Proceedings of ICEMGD 2025 Symposium: Resilient Business Strategies in Global Markets
DOI: 10.54254/2754-1169/2025.CAU25655

The Application and Challenges of Blockchain Technology in Cross Border Payment Systems

Xiaojun Qin

Nankai University, Tianjin, China
2210880@mail.nankai.edu.cn

Abstract. With the rapid growth of international trade and cross border capital flows, traditional payment systems such as SWIFT are increasingly challenged by inefficiencies, high fees, and a lack of transparency. As a response, blockchain technology, characterized by decentralization, immutability, and traceability, has emerged as a potential solution for modernizing cross border payments. This paper offers a comprehensive analysis of the current state of blockchain technology in this domain, reviewing its applications, key advantages, and limitations. By examining how distributed ledgers and smart contracts can streamline payment processes, reduce intermediary costs, and enhance transparency and compliance, the study highlights blockchain's transformative potential. However, challenges such as regulatory fragmentation, limited technological maturity, and accessibility barriers remain significant obstacles to large scale adoption. Relying on secondary data and existing literature, this study also emphasizes the need for future empirical research and case based analysis to evaluate performance, security, and scalability of blockchain based systems in real world cross border payment scenarios.

Keywords: Blockchain, Cross Border Payments, Financial Technology, Smart Contracts, Payment Innovation

1. Introduction

In recent years, with the continuous acceleration of global economic integration, international trade and cross-border capital flows have shown a rapid growth trend. As an important infrastructure of the global financial system, the cross-border payment system plays an important role in connecting international trade, capital circulation and residents' consumption. However, traditional cross-border payment systems such as SWIFT [1], due to their reliance on multi-level intermediary banks and complex clearing processes, generally have many problems such as slow transaction speed, high handling fees, opaque information and difficulty in tracking [2]. In this context, blockchain technology has become the focus of attention in the field of financial technology in recent years with its unique advantages such as decentralization, immutability and full-process traceability. The distributed ledger and smart contract mechanism of blockchain can theoretically greatly improve the efficiency and security of cross-border payments, reduce intermediary costs, and realize real-time settlement and full-chain transparency of capital flows.

DOI: 10.54254/2754-1169/2025.CAU25655

Although blockchain-based cross-border payment solutions have been explored globally, they remain in the early stages of development. Challenges such as limited technological maturity, regulatory uncertainties, and a lack of international coordination continue to hinder their widespread adoption. This paper will focuses on analyzing the current state of blockchain development and reviews the overall trends and existing issues within the global cross-border payment landscape. It systematically examines the potential advantages, current applications, and major obstacles associated with applying blockchain technology to cross-border payments, aiming to offer theoretical insights and practical references to support innovation and modernization of the global payment system.

2. Overview of the traditional cross-border payment system

2.1. Mainstream models in contemporary cross-border payments

The current mainstream cross-border payment models in the world mainly include the SWIFT system, clearing arrangements between central banks of various countries, and corresponding account systems between large commercial banks. SWIFT (Society for Worldwide Interbank Financial Telecommunication), as the basic network for global financial information transmission, connects more than 200 countries and regions and more than 11,000 financial institutions [2]. SWIFT uses standardized messages to achieve the secure transmission of payment instructions between banks around the world, but is not directly responsible for the actual clearing of funds. The clearing and settlement of funds usually rely on the payment systems of central banks of various countries and the "correspondent banking" model between major commercial banks. Under this system, the initiating bank transfers funds to the receiving bank through its own overseas cooperative banks (correspondent banks) through multiple levels of transfer. For example, when Chinese import and export companies pay European and American customers, they often have to go through multiple links such as local banks, overseas correspondent banks, SWIFT information transmission, and the other party's receiving bank [2].

Although some cross-border e-commerce platforms and international remittance service providers (such as Western Union, MoneyGram, etc.) have established their own clearing networks to improve transaction efficiency and reduce dependence on traditional bank intermediaries, their core processes still need to be connected to the banking system and cannot fully achieve independent clearing. With the continuous growth of global trade activities and the continuous increase in personal cross-border consumption needs, the existing cross-border payment system faces higher efficiency and transparency requirements. Therefore, countries and regions have promoted payment system reforms and explored more efficient and secure cross-border payment solutions. For example, the "Single Euro Payments Area" (SEPA) launched by Europe aims to achieve a unified and efficient transfer mechanism between EU member states and significantly improve regional payment efficiency [3]. However, the scope of application of SEPA is limited to the EU, and there are still regional restrictions in policy formulation, regulatory requirements and technical standards, making it difficult to achieve seamless interoperability on a global scale. These realistic dilemmas reflect the structural challenges faced by the existing cross-border payment system in dealing with global financial activities, and further highlight the demand and expectations for new payment technologies such as blockchain.

