

# *Application of blockchain in supply chain finance*

Guangyao Li\*

*School of Economics and Management, Guangxi Normal University, Guilin, Guangxi, 541000, China*

*\*Corresponding author: 1173787575@qq.com*

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**Abstract:** Small, medium and micro enterprises have the problem of difficult and expensive financing. As the main source of financing for small, medium and micro enterprises, supply chain finance has become more urgent in the process of transformation and upgrading under the requirements of the digital era. With the widespread use of digital technologies such as blockchain in the financial field, technological empowerment and platformization are increasingly emphasized and valued. This article conducts a comprehensive and systematic review of the literature on blockchain applications in corporate financing from theoretical perspectives, research methods and other dimensions, revealing the research progress of blockchain applications in direct financing, bank credit, supply chain finance and other scenarios. The similarities and differences between domestic and international literature were further compared. Finally, this article constructs the problems existing in the application of blockchain in supply chain finance, puts forward policy suggestions, and provides a reference for future research on this topic.

## **1. Introduction**

Small and medium-sized enterprises are an important part of the national economy, but in our country, problems such as difficult and expensive financing have always restricted the development of small and medium-sized enterprises. Compared with large enterprises, small and medium-sized enterprises lack information transparency, and most of them lack collateral and high-reputation guarantors (Lin Yifu, Sun Xifang, 2005). Many financial institutions are reluctant to provide financial services to small and medium-sized enterprises due to risk management considerations. In order to alleviate the financing problems of small and medium-sized enterprises and better promote the continuous transformation and upgrading of the economy, many scholars have put forward policy suggestions such as expanding relationship loan business and encouraging bank competition (Li Guangzi et al., 2016)[5]. In recent years, due to the impact of the epidemic, the financing problems of small and medium-sized enterprises have faced more severe challenges. Therefore, how to eliminate the gap between small, medium and micro enterprises and financial institutions requires further innovation in existing financing models.

From the perspective of financial practice, financial technology represented by big data, artificial intelligence, and blockchain has created a new paradigm shift that drives innovation in the financial field. While traditional banking products range from payments to investment services, blockchain technology challenges traditional supply chain finance by offering innovation, safer and faster

transfers, and lower costs (Lee and Shin, 2018). As a disruptive technology, blockchain technology has subverted traditional business models and traditional business transaction processes, opening up huge opportunities for co-creation of commercial value. Blockchain is expected to disrupt various industries and organizations, especially in applications in the banking and financial fields Song Hua (2020). By opening a transparent window into a business's supply chain, blockchain technology provides the ability to obtain favorable financing terms at low signaling costs. [4]With the further deepening of the application of blockchain in supply chain finance, the financing difficulties faced by central enterprises seem to be alleviated. But at the same time, because financial technology lowers barriers to entry, increases the accessibility of financial services, and challenges the nature of the financial system, supporting regulatory and legal rules should be introduced in a timely manner [6].

## **2. The meaning of blockchain and its development status**

### **2.1 The connotation of blockchain**

Blockchain is a disruptive innovation technology proposed by Satoshi Nakamoto, which was first used as a distributed ledger for Bitcoin transactions. Its peer-to-peer network structure, combined with encryption algorithms and consensus mechanisms, and several outstanding features, including decentralization, traceability, immutability, transparency and smart contracts, have aroused widespread interest in many fields [2]. Blockchain is a new digital technology that combines peer-to-peer network computing and cryptography to create an immutable, decentralized public ledger. Where a ledger records money, a blockchain is a cryptocurrency, such as Bitcoin; but ledger entries can record any data structure, including property ownership, identity and authentication, contracts, etc. (Crosby et al., 2016) . As a way of ordering transactions in a distributed ledger, blockchain provides a consensus record with a cryptographic audit trail that can be maintained and verified by multiple nodes. It allows contracting parties to dynamically track assets and agreements using common protocols, thereby simplifying or even completely eliminating many internal and third-party verification processes (Treleaven, 2017). Therefore, blockchain technology can effectively eliminate the problem of distrust caused by human factors. The economics of blockchain extends beyond an analysis of new general-purpose technologies and their destructive Schumpeterian consequences to a broader view of blockchain as an institutional technology. Blockchain technology was originally thought to be the basis of cryptocurrencies, but it has far-reaching potential in many other fields. In order to understand this potential, it is important to distinguish between two core blockchain components: distributed ledger technology and smart contracts.

