The Application of Financial Technology in Carbon Finance

Mingyi Li *

Faculty of Business Administration, University of Macau, Taipa, Macau, China

* Corresponding Author Email: BC31022@um.edu.mo

Abstract. With the rapid development of the economy, the pollution of the environment in various countries is also increasing, and the concept of carbon finance is gradually emerging. Fintech has gradually entered people's vision, and how to use Fintech to help the realization of carbon finance has become a research issue for some scholars. Existing research mainly focuses on a specific application and lacks a literature review. By summarising the literature on fintech and carbon finance, this paper outlines several currently common applications. It mainly covers the application of blockchain in carbon finance, such as using the tamper-proof nature of blockchain to make the carbon credit trading process more transparent, and using the contract layer of blockchain-smart contracts to prevent the accumulation of carbon credits by adding smart contracts into the trading process of carbon credits, etc. This paper concludes the application of big data and cloud computing in carbon finance, such as using big Data and cloud computing technology to analyze massive data, as a way to reduce the risk of carbon trading, etc. The research puts forward a certain degree of recommendations on the application of financial technology in carbon finance.

Keywords: Financial technology; blockchain; carbon finance; green finance.

1. Introduction

Since the 20th century, with the rapid development of the economy, the problem of environmental pollution has become increasingly serious. And global warming has led to rising sea levels and other phenomena more and more frequently. Countries worldwide are gradually realizing the importance of environmental protection. With the signing of two significant international conventions, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, the concept of "carbon finance" is gradually emerging.

Up to now, an identification and detection system for carbon financial risks has not been established. Carbon financial projects have the defects of long project cycles, complex transaction processes, and a high degree of information asymmetry.

At the same time, along with the gradual improvement of the financial market and the continuous innovation of science and technology, the concept of financial technology is also gradually emerging. Fintech has the inerrancy of procedures and data, and the decentralization of blockchain ensures the fairness and openness of economic activities. In such a background, countries are actively applying financial technology to industrial upgrading, and how to apply the strengths of financial technology to boost the development of carbon finance has become a research issue for many scholars.

At present, some scholars have already made some progress on this issue. According to research, every increase in the level of fintech development in a city leads to an increase in the total factor productivity of local high-carbon enterprises [1]. Blockchain smart contract technology can weaken the credit risk of carbon financial enterprises in financial risk, artificial intelligence can predict the level and volatility of the market carbon price, improve the quality of data to reduce the cost, and improve the quality of carbon emission reports [2]. The development of digital inclusive finance can reduce the intensity of regional carbon emissions [3]. Nowadays, countries are establishing carbon finance markets, but still in the early stage of establishment, the market is not perfect, and how the application of financial technology in carbon finance should be realized remains to be further studied this paper reviews the relevant articles in the field of carbon finance and financial technology. The results of the current research on the application of fintech in carbon finance are summarised, covering the role of blockchain as well as smart contracts in preventing risks in carbon finance, the application

of big data and cloud computing as well as inclusive finance in carbon finance. So that other scholars can understand the current progress of the field more quickly in future research.

2. Definition and Development Status of Carbon Finance and Fintech

2.1. Definition and Development of Carbon Finance

Carbon finance is a branch of environmental finance, which reduces greenhouse gas emissions by pricing carbon emissions through the carbon emissions market and drives environmental improvement by financial means. With the rapid development of the economy, the problem of environmental pollution is also becoming increasingly serious. All countries around the world are currently focusing on building the carbon emissions market and gradually enhancing the carbon trading mechanism, leading to an increase in carbon financial products and services.1.2 Definition and Advantages of Fintech

Fintech is how companies use technology to make financial services more efficient. The National Digital Research Centre (NDRC) of Ireland defines fintech as a financial services innovation. There is no clear definition of FinTech, but it can roughly include four directions, "artificial intelligence" "blockchain" "cloud computing" and "Big Data". Fintech has features such as the ability to collect and analyze data more easily; and blockchain decentralization, which can provide regulators and financial institutions with more accurate information and increase the transparency of information between institutions and businesses.

