The Application of Blockchain in RegTech: A Literature Review

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Abstract: With the development of high and new technologies such as big data, artificial intelligence and cloud computing, the combination of traditional finance and emerging technologies has set off a wave of financial technology, but the new risks that follow have also brought challenges to financial regulation. In order to improve the financial risk management system in the new era, regulators combine regulatory business with emerging technologies to promote the further and orderly development of the financial industry. As one of the underlying technologies of regulatory technology (RegTech), the application of blockchain technology in RegTech is still in the stage of exploration and experiment. Blockchain technology has the advantages of decentralization and trust. It has high application value and broad application prospects in the field of RegTech. This paper will first introduce the current situation and characteristics of RegTech and blockchain technology, then explore the advantages and challenges of applying blockchain technology in the field of RegTech, then summarize the specific application of blockchain technology in RegTech, and finally put forward suggestions for further application of blockchain technology in the field of RegTech.

1. Introduction

1.1 Background

Traditional finance mainly carries out lending and settlement activities to transfer funds from investors or lenders to borrowers, improve the liquidity and utilization of funds and promote economic development. Since the 21st century, with the rapid development of science and technology, frontier fields such as big data, artificial intelligence and blockchain have sprung up rapidly, which has brought a new development direction to the traditional financial industry. Many banks, insurance and other financial institutions began to explore the possibility of integrating emerging technologies into their businesses and services, setting off a wave of research on financial technology.

Financial technology includes a variety of business types, including virtual bank, rapid payment, intelligent financial management, etc. its main applications include payment clearing, intelligent investment adviser, financial product pricing and risk management [1]. The development of financial technology has received extensive attention and support. In 2017, the People's Bank of China established the Financial Technology Committee to focus on financial service models and products , and expand service quality through the application of scientific and technological methods. In 2019, the central bank issued the "fintech development plan (2019-2021)", which provided guidance for the development of China's financial technology in the next three years. In 2021, the Hong Kong Monetary Authority (HKMA) also proposed "Fintech 2025", which requires all banks to go financial technology (Fintech).

While financial technology brings innovation, it also brings new risks. The types of risks can be divided into data security risks, network security risks, technical risks and regulatory risks [2]. Among them, the dissemination of false information, systemic financial risks and regulatory difficulties are urgent problems to be solved [3]. In China's regulatory field, there are generally weak risk control, lagging regulation, imperfect regulatory system and network security and technical risks [4]. In order to improve the financial risk management system in the new era, the traditional regulation mode of the financial industry is combined with emerging technologies to extend the Regulatory Technology

(RegTech) to balance the innovation of financial technology and the monitoring and management of financial risks.

One of the underlying technologies of RegTech is blockchain, which is a brand-new distributed infrastructure and computing method, but its application scenarios in the regulatory field are limited [5]. From the perspective of the whole financial field, blockchain technology is "a shift from trusting people to trusting math", which is mainly used in cross-border transactions and payment and settlement [6].

1.2 Objective and Contribution

In this paper, I aim to study the impact and application of blockchain technology in RegTech. I will first study the current situation of RegTech and blockchain respectively, summarize the advantages and challenges that the application of blockchain technology can bring to RegTech, introduce the main application scenarios of blockchain technology in RegTech, and put forward future research directions and relevant suggestions.

1.3 Remaining structure

The second chapter will introduce the concepts, characteristics, development status and typical applications of RegTech and blockchain respectively. The third chapter focuses on the advantages and challenges that the application of blockchain technology can bring to RegTech. The fourth chapter will summarize the main application fields of global blockchain technology in RegTech. The fifth chapter summarizes and prospects the application of blockchain technology in RegTech.

2. RegTech and Blockchain

2.1 RegTech

Since the 2008 financial crisis, the public has paid more and more attention to financial risks and put forward many thoughts on how to manage risks. In order to avoid another large-scale financial crisis, financial rule makers have gradually introduced many new regulations on regulation, such as Basel III, GDPR, etc.

With the emergence of financial technology, the financial industry has gained new vitality and brought RegTech to financial regulation. RegTech is based on modern technologies such as machine learning, big data, cloud computing and blockchain, and solves the regulatory, compliance and risk problems caused by the rapid development of the financial industry by creating emerging and effective compliance and RegTech solutions [7]. Table 1 shows the changes in RegTech.

Table 1. The changes in RegTech[8]

RegTech 1.0	RegTech 2.0	RegTech 3.0
-Period from 1960-2008 -Focused mainly on internal risk management and monitoring -Driven by large institutions	- Started after the Global Financial Crisis and is the phase we are in today - Mainly driven by the Financial market - Focused on solutions for compliance, reporting and processes with the new technology available to Know Your Data	- The future - Technology as a tool - Rethinking the regulatory environment - All sectors working together - From Know Your Customer

Now in RegTech 2.0, by using the regression method to study the impact of China's financial technology on the development of the financial industry, it is found that RegTech can significantly improve the achievements of financial developmen[9], which shows that the development of RegTech is also the development trend of the financial industry.

The application of RegTech is mainly in identity authentication, risk management, behavior regulation and compliance management. The classification of its main application scenarios is shown in the figure 1.

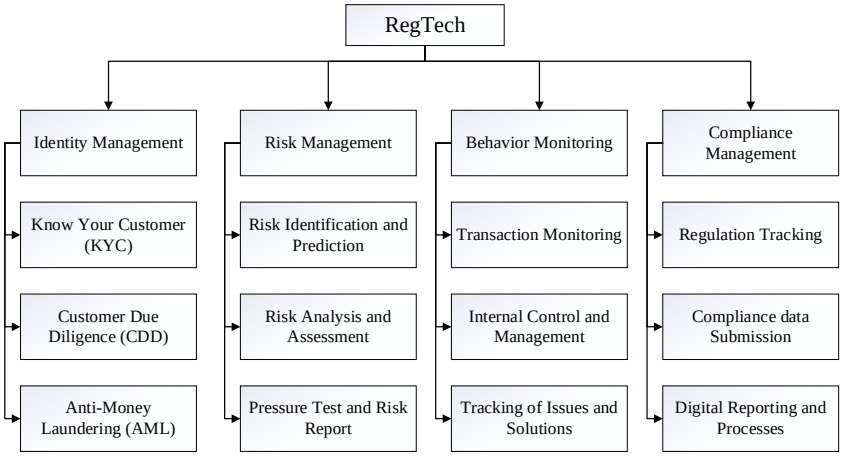

Figure 1. The classification of RegTech main application scenarios

RegTech has received extensive attention all over the world. Regulators in various countries have successively carried out the research and application of RegTech and achieved a lot of results. As shown in the following table 2.

Table 2. The research and application of RegTech

Country	Main RegTech tools and legal framework
Britain	-Financial Conduct Authority (FCA) has set up a "Regulatory Sand Box" mechanism -Organize and promote TechSprint RegTech activities -Set up an "innovation center" to help enterprises understand the regulatory framework -Set up an "innovation accelerator" to promote cooperation among enterprises, institutions and governments
U.S.A	-“The white paper on financial technology” provides 10 evaluation principles for regulators -Establish central database systems and analysis systems to ensure the authenticity and reliability of financial related data -“The modernization rules of investment companies” promote the institutionalization of regulatory science and technology
Singapore	-The monetary authority of Singapore (MAS) applies the comprehensive risk assessment framework and technology to determine the risk and regulatory level of financial institutions -Published “The ‘regulatory sandbox’ guide of financial technology” and launched the regulatory sandbox mechanism -Evaluate and monitor financial network security
Australia	-Australian Securities and Investment Commission ASIC established an "innovation center"; "RegTech Roundtable"; "Regulatory sandbox exemption" attaches importance to efficiency and risk; "Market analysis and intelligence system" realizes real-time monitoring
China	-“Blue book on regulatory science and technology: China regulatory science and technology development report (2020)” -It belongs to the passive, relatively loose and development oriented category -With the rapid development of China's financial technology market, we can foresee the huge demand for RegTech

The application of RegTech in various countries is mainly divided into the following three types: The restrictive type, represented by the United States, which applies RegTech to restrict enterprises and prevent cross-border situations; The initiative type, represented by the UK, Australia and Singapore, takes the initiative to create many regulatory scientific and technological means to support the development of financial enterprises; The passive type, represented by China, is still in a wait-and-see state.

Among them, London is a world-famous financial center. In addition to the regulators actively carrying out RegTech projects in Table 2, it also brings together many excellent RegTech companies to improve regulatory efficiency and reduce compliance costs [10].

Britain has two famous RegTech companies. Onfido has developed a biometric technology based on machine learning. Duedil has collected a large amount of financial data and registration data, which has strengthened the transparency of the market. [11].

However, at the same time, RegTech is also facing many challenges, among which the key points are the change of regulatory rules, the immature application of technology, and the regulatory difficulties caused by ignoring regulatory compliance and high technology [12].

2.2 Blockchain

In recent years, the research and application of blockchain technology have become a hot spot. The financial industry is inseparable from money, before the development of blockchain technology, money was issued by the state and controlled by the central bank. In the traditional lending business, lenders and borrowers need to act as the center through the bank to realize the flow of funds, which is an embodiment of centralized finance. In this case, if the bank's system is attacked, the whole lending process will collapse, and we cannot transfer funds from owners to demanders.

While blockchain technology carries out financial business through decentralization. The so-called decentralization means that in the whole business process, there is no center, and the whole system is connected by blocks. The status of each block is the same. If a block is attacked, the system can still run. And the money on the blockchain is not issued and controlled by the central bank, and there is no central institution to control the transaction.

Specifically, the operation mode of blockchain is a chain structure, which is composed of various blocks in chronological order, and each block contains multiple transactions. All nodes, that is, the miners, are connected to each other through the peer-to-peer network (P2P) networking model, contribute their own computing power, execute, verify and disseminate the effective transaction data generated over a period of time according to the data verification and protocol, and generate the data block after encryption by using the hash algorithm and other technologies. The miners who become the most successful miners in this block will be encouraged, For example, bitcoin miners will receive a certain bitcoin reward after successfully generating blocks. In addition to multiple transaction data, each block also includes the hash value, time and random number nonce of the previous block. The random number is used to verify the hash value, which ensures the integrity of the whole block. Because the hash value is unique and cannot be changed, it can effectively prevent fraud. At the same time, since the nodes of the blockchain can be participated by anyone, while participating in the recording, each node also verifies the correctness of the recording results of other nodes, which improves the maintenance efficiency and reduces the cost. The blockchain is shown in the figure 2 .

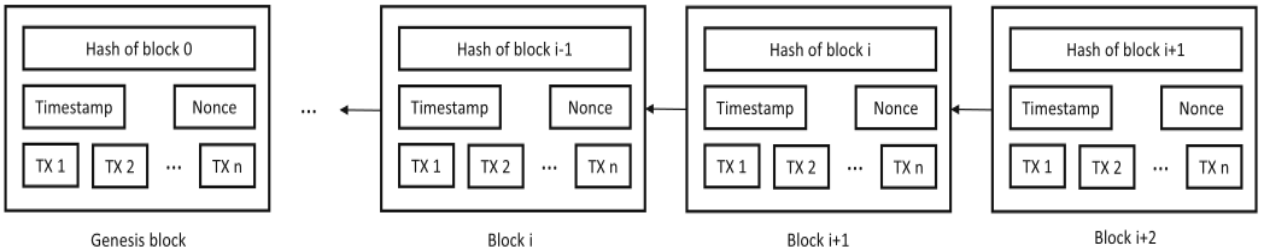

Figure 2. blockchain [6]

Blockchain can be divided into the public blockchain, the alliance blockchain and the private blockchain according to the level of authority. The public blockchain needs the least authority, is oriented to all users and is managed jointly; The alliance blockchain is jointly managed by several institutions; The private blockchain is specially managed by an organization or institution, which requires the highest permission to read and write blockchain.

Another major feature of blockchain is the trust. The processing and completion of transactions by blockchain do not require the participation of central institutions and third parties in centralized finance. Based on the distributed architecture and consensus algorithm of blockchain, its unique digital form of the smart contract can enable untrusted users to complete transactions directly. All operations on the system are transparent, anyone can find out publicly and do not have to consider the credit problem when trading, that is the trust of blockchain.

The transaction process on the blockchain is realized through smart contracts. After being jointly agreed and signed by many parties, the smart contract is submitted together with the transaction initiated by the user. After being transmitted by the P2P network and verified by miners, it is stored in a specific block of the blockchain. After the user obtains the returned contract address, contract interface and other information, he can call the contract by initiating the transaction. Among them, after the miner verifies that the transaction is valid, its transaction information will be packaged into a new data block. After being authenticated by the consensus algorithm, the new block will be linked to the main chain of the blockchain to update the whole blockchain [13].