#### **2.1.1 Distributed ledger**

A distributed ledger is a decentralized, shared, replicated and synchronized record of transactions protected by a cryptographic seal. Unlike a distributed database, nodes of a distributed ledger cannot trust other nodes and therefore must independently verify transactions before applying them. Distributed ledgers fall into two broad categories: those that seek to minimize the role of trusted and identifiable third parties, and those that explicitly rely on identifiable third parties for some subset of system properties. Not all distributed ledgers are blockchains, but all blockchains are distributed ledgers.

#### **2.1.2 Smart contract**

The introduction of smart contracts has always been key to the development of financial

technology. Blockchain technology has been continuously evolving over the past decade. The product most relevant to this evolution is smart contracts. A smart contract is a computerized transaction program that executes the terms of a contract. This means that all contract terms are embedded into the computer of the individual executing the transaction. Because these contracts automatically execute when certain conditions are met (the code in the smart contract-compliant algorithm specifies these conditions), there is no need for a central authority or third party to support these transactions (Nick, Szabo, 1994).

Smart contracts are rules mutually agreed upon by participants that govern the evolution of “facts” in a distributed ledger. Such smart contracts could be computer programs that attempt to ensure that all transactions comply with the underlying legal agreement and that the records managed are authoritative with respect to the existence, status, and evolution of the underlying legal agreement they represent. When smart contracts are used with a blockchain that records changes in asset ownership, it can act as a wrapper for transactions, automatically transferring value and enforcing the terms of the contract. Smart contracts also have the potential to automate laws and regulations, which can greatly increase the efficiency and transparency of government services.

## **2.2 Current status of blockchain development**

The blockchain technology relied on by cryptocurrencies represented by alternative tokens such as Bitcoin and Ethereum was initially perceived by most banks and has been criticized and questioned (Attaran and Gunasekaran, 2019). But because its costs are much lower than traditional business models, transaction processing times are significantly faster. Banks have been looking for ways to utilize blockchain technology for clearing and settlement as well as applying blockchain technology to financial trade (Arnold, 2017). Abroad, stock exchanges such as the Nasdaq Stock Market and the New York Stock Exchange have conducted in-depth research on blockchain technology. In 2015, Nasdaq announced that it had completed its first securities transaction using a blockchain trading platform called “Linq” (Zhu et al., 2016). In addition, financial entities such as the American Trust and Clearing Company Visa and the Global Financial Telecommunications Association have also expanded their plans in the blockchain technology sector ( Guo and Liang, 2016 ) [3] . In addition, American Express used the financial technology start-up Ripple to launch instant payments based on blockchain, becoming one of the first major users of this technology (Crosby et al., 2016). Users can verify and track their Bitcoin transactions, and the information stored in the blocks can serve as a trust element. Therefore, an effective blockchain requires centralized agents, usually provided by financial intermediaries. The main reason for this element of trust inherent in blockchain is that blockchain technology has the potential to become a transformative technology in financial services; in some areas, it may eliminate the need for intermediaries (Cynthia, 2018). Since its initial application in Bitcoin, blockchain has now been explored into different industries as more and more business leaders and entrepreneurs realize the huge potential of this transformative technology. For example, in the social media industry, Steemit uses a blockchain-based rewards platform to serve publishers. In the emerging cloud computing file sharing industry, Filecoin is a decentralized storage network that turns cloud storage into an algorithm. These highlight the opportunities the world is looking for by researching innovative blockchain applications.

## **3. The connotation and development status of supply chain finance**

### **3.1 The connotation of supply chain finance**

Supply chain finance originated from trade finance. In the 1940s, Saulnier studied the

development of accounts receivable financing in U.S. trade finance. However, at this time, accounts receivable financing is mainly through bill discounting business, and there is no obvious supply chain finance feature[1]. At the end of the 20th century, Hartley and others proposed the concept of supply chain financing and introduced the financing design of prepaid accounts. Randall and Farris define supply chain finance as the cooperation in capital flow between upstream and downstream enterprises in supply chain production, through which the overall cost of supply chain production can be reduced. The field of supply chain finance has grown significantly over the past decade, as can be seen in the growth of academic research and the expansion of the supply chain finance market, especially since the 2008 financial crisis. Compared with traditional bank credit loans or venture capital, supply chain finance relies on various production links in the supply chain. Comprehensive financial services must be provided to supply chain stakeholders based on the underlying elements of supply chain production. Supply chain finance can use financial tools to assist supply chain production, create financial value-added through supply chain scenarios, and develop good cooperative relationships between supply chain enterprises and financial institutions (Mingxiao, 2019). Supply chain finance aims to combine financial flows with physical and information flows. By implementing supply chain solutions, the working capital of supply chain enterprises can be optimized and the problem of insufficient liquidity can be improved.