DOI: 10.54254/2754-1169/2025.CAU25655

2.2. Limitations of conventional cross-border payment mechanisms

The existing cross-border payment system has played an important role in ensuring global financial circulation, but its operating mechanism has brought about a series of unavoidable structural problems. First, the slow transaction speed is the most prominent defect. Since cross-border payments usually involve multiple intermediary banks and clearing institutions, funds circulate step by step in different time zones and regulatory environments. The actual arrival time often takes 1-3 working days, and holidays will be further delayed. High handling fees have become another pain point. Cross-border transactions are typically associated with significant handling costs, which tend to be disproportionately higher in economically disadvantaged regions. The participation of layers of intermediaries means that each transaction needs to share high service fees, which is particularly unfriendly to users of small payments and greatly restricts the development of inclusive finance.

The opacity and limited traceability of traditional cross-border payment processes have also caused widespread criticism. Due to the involvement of many intermediaries and complex fund flows, it is often difficult for payers to track fund flows in real time. Once disputes, delays or transaction errors occur, the verification and recovery process is often time-consuming, labor-intensive and inefficient. In addition, as global regulatory standards continue to tighten, institutions are facing increasing compliance pressure. Different countries have different regulatory standards for anti-money laundering (AML) and counter-terrorism financing (CFT), and cross-border payment institutions need to invest a lot of resources to ensure compliance [4]. This not only increases operational complexity, but also increases overall costs and regulatory risks. In short, the traditional cross-border payment system faces multiple challenges such as efficiency, cost, and compliance in the context of globalization, and urgently needs technological innovation to drive its upgrade and transformation.

3. Blockchain technology in cross-border payment systems and its strategic benefits

3.1. Core principles of blockchain

Blockchain is a distributed ledger technology (DLT) that maintains and updates data between global nodes in a decentralized manner. Its core mechanism is that all nodes hold their own copies of the ledger, and any data changes must be confirmed by the majority of nodes in the network. This process is called the "consensus mechanism", and common consensus mechanisms include proof of work (PoW) and proof of stake (PoS) [5]. As a result, blockchain possesses strong tamper-resistance. Once data is confirmed and recorded in a block, it becomes extremely difficult to modify or delete unilaterally. Each transaction is digitally signed and verified through cryptographic algorithms, ensuring the security and privacy of information.

Another key technology is smart contracts, which are a set of automatically executed code programs that are triggered when specific conditions are met to automatically complete business operations such as payment and settlement. All transactions and contract contents on the blockchain are recorded in the block, and the information is open and transparent, and the authorized party can check it at any time. Public blockchains such as Bitcoin and Ethereum have successfully enabled the operation of large-scale decentralized payment networks. With their distributed architecture, tamper resistance, and programmability, blockchain technology offers a robust foundation for the digital transformation of financial infrastructure. As a result, blockchain is not only the core technology behind cryptocurrencies but is also increasingly recognized as the infrastructure of the emerging "Internet of Value," empowering a wide range of industries, including cross-border payments.

DOI: 10.54254/2754-1169/2025.CAU25655

3.2. Advantages of blockchain in cross-border payments

Blockchain technology has shown significant application potential and unique advantages in the field of cross-border payments. First, blockchain enables point-to-point direct payments, eliminating multi-level intermediary banks, thereby greatly increasing transaction speed [5]. Blockchain payment networks such as RippleNet can shorten the traditional 1-3 days of cross-border remittances to seconds or minutes. Secondly, blockchain eliminates intermediary fees and exchange rate losses, reducing payment costs. In its 2019 article, Deloitte mentioned that blockchain-based business-to-business (B2B) and person-to-person (P2P) payments can reduce transaction costs by 40% to 80% [6].

Blockchain transaction data remains open and transparent throughout the entire process, enabling real-time tracking. This transparency enhances the visualization of capital flows and strengthens compliance management, ultimately improving both user experience and regulatory efficiency. By leveraging encryption technology and a distributed architecture, blockchain significantly boosts payment security and mitigates risks associated with single points of failure and cyberattacks. Moreover, blockchain supports smart contracts — self-executing contracts with the terms directly written into code. For instance, in the insurance industry, smart contracts can automatically trigger claim payments once predefined conditions are met, reducing processing time and eliminating manual errors [7].

