

The Application of Blockchain Technology in the Financial Field

Yanling Liu*, Yun Li

Hainan Vocational University of Science and Technology, Haikou, Hainan 570100, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Blockchain technology, as a revolutionary tool, is profoundly changing the way the financial field works. Its application has expanded from digital currency to many fields, such as smart contracts, cross-border payments, trade finance, and digital identity management, providing important support for simplifying financial service processes, reducing costs, and improving efficiency. However, the widespread application of blockchain technology still faces challenges such as scalability, regulatory compliance, and cybersecurity, limiting its full integration in the financial industry. This study systematically reviews the status quo, development history, and future trends of blockchain technology application in the financial sector, analyzes its key role in capital markets, decentralized finance (DeFi), and other fields, and explores the potential of emerging solutions such as hybrid blockchain and dynamic regulatory frameworks.

Keywords: Blockchain; Decentralized finance; Smart contracts; Cross-border payments

Online publication: April 28, 2025

1. Introduction

The financial sector has been at the forefront of technological innovation, driven by increased transaction and operational efficiency, transparency, and security. The decentralized and secure nature of blockchain technology offers powerful solutions to many of the challenges faced by the traditional financial system ^[1]. The technology allows for secure and transparent record-keeping, which can significantly reduce fraud and errors in financial transactions. During this phase, the operation of Bitcoin demonstrated the potential of blockchain to provide a secure, transparent, and immutable record of transactions, gradually attracting the attention of global financial institutions. With the deepening of people's awareness of blockchain's advantages, various banks and financial entities began to actively explore its application possibilities ^[2].

In the years since Bitcoin's launch, financial use cases for blockchain have continued to emerge. The introduction of a new generation of blockchain platforms, such as Ethereum, has expanded the application possibilities of blockchain through smart contracts. These technological developments demonstrate the great potential of blockchain in streamlining all kinds of financial processes, from transaction settlement to fraud prevention to compliance management, with significant optimization. Major international banks such as JPMorgan

Chase and Goldman Sachs have successively announced strategic partnerships and developed proprietary blockchain solutions, marking the mainstream development of the application of blockchain technology in the financial sector. At the same time, there is growing research interest in tokenized assets and digital currencies, and these innovations are expected to significantly improve the liquidity and accessibility of financial markets ^[3].

As blockchain technology continues to mature, the need for a comprehensive regulatory framework becomes even more urgent. Regulators around the world are beginning to develop guidelines to address the many challenges posed by blockchain technology. These regulatory efforts play a key role in ensuring that blockchain solutions are aligned with international standards and securely integrated into the existing financial ecosystem.

2. Status of application

2.1. Smart contract

Smart contracts represent a significant advance in the way agreements are formed and enforced in the digital age. As self-executing contracts, their terms are written directly into computer code and automatically trigger execution when certain conditions are met. This innovation eliminates the reliance on third-party verification and significantly streamlines business processes across multiple industries, including finance, real estate, and supply chain management. In the logistics sector, for example, companies can set up smart contracts to automatically trigger payments when goods arrive at their designated destinations, thus ensuring the timely completion of transactions and the establishment of trust between the two parties.

2.2. Cross-border payments and asset management

Blockchain simplifies international money transfers by eliminating intermediaries, reducing transaction costs, and increasing processing speed while maintaining security through its decentralized nature. The tokenization of assets on the blockchain allows for partial ownership and easier transferability while providing a transparent record of ownership to reduce the risk of fraud ^[4].

2.3. Trade finance

In the field of trade finance, blockchain technology has significantly improved the efficiency and security of international trade transactions. By providing necessary financial instruments such as letters of credit and trade letters of credit, blockchain has effectively reduced risks such as currency fluctuations and payment defaults in cross-border transactions. Such technological integration not only optimizes cash flow management but also improves cooperation among all parties in the supply chain, providing strong support for global business operations.

2.4. Cryptocurrency management

Blockchain technology provides a revolutionary infrastructure for the management of cryptocurrencies, enabling a truly decentralized transaction system. As the first and most influential cryptocurrency, Bitcoin's operation on the blockchain network demonstrates an entirely new mode of value transmission. In this system, participants can conduct peer-to-peer transactions directly, while the mining process validates transactions by solving complex mathematical problems and rewards miners with newly generated digital currency, thus maintaining the healthy functioning of the entire cryptocurrency ecosystem.

2.5. Supply chain management

The application of blockchain technology in the field of supply chain management is significantly improving

operational transparency and efficiency. Through blockchain technology, organizations can optimize the whole process of management from procurement to distribution, effectively reducing operational costs and improving customer satisfaction. Especially in the collaborative application of trade finance and supply chain management, this advantage is more obvious, enabling enterprises to establish a more stable supplier relationship network and ensure the timeliness and reliability of capital flow.

These applications can reduce transaction costs and improve operational efficiency across the financial sector^[5].

3. The advantages of blockchain in finance

Blockchain technology has brought many innovative advantages to the financial field. Its decentralized nature effectively eliminates the need for traditional intermediaries, which not only significantly reduces operating costs but also significantly improves transaction efficiency^[6]. At the same time, blockchain's inherent immutability and transparency features further enhance system security and promote trust-building among participants, making it a powerful tool for preventing financial fraud.

3.1. Reduced costs and improved efficiency

One of the most significant advantages of blockchain technology in the financial sector is the significant reduction of transaction costs. By enabling a true peer-to-peer transaction mechanism, blockchain enables users to bypass the traditional banking system and enables faster and more economical international remittance services.

3.2. Enhanced security and transparency

Every transaction recorded on the blockchain is immutable and fully transparent, meaning that transactions cannot be changed or deleted once confirmed. This transparency significantly increases the level of trust between users, as all participants can independently verify transactions recorded on the public ledger, significantly reducing the probability of fraud. In addition, the decentralized nature of blockchain effectively reduces the risk of a single point of failure, making the financial system more resilient in the face of cyber threats.

3.3. Innovative applications in trade finance

Blockchain technology is profoundly transforming how the trade finance sector operates. For example, blockchain-based letters of credit and trade loans enable more efficient management and significantly streamline the flow of funds within the supply chain by providing greater control and accessibility. The computational logic and data mining capabilities of blockchain technology can not only effectively verify the authenticity of transaction data but also further enhance the overall operational efficiency of trade finance and provide more reliable financial support for international trade^[7].

3.4. Positive impact on the capital market

The capital market has become one of the important areas to benefit from the application of blockchain technology. By facilitating seamless peer-to-peer communication and collaboration among participants, blockchain technology has significantly simplified the transaction process of the capital market and promoted the efficiency of the entire financial market. Especially in the clearing and settlement process, the application of blockchain technology can shorten the process that traditionally takes days to a few hours or less while significantly reducing the associated operating costs.

4. Challenges and limitations

Despite the transformative potential of blockchain technology for the financial industry, there are still several significant challenges and limitations to its practical application, which to some extent limit its wider adoption and effectiveness.

4.1. Scalability

Scalability has always been a core technical challenge for blockchain applications, especially in high-volume financial environments ^[8]. Traditional public blockchains are plagued by transaction throughput limitations and processing delays that can seriously impact the overall performance of the financial system, especially when it comes to processing massive amounts of data generated by a rapidly growing user base.

4.2. Regulatory uncertainty

One of the biggest obstacles to blockchain adoption is the lack of regulatory transparency. Financial institutions operate in a heavily regulated environment, and the murky legal status of blockchain technology can create uncertainty. Regulators are still developing frameworks to govern blockchain applications, raising concerns about compliance and potential legal consequences. This uncertainty could deter financial institutions from investing in blockchain initiatives for fear of non-compliance or future regulatory changes that could affect their operations ^[9,10].

4.3. Privacy and security

In financial services, privacy and security are always the most important considerations. The transparency features of blockchain can conflict with certain privacy protection requirements, a problem that is particularly acute in industries such as healthcare or financial services that require strict protection of sensitive information. Although blockchain offers advanced encryption and decentralized data management mechanisms, security vulnerabilities remain, especially in networks that employ sharding technology, where smaller groups of nodes may be more vulnerable to security threats.

4.4. Technical limitations and energy consumption

The technical framework of blockchain also presents its own set of challenges, especially in terms of energy consumption and consensus mechanisms. The shift from a proof-of-work (PoW) to a proof-of-stake (PoS) model represents an important step in reducing the environmental impact of blockchain operations. However, the continued demand for software upgrades and innovative architectures shows that scalability and sustainability remain key areas where significant R&D resources need to be invested.

4.5. Adaptability of the regulatory framework

The rapid pace of fintech innovation needs to be underpinned by a more adaptive regulatory framework. The volatility of the initial coin offering (ICO) market in 2017 is a reminder of the risks posed by the inability of static regulatory frameworks to effectively keep pace with technological advances. The imperative is to establish dynamic regulatory approaches that can evolve alongside emerging blockchain technologies to effectively reduce systemic risk and protect the interests of market participants.

Addressing these challenges is critical to realizing the full potential of blockchain in the financial sector ^[11].

5. Future trends

5.1. Hybrid blockchain

The development of hybrid blockchains represents an important trend for the future, and it aims to combine the advantageous features of public and private blockchains ^[12]. This hybrid scheme provides organizations with the transparency and accessibility of a public blockchain while maintaining effective control over data and operations through private blockchain functionality. These types of systems significantly increase the flexibility and practicality of blockchain applications in the financial sector, with the ability to provide customized solutions tailored to the specific needs of different organizations.

5.2. Interoperability

Interoperability between different blockchain networks has become another key development direction ^[13]. As blockchain and distributed ledger technologies continue to emerge, it is becoming increasingly important to ensure that these platforms can communicate and interact seamlessly. The development of solutions that facilitate cross-chain transactions is expected to further unlock the potential of blockchain technology, making it easier for financial institutions to integrate and collaborate their systems.

5.3. Regulatory framework

The regulatory environment related to blockchain technology is undergoing significant change. Governments and regulatory bodies across the globe increasingly recognize the need for dedicated frameworks to address the unique challenges presented by blockchain, including issues such as data privacy and security. Future regulatory policies are expected to actively promote the innovative development of blockchain solutions in the financial sector while protecting the rights and interests of consumers. In addition, a unified global standard for cryptocurrency regulation is expected to be gradually established, which will effectively boost market confidence and promote the development of international transactions.

5.4. Decentralized finance

The rise of decentralized finance (DeFi) represents another important transformative trend in the financial industry ^[14,15]. DeFi makes full use of blockchain technology to provide financial services without the involvement of traditional intermediaries, thus achieving the dual goals of reducing costs and improving accessibility. The potential that DeFi has demonstrated in reshaping the financial services landscape deserves in-depth study, especially its potential impact on the traditional banking system.

5.5. Security and compliance challenges

Despite the promising applications of blockchain in the financial sector, challenges in cybersecurity and regulatory compliance remain. Financial institutions and innovative enterprises need to take effective measures to address these challenges to fully realize the potential of blockchain technology. Ensuring strong security safeguards and making blockchain applications compliant with regulatory requirements will be key factors driving the widespread adoption of the technology in the financial sector.

6. Summary and outlook

Blockchain technology holds transformative potential for the financial industry by increasing security, transparency, and efficiency. From its initial cryptocurrency experiments to today's widespread application scenarios, blockchain has proven its potential to transform the way financial services are delivered. While

many challenges remain, blockchain is expected to play a bigger role in driving financial innovation, improving operational efficiency, and enhancing security as the technology continues to mature and the regulatory framework gradually improves. In the future, as new application scenarios continue to emerge and existing solutions continue to be optimized, blockchain technology will continue to drive the digital transformation of the financial industry and contribute to building a more efficient, transparent, and inclusive financial system.

Funding

Exploration and Practice of the Application of Blockchain Technology to the Cultivation of Compound Talents under the Background of Free Trade Port (HKJG2023-18)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Polyviou A, Velanas P, Soldatos J, 2019, Blockchain Technology: Financial Sector Applications Beyond Cryptocurrencies. *Proceedings of the 10th International Conference on Digital Technologies*, 28(1): 7.
- [2] Hashimzai IA, Ahmadzai MZ, 2024, Navigating the Integration of Blockchain Technology in Banking: Opportunities and Challenges. *International Journal of Software Engineering and Computer Science (IJSECS)*, 14(2): 45–56.
- [3] Han Y, 2025, Blockchain Technology Promotes the Innovation and Development of Asset Transaction Modes. *Fintech Times*, 33(01): 112–125.
- [4] Lu M, 2025, Application Research of Blockchain-Based Digital RMB in Patient Capital Risk Management. *Lanzhou Academic Journal*, (1): 88–99.
- [5] Roucheet B, Bhavish J, Tosina D, 2023, Evolution of Blockchain Technology in the Financial Sector: An Empirical Analysis. *Tuijin Jishu/Journal of Propulsion Technology*, 12(1): 67–80.
- [6] Wang X, 2025, Analysis of Follow-up Management of Corporate Venture Capital Based on Blockchain. *Business and Management*, (01): 55–70.
- [7] Ni N, 2023, The Application of Blockchain Technology in Digital Asset Security Transactions. *Digital Technology and Application*, (10): 88–101.
- [8] Shorman AA, Eddin K, Sabri MA, et al., 2020, Blockchain for Banking Systems: Opportunities and Challenges. *Journal of Financial Technology*, 21(3): 102–118.
- [9] Suyanto S, Astuti I, Duryana D, 2024, Exploring Blockchain Technology for Transparency and Efficiency in Indonesia's Financial Sector. *Nomico*, 45(2): 112–123.
- [10] Noch MY, 2024, The Application of Blockchain Technology in International Financial Management: Opportunities and Challenges. *Golden Ratio of Mapping Idea and Literature Format*, 19(3): 25–38.
- [11] Kumar N, 2024, A Systematic Review of Fintech Development. *International Journal of Scientific Research in Engineering and Management*, 7(4): 29–42.
- [12] Abeysekera MC, Kumarawadu P, 2022, Analysis of Factors Influencing Blockchain Implementation in the Finance Sector in Sri Lanka. *Ho Chi Minh City Open University Journal of Science — Economics and Business Administration*, 12(4): 220–231.
- [13] Agyapong K, Boakye I, 2024, The Role of Blockchain Technology in Securing Banking Transactions in Africa. *European Journal of Economic and Financial Research*, 9(2): 77–89.

- [14] Tambe MT, 2024, Blockchain's Role in Finance Beyond Cryptocurrency. *International Journal for Research in Applied Science and Engineering Technology*, 12(5): 78–91.
- [15] Akindotei O, Emmanuel I, Awotiwon BO, et al., 2024, Blockchain Integration in Critical Systems Enhancing Transparency, Efficiency, and Real-Time Data Security in Agile Project Management, Decentralized Finance (DeFi), and Cold Chain Management. *International Journal of Scientific Research and Modern Technology (IJSRMT)*, 10(1): 134–150.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.