Supply chain finance is a financing model in which banks connect core enterprises with upstream and downstream enterprises to provide flexible financial products and services. In traditional supply chain finance, core enterprises with strong competitiveness and large scale play an irreplaceable role in managing supply chain information flow, logistics, capital flow, etc., resulting in problems of inequality and information asymmetry. Fraud is also very serious in supply chain finance. With the application of blockchain in supply chain finance, it effectively solves the problem of distrust between supply chain participants, improves the efficiency of capital flow and information flow, reduces costs, and provides supply chain related parties with provide better financial services.

### **3.2 The development status of supply chain finance in China**

My country's supply chain finance started late, but due to the rapid development of accounts receivable, commercial paper and financing market businesses have developed rapidly. Supply chain financial management usually involves core supply chain enterprises, logistics enterprises, supporting small and medium-sized enterprises, banks and other institutions. Different companies and institutions play different roles. According to the information asymmetry theory and principal-agent theory, supply chain finance participants screen their own favorable information in business cooperation; therefore, the comprehensiveness of business information cannot be guaranteed. Only by ensuring the full exchange and credibility of supply chain financial cooperation information can the efficiency of capital flow and logistics be ensured. In this digital era, the entire world has experienced the rapid development of information technology. There is huge market potential in supply chain finance so far, but how to fully realize the potential of supply chain finance is still a challenge faced by academia and industry.

Some common problems in current supply chain finance focus on the credit risk of supply chain finance. In the current supply chain financial system, credible data is difficult to obtain and risks are difficult to control. Therefore, a platform must be built to achieve data sharing. Blockchain technology can be used to build a supply chain financial platform to effectively solve the problem of insufficient data sharing. The technical characteristics of blockchain bring convenience to auditing and supervision, and are also beneficial to the risk control of supply chain financial business.

## **4. Application of blockchain in supply chain finance**

### **4.1 Some problems existing in the application of blockchain**

Although supply chain management has experienced more than 20 years of development, traditional supply chain management still has many challenges that hinder the implementation of supply chain management [7]. Unless these challenges are identified and properly addressed, the huge potential value of supply chain finance will not be fully realized. Stakeholders in the supply chain have independent profit maximization goals under different organizational structures, costs, and risks, which increases the difficulty of coordination and leads to low performance throughout the supply chain. In addition, supply chain finance involves multiple partners and complex business processes, but previous technologies cannot provide transparency to eliminate information asymmetry problems, resulting in the inability to effectively integrate information flows, physical flows, and financial flows. Small and medium-sized enterprises have become the main driving force of economic development. However, due to the limited scale and working capital of small and medium-sized enterprises, although they need financial support, they always face the problem of shortage of liquidity and difficulty in obtaining financial services. On the one hand, financial institutions have a conservative financing attitude toward small and medium-sized enterprises due to difficulties in risk control[8]. On the other hand, supply chain financial means can only radiate to a small number of small and medium-sized enterprises. For example, in reverse factoring, first-tier SME suppliers can obtain loans from banks and other types of lenders through the endorsement of the central enterprise. However, lower-level SME suppliers generally cannot apply for loans using the central enterprise's credit because they do not have direct contracts with the central enterprise. In addition, since manual processes and paper documents in supply chain finance activities remain invisible to counterparties due to extensive manual inspection and paper transactions, the opacity increases the likelihood of fraud risks, including invoices. Fraud and data tampering. A well-known financial fraud is double financing, where a business sells the same invoice to two or more financial institutions. These frauds undermine mutual trust among stakeholders in supply chain finance and hinder integrated management and warehouse supervision. In traditional transactions, indirect interactions between two major entities lead to inefficient operations in supply chain finance operations. Additionally, paper-based transactions and lack of automation increase total transaction costs for supply chain partners. In summary, the above challenges hinder the development of traditional supply chain finance; therefore, business processes, the roles of different stakeholders and supervisory methods may need to be adjusted to fully activate the potential of supply chain finance. It can increase credit for enterprises and build trust among stakeholders, which is conducive to stimulating the potential and creativity of supply chain finance[9].

### **4.2 Some problems existing in the application of blockchain**

#### **4.2.1 Risks of the technology itself**

Blockchain originally originated from Bitcoin, so many technical features in blockchain technology are directly or indirectly influenced by Bitcoin. In a centralized trading system, the privacy protection strategy is to determine the identity but hide the transactions. It is difficult for nodes other than centralized nodes to fully know all transactions for a specific account. The original blockchain transaction system represented by Bitcoin is essentially an open, distributed accounting system. All account and transaction information is transparent, thus requiring a different privacy model. The strategy of these blockchain transaction systems is to hide identities but determine transactions by using a decentralized system where electronic identities do not have to correspond

to real identities. A real-world individual can have multiple account addresses without his real identity hiding his operations. While systems like Bitcoin protect the true identity of the owner of a transaction address, by analyzing data from public transactions in a way, different account addresses can be linked, thus invading user privacy. After the emergence of the consortium chain architecture, the submission of transactions requires identification signed by consortium members, thus invalidating the privacy protection model that relies on protecting the true identity of the owner of the transaction address[10].

