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# Cross-border payment based on blockchain technology and digital currency

**Chengjie Li**

Department of Financial Engineering, Jiangsu Normal University, Jiangsu, China, 221000

3020203757@jsnu.edu.cn

**Abstract.** With the rapid development of financial globalization and currency globalization, trade exchanges between various countries are increasing, and the demand for cross-border payment in multiple countries is increasing, which leads to a series of issues related to cross-border payment, such as payment efficiency, payment cost, and payment success rate, etc. Therefore, blockchain technology is introduced, a decentralized, non-tamperable, and traceable distributed accounting technology. Based on improving the current cross-border payment system, this paper studies the use of blockchain technology to solve related problems in the traditional cross-border payment model in legal digital currency (Central Bank Digital Currency) and currency digitization (fund lending). Through the reading of many documents and the search for information, the application of blockchain technology combined with digital currency has broad development prospects, which will completely improve the existing payment model and achieve a more efficient and safer transaction environment. However, the current development of this technology is still in its infancy, and no country or region has yet achieved large-scale operation of this technology. The technology still needs to be improved in terms of practice, unified consensus algorithm, and legal supervision.

**Keywords:** cross-border payment, blockchain, digital currency, central bank digital currency.

## 1. Introduction

Cross-border payments are transnational and cross-regional transfers of funds between two or more countries or regions through various types of economic activities, using certain settlement instruments and payment systems. It is an important part of the international monetary and financial system. With the accelerated pace of financial globalization, the continuous expansion of trade exchanges between countries, and the increasing demand of nationals for studying abroad, tourism, and imported goods, cross-border payment has gradually emerged and flourished [1]. In 2021, Chinese regulatory authorities will actively introduce supportive policies to promote cross-border trade and payment development in China. According to data from the association, a total of 43 payment institutions have carried out cross-border payment business throughout the year, handling a total of 7.191 billion cross-border payment business and 972.363 billion yuan, an increase of 62.55% and 21.56%, respectively, and the growth rate increased by 31.62 and 7.01% compared with 2020. The cross-border foreign exchange payment income of payment institutions increased by nearly 25 billion yuan compared with 2020, and the cross-border RMB income increased by 120 billion yuan compared with 2020 [2]. However, at this stage, with the

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increasing volume and scale of cross-border payment, its existing system is difficult to meet the needs of transaction customers. Therefore, the innovative application and development of new technologies for cross-border payment have great practical significance.

At present, the current cross-border payment system has long transaction links, high fees charged by third-party agencies, and information asymmetry between the two parties due to differences in regions and time zones, which lead to low transaction efficiency, high transaction cost, and opaque transaction process in the existing cross-border payment system. Therefore, this article introduces blockchain technology and digital currency into cross-border payment.

Blockchain technology is a distributed shared accounting technology. It does not belong to a specific industry but is based on data blocks, focusing on constructing and operating distributed ledger systems. It establishes a decentralized database and forms a shared accounting system through point-to-point transmission, encryption algorithms, and other technologies. Cross-border payment uses blockchain technology for digital currency transactions, which provides a more exact and immutable transaction process, lower payment costs, and improves the transparency and traceability of payments.

Digital currency is an alternate type of payment that uses technology. It is a digital type of encrypted cash. Private digital currency and lawful digital currency are the two categories. Among them, legal digital currency, sometimes referred to as Central Bank Digital Currency, is digital currency that is issued by a nation's central bank (CBDC for short). CBDC cross-border payment may significantly boost payment convenience and security, enhance payment and settlement efficiency in international trade and economic transactions, and perhaps decrease the need of financial intermediaries and increase information flow, and lower barriers to entry in the cross-border payment market. However, countries worldwide are currently in the research and pilot stage of CBDC construction. The usage of CBDC for cross-border payments and the related technologies are still in their infancy, and it cannot be applied to real large-scale cross-border transactions. Still, it has very broad development prospects and is worthy of continuous investment in research and development by various countries.

The remainder of the paper introduces the current cross-border payment platform (Section 2), digital currency and its advantages in cross-border payment (Section 3), describes the difficulties faced by cross-border payment (Section 4), introduces the blockchain Technology, including its principle and role in cross-border payment (section 5), assesses and examines the level of interest in "blockchain technology + cross-border payment" during the previous five years. (Section 6), elucidate the difficulties with cross-border payments and uses of blockchain technology. (Section 7).