Blockchain also has the characteristics of tamper-proof, traceability and sharing mechanism, which has had a great impact on the current financial field: Reduce the cost of money circulation in cross-border payment and settlement; Change the supply chain structure, reduce intermediaries and truly realize P2P; Solve the problem of information asymmetry in insurance and improve the efficiency of claim settlement; Improve the standardization and transparency of the bill market; In the credit management of banks, it is also possible to obtain credit information in blockchain without protecting the privacy of individuals. Also, the Digital currency was born and is gradually replacing the old money market [14].

It can be said that blockchain technology is a reform of the financial industry. After decentralization and trust, the transaction will no longer pass through the central bank and there are no various restrictions in the transaction. It can easily and conveniently realize the transaction, which has greatly promoted the development of the financial industry.

3. Advantages and challenges of applying blockchain in RegTech

3.1 Advantages of applying Blockchain in RegTech

Blockchain has the following advantages: decentralization, trust, tamper resistance, traceability and sharing mechanism, which can provide support for regulators in terms of regulatory data and RegTech [15].

In terms of regulatory data, blockchain can bring the following advantages in RegTech:

(1) Reduce the risk of information asymmetry. Due to the sharing mechanism of blockchain, the data information between all nodes is recorded synchronously through the P2P network, and all information is shared distributed so that all users have the same information to prevent unilateral loss caused by information asymmetry.

(2) Improve system maintenance efficiency. Due to decentralization and trust, everyone can participate, jointly record and verify the correctness of data and blocks, reduce maintenance costs and improve maintenance efficiency.

(3) Ensure the authenticity of data. Due to the traceability and tamper resistance of blockchain, once the information is confirmed, it cannot be changed. Moreover, the use of algorithm verification and tools can accurately and completely obtain the trader's credit, account and other records, reducing the credit risk.

In terms of regulatory technology, blockchain can bring the following advantages in RegTech:

(1) Improve the regulatory efficiency of regulators and reduce regulatory costs. Through the sharing mechanism and decentralization of blockchain, the regulation system can be integrated into the distributed accounting system of blockchain to realize the decentralization of regulation.

(2) Reduce information asymmetry and credit risk. At the same time, it can be supported by blockchain technology. Through authentication, real-time regulation and other functions, it can serve regulators to obtain accurate and complete data.

(3) Easy regulatory decision-making and innovation. The advantages of blockchain technology can make a real-time and accurate assessments of the status, capabilities and risks of regulated financial institutions so that regulators can have all-around references to put forward new guidelines and requirements.

(4) Track down financial crimes. As the blockchain is tamper -proof and traceable, once a crime occurs, the supervisor can trace it through the records on the blockchain [16].

(5) Build an international governance system. In global governance and regulation, blockchain can help establish a more flexible and reliable international governance system and reach a “global social contract”to meet global challenges [17] .

3.2 Challenges of applying Blockchain in RegTech

The application of blockchain in RegTech also has certain challenges, mainly due to the characteristics of blockchain itself and whether it can adapt to market conditions and regulatory requirements.

(1) System vulnerabilities: syntax errors, link configuration and graphical interface errors are the top three roof defects in the blockchain system. Vulnerability attacks will pose a great security threat to the blockchain system [18].

(2) Legal obstacles: changing the way of establishing legal centralized authority has brought challenges to the current legal system in terms of proof of rights and interests, transfer of real rights, signing of smart contracts, etc. [19].

(3) Technical risk: on the blockchain, there have been many frauds and hacker attacks in which attackers use more computing power than other participants to modify and control transaction records. The application of blockchain will also bring challenges to the technical security of the regulatory system [20].

(4) Secret disclosure: due to the consensus mechanism of blockchain, the transaction information will be forced to be disclosed in the system, and the trade secrets involved will be difficult to be guaranteed [21].

(5) The flexibility of smart contracts is poor. As the smart contract must be strictly implemented and cannot be modified or revoked, it will cause unnecessary losses in case of breach of contract caused by force majeure [22].

(6) Adaptability to the market. Regulators will have some experience in the risk and economic impact of the market, but it is still unclear whether the application of blockchain technology combined with regulation can adapt to the market in terms of performance and security [23].

4. The practice of combining Blockchain with RegTech

In recent years, blockchain has been applied to various scenarios of RegTech and achieved some results

(1) Bill regulation and blockchain. In 2018, the Central Bank of China launched the experimental production system of digital bill trading platform based on blockchain to realize the registration and operation of digital bills in the whole life cycle, detect transactions and protect privacy in the process, and optimize the process of transaction and settlement by designing smart contracts [23].

(2) Internet financial regulation and blockchain. In monitoring the illegal fund-raising activities of P2P online loan platforms, China has applied blockchain and other technologies to develop a "smoke index" and carry out risk early warnings. It has predicted the risk of e-rent treasure and deployed it in advance, reducing the impact of the event [24]. In 2021, based on the four types of risks of Internet

finance, some scholars used the Decision Laboratory method (DEMATEL) and the Interpretive Structure Model (ISM) to study and analyze the path of Internet financial risk prevention and control, so as to explore the role of blockchain technology in the process of Internet risk prevention and control [25].

(3) Database and blockchain. In 2015, NASDAQ developed LINQ, an open-source database for private equity transaction management based on blockchain, which can provide an interface for other companies to ensure clear ownership, openness and transparency and data availability in the process of stock issuance [24].

(4) Transaction process and blockchain. The Australian Stock Exchange (ASX) cooperated with blockchain startups in 2016 to improve the clearing and settlement process of cash stocks [24]. In 2018, scholars designed, developed and implemented a system that uses blockchain to ensure the security of stock trading [26].

(5) Compliance and blockchain. In 2014, Deloitte developed Rubix, a one-stop compliance customization platform based on blockchain, to provide enterprises with customized, highly scalable and highly compatible blockchain compliance solutions [24]. In 2020, the case study of the project Maison proof of concept blockchain system for regulatory reporting of mortgages in the U.K. showed that the application of blockchain technology in the field of compliance can reduce compliance costs and alleviate regulatory pressure [27] in 2017, we studied the way of algorithmic regulation and took the algorithmic trading system as the model to realize the compliance of automatic financial regulation [28].

(6) Credit and blockchain. In 2017, blockchain was studied to integrate the organization's participants, reputation and other information to form a lasting and undeniable trust chain to help monitor the credit of technology tracking organizations [29]. At the same time, blockchain can also help KYC solve the problems of client identification and verification, client identification and verification, additional information and Customer risk analysis, survey reviews, updates and transaction monitoring to improve efficiency [30].

(7) Sandbox regulation and blockchain. In the insurance industry in 2020, blockchain was proposed to be combined with a regulatory sandbox to form a new regulatory model. Blockchain technology can improve the risk control ability of the insurance industry and reduce fraud risk and cost. Regulatory sandbox can effectively prevent the risks at the technical level of blockchain [31].

(8) Supply chain and blockchain. Many enterprises in the field of supply chain finance have applied blockchain technology. Regulators can establish "regulatory sentinels" combined with blockchain technology, install "regulatory sentinels" in the block, timely obtain supply chain financial information and identify global risks in advance [32].

(9) Risk monitoring report and blockchain. In 2017, based on the distributed computing and decentralized data management technology of blockchain, a standardized financial risk monitoring technology was proposed, and a report was formed to automatically provide important contract data and other information to legally authorized regulators, so as to realize the synchronous contribution of risk data [33].

(10) Risk regulation model and blockchain. Taking blockchain as the underlying technology, using cloud computing technology, Internet data collection and mining technology, big data analysis technology and information processing technology, and relying on the combination of online monitoring and offline regulation, build a financial online service and risk regulation model of "capital flow" and "information flow" dual deposit and certificate system [34].

5. Conclusion and Discussion

Applying blockchain technology to the monitoring and compliance of RegTech will improve regulatory efficiency and reduce regulatory costs. Based on the current relevant research is still in the stage of exploration and preliminary application, to further apply blockchain technology in RegTech, we need to learn from the actual experience of existing RegTech and blockchain, and take advantage of the decentralization and trust of blockchain to pay attention to and solve the risks of system

vulnerabilities, technical risks and secret disclosure. Regulators also need to pay attention to whether the RegTech system based on blockchain technology meets the needs of the market and regulation. The country also needs to build new laws to adapt to the legal impact brought by blockchain technology. At the same time, the further improvement and practice of blockchain technology will continue to provide technical support for the application scenarios of RegTech, bringing new solutions to the application fields of RegTech such as Anti-money Laundering (AML) and internal regulation of organizations, and improving the application status of blockchain in RegTech.

With the further development of science and technology, regulators in the financial field of various countries will continue to develop regulatory science and technology. The use of blockchain technology, big data, artificial intelligence and other high and new technologies, will bring new vitality to the financial industry, and finally, achieve the ultimate goal of strengthening regulatory science and technology and improving the financial risk management system in the new era.

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