This process will lead to privacy leaks. After the transaction data is accumulated, attackers can easily use big data analysis technology to aggregate and extract the user's transaction address and transaction path, thereby locating the user's identity and learning the user's behavior, causing considerable damage. Risk of privacy leakage. So in this case, it is important to hide the user's trading behavior by obfuscating transactions. The core idea of the token mixing mechanism is to split and reorganize multiple transactions to interrupt the direct connection between the input address and the output address in a transaction, making it impossible for attackers to obtain the user's real transaction data. Many researchers have focused on privacy protection, and some methods have been used in blockchain. The main methods include ring signatures, blind signatures, zero-knowledge proofs, homomorphic encryption, etc.

#### 4.2.2 Regulatory issues

One of the common features after any financial crisis is the belief among regulators in stable and optimal rules. On the one hand, the risk that policymakers do not incentivize innovation through appropriately crafted adaptive regulations could mean the loss of a country's competitive advantage. Some fintech startups may even end up moving to more favorable jurisdictions in other parts of the world. On the other hand, unregulated conditions may foster the creation of criminal organizations that will profit from the lack of laws governing these activities. However, this framework relies on stable and predictable rules and may not be sufficient in many cases, especially when disruptive technologies such as blockchain are introduced into the equation. In the context of blockchain technology, a major key challenge can be associated with regulatory issues. Although technology itself is not averse to regulation by definition, the diversified use of technology needs to include cryptocurrencies, blockchain, shared ledgers, smart contracts, etc. Therefore, appropriate regulatory mechanisms need to be applied depending on the specific circumstances of the financial processes provided by blockchain[11].

In this regard, at the global level, policymakers and regulators have been focusing mainly on regulating the use of cryptocurrencies to avoid taxation and criminal activities ( Cermeno , 2016). Some countries consider cryptocurrencies as digital currencies, others as commodities. Regulatory approaches therefore need to delicately balance their innovative spirit while recognizing the potential for the technology to inadvertently create systemic risks to the financial system. While blockchain offers opportunities, its wider adoption and use still faces challenges. He believes that blockchain relies on collaborative governance to provide trust in financial markets and ensure that all parties function according to agreed rules. This lack of governance has been one of the main reasons behind various blockchain cybercrimes and other criminal activities (Yeoh , 2017) . Broader and deeper applications of blockchain are potentially limited by technical and scalability challenges, business model challenges, government regulations, and privacy challenges. Regulation involves laws designed to control behavior, while governance involves management, cooperation, and incentives for the common good ( Harwood -Jones , 2016). At the same time, as the application of blockchain in supply chain finance deepens , it has exploded from a niche market to a billion-dollar industry, bringing new applications, including Bitcoin , crypto mortgages, and trustless financing transactions. And decentralized exchanges . However, as blockchain investments grow, so do

related incidents and hacking rates, with more than \$153 million stolen in 2020 alone, many by exploiting smart contract vulnerabilities.

## 5. Conclusions and prospects

In theory, blockchain technology can facilitate banks and other financial institutions to manage the financing risks of small size, limited working capital and low credit. On the one hand, credit can be provided to small and medium-sized enterprises from key enterprises in the supply chain. On the other hand, the authenticity of transactions can be verified through a blockchain-based supply chain finance platform to avoid fraudulent financing behaviors such as double financing [12]. As a result, supply chain finance providers can provide finance to a large number of lower-tier suppliers and retailers. Research on supply chain finance and blockchain has attracted widespread attention in recent years, but so far there is little systematic analysis of blockchain in supply chain finance. Most research focuses on the theoretical analysis of the application of blockchain technology itself in supply chain finance, and some articles conduct a quantitative analysis of blockchain from the perspective of game theory. A review of the existing literature can help us better understand the modes, processes and mechanisms of the integration of the two. For example, blockchain has been widely used in many fields of finance; blockchain has a long-term impact on finance in smart cities, sharing economy and other fields; blockchain can be deeply integrated with other technologies to promote the diversification of the financial industry develop. Future research can conduct specific case analysis or related empirical studies to verify the effectiveness of the proposed framework.

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