## 2. Current cross-border payment platform

The principal cross-border payment can be divided into four modes: banking wire transfer, specialist remittance company, global credit card provider, and a third-party payment service. Banking wire transfer refers to the remittance settlement method in which the remittance bank submits a remittance application to the destination bank or agency bank (remittance bank) by telegram, telex, or **S**ociety for Society for Worldwide Interbank Financial Telecommunication (SWIFT for short) and instructs the remittance bank to pay a certain amount to the payee. The cross-border wire transfer business of banks generally adopts SWIFT. Specialist remittance company typically collaborate with banks, post offices, and other organisations. and use these institutions to set up agencies to expand business coverage. Cross-border payments are also possible with global credit cards provided by international credit card issuers, but the success rate of cross-border payments with international credit cards is low.

The reason transactions through third-party institutions are currently used more than through banks is that more digital currency transactions are used for cross-border payments, and traders belong to lending relationships between banks or third-party software. CBDC has yet to be popularized in daily life. For the consumption of multinational residents, it is more practical to consume through the credit cards applied by major domestic banks and settle the exchange rate and repayment through the bank platform when it expires. For overseas exchange, it is necessary to submit a declaration to the Foreign Exchange Administration. It takes time and cost, and the remittance is directly remitted to the user's

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foreign currency account. The following lists several major payments with a high cross-border payment usage rate.

### *2.1. PayPal*

With hundreds of millions of users worldwide, PayPal is a widely sought-after tool for international commerce payments. It pays instantly, arrives instantly, supports multiple languages, and can easily withdraw cash through local banks in various countries, solving the problem of foreign trade collection. Application areas for PayPal include international e-commerce retailing and minor transactions costing between tens and hundreds of dollars.

### *2.2. The China People's Bank created the international payment system*

A wholesale payment system with a focus on cross-border RMB payment and clearing services is called the Cross-border Interbank Payment System (CIPS for short). It intends to better integrate the already available RMB cross-border payment and settlement channels and resources, increase the effectiveness of cross-border clearing, cater to the demands of RMB business expansion in significant time zones, enhance transaction security, and create a competitive market environment.

### *2.3. Credit card payment*

Cross-border e-commerce websites can work with global credit card companies like Visa and MasterCard or directly with foreign banks to create ports for accepting credit card payments from those institutions. There are five major credit card brands in the world: Visa, Mastercard, AmericaExpress, Jcb, and Diners Club, among which everyone widely uses the first two. And the range of credit card applications: independent B2C and platforms involved in international retail e-commerce.

### *2.4. MoneyGram*

MoneyGram business is a global rapid remittance service between individuals that can complete the remittance process from the remitter to the payee within more than ten minutes and is characterized by speed and convenience. The payee can receive the money with the number provided by the remitter.

### *2.5. Telegraphic transfer*

Telegraphic transfer is a payment technique where the payer pays a certain amount of money in the remittance bank, and the remittance bank transfers it to the destination branch or agency bank (remittance bank) via telegraph or telephone and orders the remittance bank to pay a specific amount to the payee. A dependable B2B (business-to-business) payment method for large-amount transaction payments is telegraphic transfer.

### *2.6. Tenpay*

Tenpay is a reputable online payment platform that was formally introduced by Tencent in September 2005. Its primary function is to assist both parties in carrying out online transactions to accomplish payment and collection.

### *2.7. Online Banking*

Online Banking (Beijing) Technology Co., Ltd. (called Online Banking) is a wholly-owned subsidiary of JD.com and a leading electronic payment solution provider in China, focusing on providing safe and convenient integrated electronic payment services for various industries. The core business includes payment processing (online payment gateway, online banking wallet, quick payment), prepaid cards, and other services.

## 3. Advantages of digital currency in cross-border payment

In 2021, According to a study of central banks conducted by the Bank for International Settlements (BIS), 86% of them are actively investigating the possibilities of CBDCs, 60% are experimenting with

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the technology, and 14% are implementing trial programmes. If follow-up studies are positive, CBDC could ensure that the public will continue accessing the safest form of money as the economy goes digital. This can promote the diversity of payment options. CBDC cross-border payment greatly improves the convenience and security of payment by reducing the intermediate process, and reduces the cost of financial intermediary use. At the same time, increase information exchange, reduce market access threshold, and improve payment and settlement efficiency of international economic and trade exchanges. and may facilitate fiscal transfers during a time of relief crisis [3].

From the perspective of scenario use, digital money can be utilised in scenarios involving low-volume, retailing, and high-frequency business transactions. It does not compute or pay interest. The usage method is similar to banknotes. But compared to paper currency, it does not rely on bank accounts and payment accounts. It can be used if the user has installed a digital currency wallet. In addition, the digital renminbi makes use of the most recent dual-offline technology, enabling usage even in the absence of a mobile phone signal. Specific usage scenarios: As long as the user has a digital wallet installed on the mobile phone, no network is required, the transaction operation can be carried out only by keeping the mobile phone charged, and the digital currency can be transferred from one user's digital wallet to another user; and, when paying, there is no need to bind any bank account. This is the main reason why countries are actively launching digital currencies. On the other hand, creating digital assets through tokenization has the potential not limited to the financial sector. First, it enables the monetization of any asset, tangible or intangible. Second, tokenization makes asset division easier. Third, tokenization makes asset transactions safer and smoother without intermediaries. Assets that can be tokenized and traded include art, real estate, commodities, and even livestock. Not all tokenized assets make sense, but the ones that do might help unlock economic value that has hitherto been untapped [4].

## 4. Difficulties faced by cross-border payments at this stage

However, with the rapid development of globalization, the technical means of cross-border payments are gradually unable to meet the growing scale of cross-border payments. The friction caused by currency differences between countries is the most obvious among them. The settlement between different currencies is more complicated than the domestic single currency settlement, bringing more risks and costs [1].

Since the cross-border payment process involves the transactions of multiple currency funds in multiple countries and regions, the relevant laws and regulations on the supervision and control of financial assets in different countries are also different, so cross-border payments have a relatively complex market structure. In addition, the current cross-border payment still needs fixing, such as opaque transaction processes, high transaction costs, and low transaction efficiency.[5] Among them, due to the geographical distance between different countries, it is difficult for both parties to understand each other fully, and there is an excellent information asymmetry, which leads to the opacity of the transaction process; The fact that using the current cross-border payment system for transactions would involve a large number of third-party intermediaries and there are numerous transactions is an explicit example of the low efficiency of cross-border payment transactions due to network influence and scale economies in the growth of cross-border payment; The high transaction cost is because there will be transactions in different currencies between different countries, which means that there will be payment of handling fees between platforms and loss of exchange rates. Therefore, the global cross-border payment ecosystem faces financial innovations and changes aimed at improving the speed, efficiency, transparency, and reducing transaction costs of cross-border payments.

**Regulatory issues related to cross-border payments.** No relatively specific international laws and regulations have introduced a series of regulatory policies and systems for digital currencies, especially those based on blockchain. Due to the fact that most nations are still in the experimental and pilot stage for CBDC, it is not yet prohibited or controlled by pertinent laws and regulations. There are three core legal issues: one is to study the contradictions of currency sovereignty and extraterritorial effectiveness in cross-border payments; the other is to find the uniformity of settlement standards in CBDC cross-border payments; the third is to examine the international supervision of CBDC. The most fundamental

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problem in cross-border payments for currency digitization is multi-currency trade transactions. Still, there needs to be a unified consensus algorithm and digital currency usage regulations worldwide. And no relevant regulatory policies have been issued yet for the node attacks in the transaction process or the gray zone transactions based on the anonymity of blockchain technology.

**Cross-border payment success rate is low.** Because cross-border payment covers multiple countries and has a long transaction process, there is a problem of low payment success rate. First, there is the issue of trading accounts. The merchant's cash register needs to provide the payment method that the user wants. When the user makes a transaction, the payment method that the user wants cannot be found. For example, only PayPal is provided, and no international credit card or other electronic payment method exists. Second, the website loading needs to be fixed. The loading speed of the website is too slow or crashes, causing consumers to voluntarily give up the payment, or the slow loading speed of the website causes the page to freeze, and the payment platform has no way to successfully capture the information on the payment page, resulting in payment interruption. Third, the problem of payment trust: there is an information asymmetry problem between users and third-party transaction institutions, the transaction interface's domain name needs to be fixed, and there needs to be more trust in overseas e-commerce websites. Fourth, transaction issues: The entire transaction process of cross-border payment involves the interaction of various parties, so the transaction risk of cross-border payment is also a key issue for the healthy development of cross-border payment. There are two types of risks: non-compliant transactions of third-party payment institutions and transaction risks encountered by users. Fifth, regulatory issues: Under the background of untouchable gray areas in foreign exchange supervision, some transactions are conducted through third-party payment platforms instead of banks for foreign exchange transactions. Banks cannot learn users' specific information through third-party agencies and cannot monitor them promptly. Sixth, the traditional cross-border payment method involves many intermediate links, the cost is high, and the timeliness of the account could be higher. In addition, relying on third-party institutions, the entire cross-border payment needs to pay corresponding handling fees, which greatly affects the effect of payment.

## 5. Blockchain technology

Blockchain is a non-tamperable, decentralized distributed ledger called a transaction ledger. A blockchain is made up of four main parts: a hash, which uses one-way mathematical operations to produce distinct indexes; a cryptographic transaction signature that makes use of a public key; a peer-to-peer (P2P) network serving as a framework for routing for nodes employing the distributed hash; and a consensus process, which is a series of digital operations designed to guarantee the quality and consistency of the data stored among the involved nodes. [6].

Blockchain technology uses smart contracts to edit and process data, realize data acceptance, storage, addition, deletion, modification, and query of assets in the blockchain network, and use cryptography to ensure transmission and access security. Since all data on the blockchain is open and transparent, and the accuracy and authenticity of the information can be verified retroactively, there is no need for a centralized server system as a trust intermediary support to technically ensure the authenticity and immutability of information on the blockchain. In many nations, the idea of blockchain has attracted a lot of interest in cross-border payments. The core technology of blockchain in payment and settlement mainly involves distributed peer-to-peer networks, consensus mechanisms, P2P transmission, and encryption techniques. Blockchain technology is considered a subversive innovation in the Internet era and the underlying system of the global transaction system [7]. The blockchain's advancements in data storage and information transmission may fundamentally alter the way that finance and the economy now function, sparking a new wave of technical innovation and “industry 4.0” in the fintech sector. [8].

Applying blockchain technology in cross-border payment solves the low efficiency of cross-border payment. The specific procedure is that blockchain technology can provide a fast, low-cost, and safe payment method to replace traditional bank payment methods and speed up liquidation speed. At the same time, by simplifying the payment transaction process and storing each transaction information in each node, these many nodes store transaction information from a secure distributed ledger. Reconciling

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payment information can happen more quickly when using blockchain for cross-border payments. the payment and clearing of all transactions are synchronized, and all account book information is updated synchronously when the transaction is completed. This payment system effectively avoids the liquidity cost generated by the multi-day settlement time frame that often occurs in the traditional payment mode.

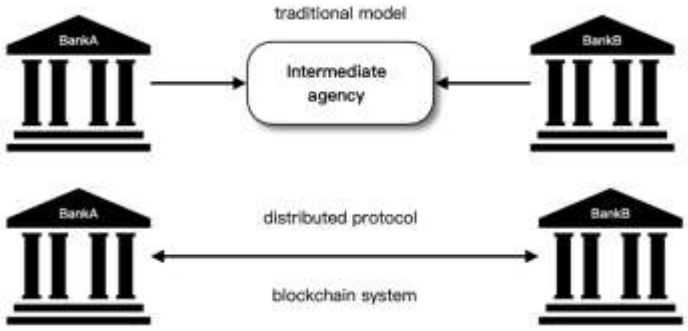


**Figure 1.** Traditional transaction model and blockchain transaction.

On the other hand, cross-border payment supported by blockchain can bring lower costs and benefits to import and export enterprises and consumers by reducing the intermediary transaction costs incurred in cross-border payments. Bank-to-bank transactions can no longer go through third-party institutions but use blockchain technology to create a point-to-point payment method. as shown in figure 1. This helps reduce capital transaction risks and meet users' needs for timeliness and convenience of payment and settlement services. According to McKinsey's calculations, applying Blockchain technology for B2B international payment and settlement services will worldwide cut the price of each transaction by around 40%. Utilizing blockchain to facilitate cross-border settlements will also result in significant cost savings for banks, which are expected to increase from $301 million in 2021 to $10 billion in 2030 [9].

Moreover, blockchain cross-border payments can rely on cryptocurrencies or use blockchain to register fiat currency exchanges and transfers. For CBDC, on the one hand, CBDC adopts a point-to-point transmission mode to reduce intermediate links, reduce payment costs, improve convenience and security, and then make global transaction and settlement more effective. On the other hand, through the system and technical design, CBDC can improve data analysis and processing capabilities and docking compatibility, realize 24-hour operation, resolve time zone mismatch problems, and reduce transaction risks.

The application of blockchain technology in cross-border payment has very long-term development value. Its development can be divided into three stages: The first stage is: Payment transfers, initial transfers across non-bank systems, and online cross-border exchanges are examples of third-party payment transactions; the intermediate stage establishes standardized Internet smart contracts for financial assets; the advanced stage applies to real-world trading systems [10].

## 6. Discussion

### *6.1. Blockchain technology and cross-border payment*

Since Satoshi Nakamoto created Bitcoin in 2008, the blockchain was also born, and more and more scholars from various countries have invested in research in the field of blockchain. As the demand for cross-border payments in multiple countries becomes increasingly normal, the development of the blockchain field has gradually matured and improved. More and more scholars have focused on blockchain and cross-border payment-related applications.

The data in Figure 2 and Figure 3 come from Google Scholar, the query statistics of related literature on "blockchain technology and cross-border payment," From Figure 2 and Figure 3, the number of related documents will gradually increase from 2017 to 2021 and will ease by 2022. The fastest growing in 2019, from 2019 to 2021, the number of articles will almost remain at 31 and fluctuate. 2019 is the

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year when the COVID-19 epidemic started, which will last for three years and gradually end in 2022. The world's economy has been rapidly transitioning to a digital one as a result of the pandemic, with many nations' digital economies growing and a greater need for digital financial services. It is also the peak period of the digital development of cross-border payments. Therefore, countries have conducted much-related research in the past three years based on "blockchain technology + cross-border payment." Among them, From January 10, 2019, China's State Internet Information Office has released the "Blockchain Information Service Management Rules" to underline that after "Seeing blockchain as a crucial invention for independent development of fundamental technologies" and "Promoting industrial innovation and the development of blockchain technology," the research in this area is concentrated and expedited. The number of documents ranks first among countries. The United Kingdom and the United States rank second and third, respectively. In the past 22 years, The post-epidemic period has started, and research on cross-border payments and blockchain has steadily diminished. However, it is still one of the focuses of various countries, and countries are gradually carrying out pilot projects on CBDC. These include Project Jasper/CAD-coin, launched in Canada, and Project Ubin, launched in Singapore. Project Stella was started by the European Central Bank and Bank of Japan. [11].