4. Practical obstacles in applying blockchain technology

4.1. Regulatory issues

Although blockchain technology has obvious advantages in improving the efficiency and transparency of cross-border payments, regulatory issues are still the biggest obstacle to its global application. First, blockchain networks naturally cross national borders, and there are large differences in the legal systems of digital assets, data sovereignty, and payment settlement in various countries. For example, the EU GDPR emphasizes data privacy and personal information protection, while the United States focuses more on financial innovation and anti-money laundering supervision, resulting in legal gray areas for how blockchain data can be stored and transferred across borders in compliance. The International Monetary Fund (IMF) highlights in its 2022 working papers and reports that the regulatory oversight of digital currencies and blockchain-based payment systems faces significant challenges [8]. Key difficulties arise in implementing effective customer due diligence measures such as Know Your Customer (KYC), anti-money laundering (AML), and counter-terrorism financing (CFT) protocols [4]. Additionally, the lack of globally consistent regulatory frameworks and standards complicates supervision and enforcement, increasing risks related to financial integrity and consumer protection. The IMF calls for enhanced international cooperation and the development of harmonized compliance standards to address these emerging risks in digital financial services.

Also, the current legal system is often difficult to adapt to emerging forms such as blockchain smart contracts and decentralized autonomous organizations (DAO). For example, once a dispute or fraud occurs on the chain, it is difficult to define the responsible party and difficult to enforce supervision. Some countries, such as China, strictly restrict digital currency payments, while Switzerland and Singapore are relatively open, and there is a lack of a unified regulatory framework globally. The 2023 G20 summit document also pointed out that the international community urgently needs to promote cross-border regulatory coordination and establish a standardized

DOI: 10.54254/2754-1169/2025.CAU25655

compliance system to promote the healthy development of blockchain payments [9]. Therefore, regulatory lag and legal fragmentation have become the primary problems for the commercialization and popularization of blockchain cross-border payments.

4.2. Challenges in technology maturity

Blockchain technology currently still faces significant challenges in terms of performance, scalability and system stability, which affect its widespread application in the field of large-scale cross-border payments. The transaction processing capacity of mainstream public chains such as Bitcoin and Ethereum is limited. The former can only process 7 transactions per second (TPS), and Ethereum is about 30 TPS, which is far lower than the thousands of TPS of traditional payment networks such as VISA. If blockchain is used as the backbone system for cross-border payments, its throughput and latency issues will seriously restrict the large-scale application of financial institutions and enterprises.

The stability and fault tolerance mechanism of the blockchain network need to be improved. Blockchain technology faces several technical risks, including 51% attacks, blockchain forks, and node outages, which have in some cases resulted in significant digital asset losses and service disruptions. Additionally, vulnerabilities in smart contract code can be exploited by hackers, as exemplified by the infamous Ethereum "DAO incident," where hundreds of millions of dollars were stolen. Although next-generation permissioned and hybrid blockchains such as Hyperledger Fabric and Corda have enhanced performance and security by supporting thousands of transactions per second, their large-scale commercial deployment and cross-industry interoperability still require further validation. There is currently no blockchain cross-border payment system that covers the world and has been operating stably for many years, and the industry infrastructure and technical standards are still in a rapid evolution stage. Hence, the issue of technological maturity is still an important bottleneck affecting the widespread implementation of blockchain cross-border payments.

4.3. Access barriers and financial inclusion

Although blockchain has the open characteristics of "no threshold" and decentralization in theory, its access threshold and financial inclusion issues are still very prominent in practical applications. Blockchain cross-border payment requires users to have not only digital identity authentication and encrypted wallet operation capabilities, but also a stable and high-speed network access environment. According to the 2023 report of the International Telecommunication Union (ITU), about one-third of the world's people cannot access the Internet, especially in low-income and rural areas, which seriously restricts the popularization and use of blockchain financial services [10]. In addition, users have low awareness of blockchain technology and digital assets. The World Bank's 2022 Global Financial Inclusion Report pointed out that about 40% of adults in developing countries do not have valid financial accounts or digital payment tools, which makes it difficult for them to enjoy the convenience of digital financial services even if they have theoretical channels [10]. In practical operations, blockchain payments also face challenges in private key management, wallet security and anti-fraud. Ordinary users are prone to property losses due to lack of sufficient security awareness and operating experience. Enterprise users need to face complex compliance requirements for on-chain businesses, as well as technical costs and management difficulties in docking with existing IT systems. Industry research generally believes that in order for blockchain payment systems to achieve the goal of "inclusiveness", they need to strengthen digital infrastructure

DOI: 10.54254/2754-1169/2025.CAU25655

construction, promote user education, optimize simplified operation interfaces, and promote organic integration with local financial systems.

