliance Chain Governance.

JDH's alliance chain requires strict node access rules (e.g., supplier scale, qualification audits). While ensuring data quality, trustworthiness, and regulatory compliance (anti-money laundering, data privacy), these rules may limit openness, potentially excluding smaller suppliers or discouraging sharing of sensitive data, thus affecting risk-control model precision. Balancing compliance/security with openness/sharing is an ongoing governance challenge.

4.3.2 Practical Limitations of Technical Performance.

With growing business volume, JDH's alliance chain transaction processing speed (TPS) may face bottlenecks, especially during peak periods. While typically higher

than public chains, coalition chain TPS can still be pressured in high-transaction systems like TCL's. Scaling TPS requires technical upgrades, such as optimizing consensus algorithms or adopting sharding.

5   Research Conclusions and Policy Recommendations

5.1   Research Conclusion

This study focuses on the application of blockchain technology in supply chain finance cash flow optimization. Through in-depth analysis of the 'pain points' of traditional supply chain finance, combined with the characteristics of blockchain technology, the construction of a theoretical analysis framework and case verification, the following conclusions are drawn:

5.1.1 Blockchain Technology Can Solve the Traditional Supply Chain Finance 'Pain Points'.

Traditional SCF's issues—information silos, credit transmission failure, and lagging dynamic risk control—restrict cash flow optimization. Blockchain's distributed ledger breaks information barriers for real-time, validated data sharing, reducing information costs. Tokenized credit and digital credentials enable core enterprise credit to penetrate the supply chain, enhancing end-enterprise financing availability. Smart contracts build dynamic, collaborative risk control, enabling timely risk response and ensuring cash flow stability.

5.1.2 Based on Blockchain Technology, Three Effective Cash Flow Optimization Models Can Be Formed.

1. Trusted data sharing model: Improves transparency and transaction verification efficiency via distributed ledgers and ZKP.2. Credit transmission and financing cost optimization model: Reduces financing costs and improves efficiency using divisible digital certificates and automated smart contract matching.3. Dynamic risk monitoring and response model: Achieves timely risk warning and automated disposal via real-time data and smart contracts, improving cross-agency collaboration.

5.1.3 The case Verifies the Positive Role of Blockchain Technology in Reducing Financing Costs, Improving Turnover Efficiency and Optimizing Risk Control.

TCL Group's JDH platform demonstrates reduced financing costs (below market rates), improved turnover efficiency (shortened accounts receivable/inventory days), and optimized risk control (reduced bad debt reserves). However, challenges like alliance chain governance compliance and technical performance limitations persist.

5.2   Policy Recommendations

Based on the above research findings, the following policy recommendations are proposed to better promote the application of blockchain technology in supply chain finance.

5.2.1 Improve Policies and Regulations to Standardise Technology Application.

Governments should develop specific policies clarifying blockchain application specifications and regulatory standards in SCF, encouraging innovation while safeguarding data security, privacy, and financial stability. Establish regulatory sandboxes for safe testing and promote successful models.

5.2.2 Strengthen Infrastructure Construction and Promote Technology Integration.

Increase investment in blockchain infrastructure, supporting industry-university-research cooperation. Promote deep integration of blockchain with IoT, big data, and AI. Enhance blockchain platform performance (TPS, data storage), reduce enterprise application costs, and improve technology availability and reliability.

5.2.3 Incentivise Core Enterprises to Lead and Promote Supply Chain Collaboration.

Encourage core enterprises to lead in building blockchain-based SCF platforms and extending credit. Provide policy support (tax incentives, subsidies) to actively participating core enterprises. Guide SMEs to access these platforms, enhancing overall supply chain synergy and competitiveness.

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