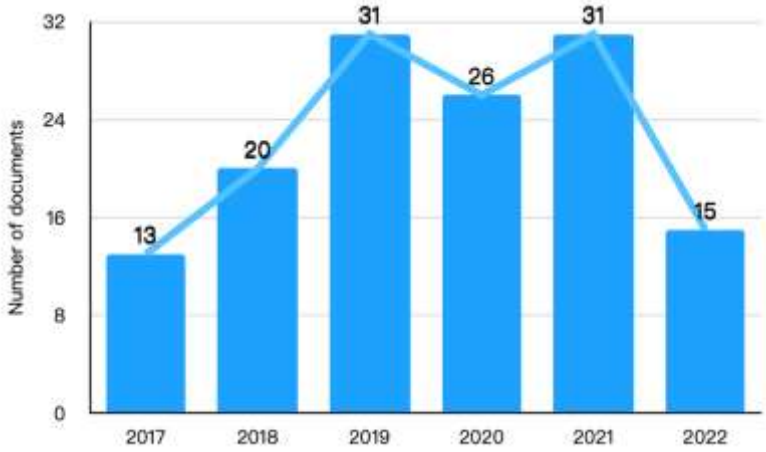


**Figure 2.** Trend chart of the number of documents.

*6.2. Challenges in using blockchain technology for international payments*

**Challenges of using blockchain technology for cross-border digital currency payments.** Blockchain technology is characterized by decentralization and non-tampering. However, as far as the current development of digital currency is concerned, it is challenging to realize decentralized applications in the field of cross-border payments. Digital currency is divided into legal digital currency, some stable and encrypted currency. Unlike legal digital currencies, cryptocurrencies are often difficult to gain the trust of sovereign countries. Cryptocurrencies do not pursue the stability of asset values, their prices fluctuate considerably, and the transaction verification process is relatively cumbersome, so it takes a lot of time and transaction costs. Therefore, a country often prefers to use something other than cryptocurrency as its digital currency for transactions, which is widely used in cross-border payments. It will be permissible to use the central bank's officially issued digital money. CBDC has sovereignty in cross-border payments. Creating national currency is an important financial feature of a sovereign state. It is clearly stated in the currency state theory that a country has the right to establish and define its currency system within its legal system and accept the issuer's jurisdiction. Only a legally effective medium of exchange issued according to the country's highest legislative power and having the accounting unit's function can become legal tender. Currency sovereignty embodies national sovereignty; all countries will maintain this sovereign authority. Therefore, CBDC cannot be issued in a decentralised manner and must be issued by the China People's Bank based on national credit. Most of the research and development projects related to CBDC are concentrated in the country and at the

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retail level. Although countries worldwide pay more attention to and research the application of CBDC cross-border payment, Blockchain technology has not yet been used to construct CBDC-based global payment systems.

**Cross-Border Payment Challenges in Digital Monetization: Blockchain Technology.** First, in a completely open trading system for trade exchanges among countries, trading countries have different currency systems, legal norms, transaction paths, transaction scenarios, and needs, so reaching a consensus on cross-border payment isn't easy. Countries also have certain differences in the application of blockchain technology, such as the selection of algorithms and the use of digital currency. So far, the international community still needs to formulate relevant laws and regulations for applying blockchain technology in cross-border payment. The regulatory system for payment and settlement, policies, and industry standards for payment and settlement-related industries need improvement. Secondly, blockchain technology also has the characteristics of anonymity, which is prone to a gray area transaction that cannot be touched by foreign exchange supervision. It has made it more difficult to supervise cross-border payments.

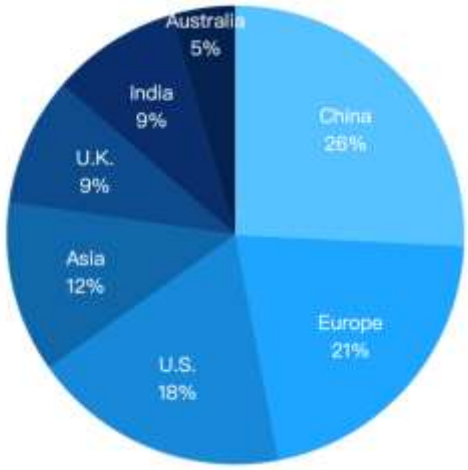


**Figure 3.** Trend chart of the number of documents. Distribution map of the number of documents in each country.

On the other hand, although blockchain technology has improved transaction efficiency and reduced transaction costs, the demand for transactions is also very high due to the comprehensive coverage of cross-border payments in countries and regions. The average time to add a new block to the blockchain system is 10 minutes. Each block has a 1MB capacity, and the online power can support only eight transactions per second [12]. There is a huge gap between this speed and other third-party software on the market, which is unsuitable for large-scale blockchain transactions. And in the process of cross-border payment, each node in the blockchain network will store a lot of information, which has high requirements for the information storage capacity of each node. At the same time, because of the huge transaction volume and the protection of both parties, the processing capabilities of each node on the blockchain network for malicious attacks still need to be improved. If the key or password is lost or leaked, the system will be difficult to recover, and it will cause irreparable losses to the assets of trading users.

## 7. Conclusion

The outcomes of this research show that using blockchain technology might offer enormous efficiency and security. For the CBDC's use in cross-border payments, its centralized characteristics will bring more standardized use and supervision. For CBDC, the growing global demand for digital cross-border payment and the development of digital financial payment have promoted the research and development of CBDC and CBDC cross-border projects in various countries. However, since blockchain technology involves many high-tech fields, the construction of its financial system based on cross-border payment

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is still in the initial stage, and there are still many problems and challenges to be solved and improved. Especially for the joint application of blockchain technology and CBDC, a country still needs to organically combine the contradiction between its centralization and the decentralization of the blockchain. It is undeniable that its development prospects and development space are unlimited. The popularization of this technology in the future will change the existing payment transaction system and bring unprecedented convenience experience to users worldwide: Higher efficiency, a safer trading environment, and lower costs. For the many current problems, countries need to jointly negotiate and formulate a unified system consensus and relevant regulatory laws and regulations, strengthen international cooperation and exchanges, jointly explore solutions, and jointly break through the technical bottleneck of the blockchain.

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