5. Discussion

Blockchain technology provides significant benefits for cross-border payment systems by improving efficiency, reducing costs, and enhancing transparency; however, its widespread adoption still faces practical challenges related to regulatory oversight, technological robustness, and financial inclusion. Future development trends deserve close attention. The research and development of central bank digital currencies (CBDCs) by major central banks worldwide continues to advance steadily, providing a strong policy foundation for on-chain fund settlement and cross-border payment compliance. Technological innovation is continuously breaking through the performance bottleneck of blockchain, and new solutions such as alliance chain, sharding, and cross-chain interoperability are constantly improving the throughput and security of the system. More and more financial institutions and technology companies are exploring the balance between compliance and efficiency through a hybrid model of "combining off-chain and on-chain", paving the way for industrial promotion. To achieve the sustainable development of cross-border payments of blockchain, it is also necessary to strengthen international cooperation in regulatory policy coordination, standard setting, and technical infrastructure construction.

6. Conclusion

In conclusion, this study systematically explores the current application and advantages of blockchain technology in the field of cross-border payments, highlighting its significant potential in improving efficiency, reducing costs, and enhancing transparency and security. Through decentralized distributed ledgers and smart contract mechanisms, blockchain enables peer-to-peer settlements, minimizes traditional intermediary layers, and improves the traceability and compliance of payment processes. However, practical implementation still faces multiple challenges, including inconsistent regulatory policies, insufficient technological maturity, and high access barriers, which to some extent hinder its commercialization and sustainable development.

This research mainly relies on secondary data and existing literature. Given the rapid evolution of blockchain-based cross-border payment technologies, some technical details and real-world cases remain incomplete, resulting in a degree of uncertainty in evaluating system performance. Future studies could adopt more diversified data collection methods, such as field investigations and experimental data, to conduct in-depth analyses of how different blockchain structures and consensus mechanisms perform in cross-border payment scenarios, thereby providing stronger empirical support for the optimization and implementation of blockchain technologies.

References

[1] Cipriani, M., Goldberg, L. S., & La Spada, G. (2023). Financial sanctions, SWIFT, and the architecture of the international payment system. Journal of Economic Perspectives, 37(1), 31-52.
[2] Rijanto, A. (2021). Blockchain technology adoption in supply chain finance. Journal of Theoretical and Applied Electronic Commerce Research, 16(7), 3078-3098.
[3] Drigă, I., & Dura, C. (2022). Retail payments landscape in Europe. Annals of the University of Petroşani, Economics, 22(2), 181–192.
[4] Gaviyau, W., & Sibindi, A. B. (2023). Global anti-money laundering and combating terrorism financing regulatory framework: A critique. Journal of Risk and Financial Management, 16(7), 313.

DOI: 10.54254/2754-1169/2025.CAU25655

[5] Komalavalli, C., Saxena, D., & Laroiya, C. (2020). Overview of blockchain technology concepts. In Handbook of research on blockchain technology (pp. 349-371). Academic Press.
[6] Forbes Technology Council. (2019, March 12). How blockchain is transforming cross-border payments. Forbes. https: //www.forbes.com/councils/forbestechcouncil/2019/03/12/how-blockchain-is-transforming-cross-border-payments/
[7] Reuters. (2024, October 9). Is blockchain the next big thing for insurance companies? Reuters. https: //www.reuters.com/legal/legalindustry/is-blockchain-next-big-thing-insurance-companies-2024-10-09/
[8] International Monetary Fund. (2022). Digital money and payment systems: New challenges for regulation and supervision (IMF Working Paper No. 2022/151). International Monetary Fund.
[9] Financial Stability Board. (2023, February 23). G20 Roadmap for Enhancing Cross-border Payments: Priority actions for achieving the G20 targets.
[10] International Telecommunication Union. (2023). Global internet usage statistics. Retrieved June 3, 2025, https: //www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx