

Research Progress on Financial Innovation Based on Blockchain Technology

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Abstract: The development of emerging technologies such as blockchain, big data and artificial intelligence has provided new impetus for financial technology innovation. The inherent characteristics of blockchain technology, including multi-party consensus, transparency, immutability, and smart contract functionality, naturally align with the needs of the financial industry. In recent years, blockchain has been applied in various financial domains such as payments, credit reporting, factoring, trade finance, supply chain finance, securities trading, etc., while also presenting problems in the innovation process. In this paper, we provide a theoretical and practical overview of blockchain technology and its intersection with financial innovation, analyzing its key stages, application scenarios, and potential issues.

Keywords: Blockchain Technology, Financial Innovation, Research Progress.

1. Introduction

The decentralization, trustlessness, code-based operation, and autonomy of blockchain have changed the trust model of traditional finance, providing innovative solutions for financial problems. It is gradually becoming the underlying technology of financial technology, which not only improves existing financial services and enhances the efficiency of the financial industry but also helps to accelerate the transformation of other related industries. In recent years, blockchain applications in areas such as fund regulation, supply chain finance, trade finance, payment clearing, and other domains have demonstrated enormous potential. However, limitations in the maturity of the technology, governance mechanisms, and infrastructure of blockchain persist, hampering its full application value. The mass promotion of blockchain faces certain challenges and potential risks that must be addressed. Overcoming these limitations is the key to further realizing the financial application value of blockchain. Based on this, this paper comprehensively elaborates on the application of blockchain in the financial field, beginning with an overview of its

technological characteristics and innovativeness.

2. Basic Concepts of Blockchain and Financial Innovation

2.1. Concepts of Blockchain Technology

The concept of blockchain was first proposed in Satoshi Nakamoto's "Bitcoin: A Peer-to-Peer Electronic Cash System". As a distributed ledger system based on cryptography, blockchain technology utilizes a blockchain data structure to verify and store data. It employs a consensus algorithm that involves distributed nodes to guarantee the secure transmission and access of data. Blockchain takes a decentralized and trustless approach to provide a reliable database for the entire system, making it an effective solution for managing and analyzing complex data. Traditionally, large organizations utilize databases to store data, support transactions, and carry out other functions. However, they do not share these data but charge a certain fee to maintain the integrity of the data. Table 1 summarizes the fundamental concepts of blockchain technology.

Table 1. Concepts of Blockchain Technology

Sources of Concept	Blockchain Definitions
The White Paper on China's Blockchain Technology and Application Development [1]	Distributed data storage, peer-to-peer transmission, consensus mechanism, encryption algorithm, and other new computer technology application patterns
JD Blockchain Application White Paper (2018) [2]	A new distributed infrastructure computing paradigm that uses a blockchain data structure to verify stored data
Blockchain Industry Dictionary [3]	Blockchain technology refers to a technical solution for collectively maintaining reliable data through decentralization and trustlessness.
Standard for Application of Blockchain Technology in Big Data Trading	A new type of application pattern for distributed data storage, peer-to-peer transmission, and computer encryption technology under the consensus mechanism rules.
Report on Development of China's Blockchain Technology and Industry (2017) [4]	Blockchain is based on cryptographic algorithms and builds an immutable point-to-point distributed ledger technology in a multi-center system.

2.2. Blockchain and Financial Innovation

2.2.1. Background of Financial Technology Development

Financial IT is a revolutionary technology that provides a new, sustainable, and efficient solution for modern finance, enabling the financial industry to better meet customer needs and improve the quality of financial services more effectively. Its emergence provides robust support for the development of the international financial industry, promotes innovation in financial markets, and offers greater flexibility and operability to financial institutions.

So far, financial technology has undergone three different stages of development:

First, the stage of financial IT application. IT technology has been widely used in daily financial business. Online

payment is a good example. By introducing mobile technology, traditional offline bank counter services have been changed, and a bridge has been built for cooperation between technology companies.

Second, the stage of internet financial management. With the progress of technology, financial institutions have transformed from traditional channels to online financial service management platforms, making information sharing and the integration of financial businesses more convenient and efficient.

Third, the 3.0 stage of financial technology. With the rapid development of financial technology, the financial industry has begun to closely link with cutting-edge technologies such as big data, cloud computing, blockchain, and artificial intelligence, forming a new, revolutionary financial model.

Table 2. Three Stages of Blockchain Technology Development [5]

Blockchain 1.0	Blockchain 2.0	Blockchain 3.0
Digital Currency	Smart Contract	The Internet of Value
It takes bitcoin as a typical application and provides a real and secure digital currency trading function, which is relatively simple.	Through smart contracts, the collaboration of multi-service systems is promoted to realize the trusted transmission of value in multiple application scenarios.	Realize the cross evolution and integration development with emerging technologies such as the Internet of Things, big data, and cloud computing, and reconstruct the digital economy development ecology.

2.2.2. Development Status of Blockchain Finance

Major financial institutions have been actively exploring the application of blockchain + finance to meet the growing financial demands. From an international perspective, over 100 banks worldwide have explored blockchain, such as HSBC conducting the world's first trade finance transaction on blockchain; JPMorgan launching blockchain payment and settlement tool JPMCoin, attracting participation from over 80 banks globally; and Wells Fargo piloting stablecoin "Wells Fargo Digital Cash". In addition, international internet giants and IT companies have also launched blockchain-based

products and technology services. For example, Facebook launched cryptocurrency Libra; IBM and Ripple launched cross-border payments based on blockchain technology. Ripple has covered more than 40 countries globally and become an active competitor of SWIFT. In China, according to the 2020 White Paper on the Development of Blockchain Financial Applications released by the Financial Technology Research Institute of ICBC, major financial institutions and internet companies have actively deployed blockchain, mainly focusing on supply chain finance, trade finance, fund management, payment clearing, digital assets, and derivatives.

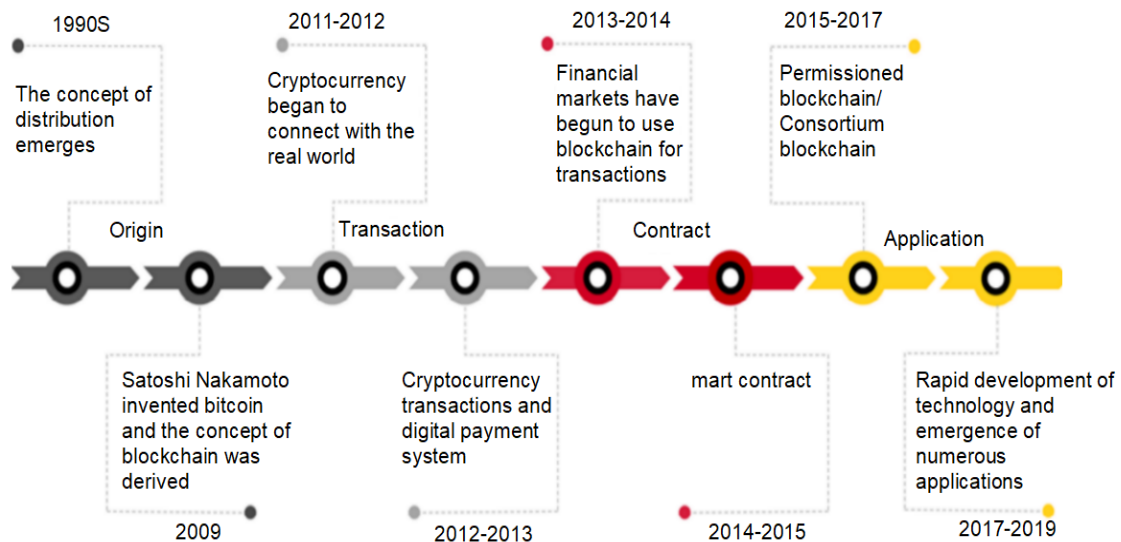


Figure 2. Development status of blockchain finance [6]

3. The Promotion of Blockchain Technology to Financial Innovation

The essence of finance lies in managing credit, and in most cases, the establishment of transaction credit relies on third-party intermediaries including financial institutions. At present, the pain points faced by the financial industry mainly include: first, difficulties in verifying the authenticity of assets and transaction information, resulting in high costs of credit evaluation and difficult landing of inclusive financial services; second, complex and lengthy cross-institutional financial transaction processes leading to low efficiency; and third, the challenge brought by the development of Internet finance's cross-border business to traditional centralized risk management and regulatory models.

The emergence of blockchain technology has provided the possibility of merging innovation for many scenarios that are difficult to integrate online due to trust granularity or trust cost issues in traditional internet applications. For the financial scenarios that have been realized, blockchain provides a transfer solution for its "trust base from offline high cost to online low cost", while the characteristic of multiple parties sharing in blockchain also strengthens the connection and cooperation between participants, enhancing the efficiency of value exchange. At the same time, blockchain provides an innovative foundation for the widely trusted financial sector business scenarios, making future cross-industry integration of business model innovation possible. Specifically, the value of blockchain in the financial field is reflected in the following areas:

3.1. Trust Enhancement

The traceability capability of blockchain information enables transaction information, fund sources, asset data, and

other data to be traced and transparently recorded in business operations, thus reducing risk control costs for financial transactions and providing genuine data support for regulatory oversight in financing services, asset mortgages, and other business scenarios.

3.2. Cross-institutional Cooperation

The anti-tampering feature of blockchain provides a natural trust basis for financial applications, ensuring the effectiveness of data obtained from the blockchain. It reduces the credit costs of traditional businesses dependent on intermediaries in cross-institutional business scenarios and can also provide assurance of authenticity in scenarios involving digital assets such as mortgages and financing.

3.3. New Model of Data Sharing

The multiple-party distributed ledger model of blockchain ensures that data is visible and consistent to all participating parties, achieving the feature of multilateral data sharing. The process of confirming transactions is the process of settlement, delivery, and auditing, which enhances the efficiency of payment, transaction, and settlement. At the same time, it saves additional work expenses caused by multi-party information asymmetry in financial scenarios, such as data transmission, settlement reconciliation, and manual verification, effectively reducing capital costs and systematic risks. Under the blockchain architecture, regulatory authorities can directly share transaction account books without affecting the original transaction process, achieving real-time or quasi-real-time access to target data and saving the step of re-submitting regulatory materials. For certain critical areas, regulatory authorities can directly observe the specific process of the entire business flow, achieving in-process regulation.



Figure 3. Technical Feasibility of Blockchain Finance [7]

4. Applications of Blockchain Technology in the Financial Industry

4.1. Payment Settlement

Modern technology enables people to achieve more convenient transactions through automated devices and network support. Compared with traditional payment models, establishing a cross-institutional payment and settlement platform has significant advantages, as it allows both parties to share information in a short time, greatly reducing transaction cycles.

4.2. Digital Bills

Currently, there are numerous institutions in China's bill market, but relevant systems have not yet been standardized, and the operating conditions are complicated and changeable. As a result, the market faces numerous challenges. Due to the strict audit standards for bills, there are many illegal behaviors in the market. By applying blockchain technology, unfairness in the traditional market can be effectively eliminated, thereby promoting the development of the bill market to a higher level.

4.3. Supply Chain Finance

Adopting blockchain technology can effectively prevent data forgery and duplication, greatly improving the traditional supply chain management mode and providing solid security guarantees for the security and reliability of the data. To achieve financing through advanced technological means, both parties must establish a consensus agreement to ensure the accuracy and completeness of each transaction.

4.4. Internet Finance

With the development of blockchain technology, the development momentum of Internet finance is strong, and citizens' credit can also be effectively managed and built. The widespread application of blockchain technology not only promotes financial innovation, improves risk control, but also provides solid support for the sustainable development of China's economy and society. By applying blockchain technology, the high-quality development of the Internet finance industry can be effectively promoted, and the ultimate goal can be achieved by reducing operating costs.

5. Challenges in Financial Innovation of Blockchain Technology at Current Stage

5.1. Severe Regulatory Backwardness in Finance

Blockchain technology will completely disrupt the traditional business cooperation model and significantly reduce the complexity of financial transactions, as it no longer relies on intermediaries and achieves decentralization. Consequently, any institution can more easily manage its own business logic. As the globalization of the three networks, i.e., the internet, finance and capital, one of the greatest challenges facing blockchain finance is how to effectively regulate them. Therefore, regulatory authorities not only need to change their traditional regulatory modes, but also reform their operating mechanisms and methods to ensure better service for investors.

5.2. Imperfect Legal System Construction

First, it is necessary to update and improve China's existing financial legal system. With the development of blockchain technology, its anonymity conflicts with China's current network real-name system, and due to the irreversibility of blockchain smart contracts, it cannot be used for revoking traditional agreements. Therefore, effective measures should be taken to strengthen the standardization and supervision of blockchain applications to ensure that they are adequately protected in future development.

In addition, due to the ambiguity of legal responsibility, the scope of digital currency must be clearly defined, and illegal transactions and criminal activities using digital currency must be severely punished. With the development of blockchain technology, it can deploy user data and financial applications to any node, completely changing the set-up of storage servers for traditional network enterprises, breaking geographical boundaries, and bringing new opportunities for determining enterprise legal responsibility, freeing ownership from restrictions by individuals or independent department organizations.

5.3. High Research and Development Costs

Firstly, there are internal capacity issues. With the development of blockchain technology, the transparency of financial data and the public availability of transaction information require each node on the server to be able to record and process large amounts of transaction information in a timely manner. Therefore, the amount of information for each node must be greater than before, and due to the large-scale batch transmission of information, the size of each node's block information will also increase accordingly. However, there are still a series of challenges due to the limitations of existing hardware facilities, such as insufficient control capacity of information, cumbersome real-time batch storage of information, and authentication processes.

Secondly, familiar and widely applicable blockchain financial products are still lacking. At present, there are no fully developed blockchain financial APP in China. Through the blockchain technology, financial APP such as currency and apps can achieve significant benefits, but the preliminary research and practice of these key technologies are still in the early stages.

Thirdly, risk factors still exist, and the national security certification system urgently needs to be further improved. With the development of technology, blockchain finance is receiving increasing attention. However, due to its low entry barrier, irreversible information security in the financial system, as well as a current lack of effective regulatory measures, there is an increased risk of personal privacy breaches. In order to address this issue, it is urgently necessary to establish and improve a set of strict security authentication mechanisms.

6. Conclusion

In summary, blockchain technology is characterized by a linked data structure and a distributed ledger. It can achieve multi-party maintenance of data, cross-verification, network-wide consistency, difficulty in tampering, and resource sharing, and has become a key technology for the development of digital economy. In the financial field, the

exploration of blockchain applications is gradually deepening, and the application scenarios are constantly enriching. In the era of digital economy, finance will be the most likely scale application scenario for blockchain, and blockchain will be the underlying infrastructure for future financial upgrading. The innovative development of blockchain financial applications is not only the need for efficiency and quality improvement in the finance industry, but also conforms to the trend of financial services for entities and inclusive finance.

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