2.2. Factors Affecting the Development Prospects of Carbon Finance (Problems)

The global carbon finance market is still in the early stage of establishment, and there are still some problems in the development of carbon finance. For example, the carbon project itself is carried out over a long period, the size of the capital is large, the asymmetry of carbon emissions information is high, resulting in large fluctuations in carbon prices, and the costs and benefits of enterprises participating in the carbon financial trading market are difficult to predict and other problems [2]. Current carbon trading also suffers from centralization, lack of participant motivation, and hoarding of carbon credits [4]. Carbon finance also has problems such as a lack of emission tracking and measurement, a complicated process of allocating carbon allowances, and high transaction costs [5].

3. The Application of Financial Technology in Carbon Finance

3.1. The Role of Blockchain in Carbon Finance

Blockchain was proposed by Satoshi Nakamoto in the Bitcoin White Paper released in 2008, and then the Bitcoin network was created in 2009. Blockchain applies computer technology such as peer-to-peer transmission, encryption algorithms, and consensus mechanisms. It is essentially a distributed ledger formed by assembling a series of data blocks into a chain of data in chronological order and using cryptographic algorithms to secure data transmission and storage. Blockchain mainly consists of a data layer, consensus layer, network layer, incentive layer, application layer, and contract layer, and has now evolved into the 3.0 era. In the 1.0 phase of blockchain, the main focus was on digital currency applications represented by Bitcoin. In the 2.0 era, the smart contract feature represented by Ether was added. In the current 3.0 era, it has become an underlying protocol for the future of society, applying to all aspects of society rather than just the financial sphere.

The core features of blockchain are mainly decentralization, robustness and immutability and the ability to store data in an open, transparent, undeniable, and anonymous form, which make blockchain a highly efficient tool to drive economic and social activities [4]. There are problems of trust and information transparency in the market transaction of carbon finance, so the development of carbon finance can be fuelled by blockchain. The introduction of blockchain technology into the transaction of carbon credits can be used to improve the transparency of the transaction by utilizing the

modification-proof nature of the blockchain, thus reducing the fraudulent behavior that occurs during the transaction process. Traders can use the blockchain to verify the authenticity and validity of carbon credits. Because blockchain is public, it can also facilitate participation in carbon trading around the world. Because of the digitization of carbon credits, it also reduces the complexity of carbon trading and lowers transaction costs [6]. The distributed bookkeeping of the blockchain also ensures the openness and transparency of the flow of funds of enterprises participating in carbon projects, prevents the phenomenon of misappropriation of funds, and reduces the financial risk of enterprises [2]. The emergence of blockchain has also brought smart contracts into the limelight, defined as "software programs that add an information layer to transactions executed on the blockchain". When there are pre-defined terms, there is no need for human intervention and the smart contract facilitates the fulfillment of the terms by creating an automatically executed process. As it exists in an immutable blockchain, it may provide the security required for carbon trading than traditional contracts [5]. The problem of hoarding carbon credits can be solved by using smart contracts that attach an expiration timer to the carbon credit trading process so that the carbon credits are used within a reasonable period, and the smart contract will enforce a timer for the carbon credits and retire the timer when it expires [6].

With the gradual increase in the application of blockchain, the security problems of blockchain are also increasing. According to statistics, smart contracts, the core technology of blockchain, accounted for more than 90% of security incidents from 2011 to 2018. Mainly because smart contracts are just in their infancy, the standardization and rigor of writing smart contracts are difficult to ensure. At the same time, smart contracts do not yet have a uniform audit standard for development [7]. Not only that, blockchain also has a certain degree of problems in node management, consensus mechanism selection, etc., and as the application of blockchain technology increases, many legal applicability issues are gradually emerging. In short, although the blockchain has developed to the 3.0 stage, it still needs to be continuously developed and improved, and there are still many security problems that need to be solved.

3.2. Application of Big Data and Cloud Computing in Carbon Finance

Big data is a collection of data that cannot be acquired, processed, and managed by traditional IT tools in a reasonable amount of time. Its main characteristics are data redundancy, high dimensionality, and complexity, characterized by large volume, diversity, fast processing speed, and low-value density. To extract valuable data from massive data, cloud computing technology also needs to be applied [8]. Cloud computing is an Internet-based computing method that makes shared hardware and software resources and information available on demand to a variety of terminals and devices, including cloud storage and computing power. Big data pursues efficient processing of massive data while cloud computing pursues resource allocation, and the combination of the two can be better utilized by applying them together.

By accessing massive amounts of real-time data, companies can tap the value stored in it to streamline production and operations, achieve digital transformation, and improve productivity [8]. Big data and cloud computing can comprehensively assess the risk of carbon finance projects by analyzing massive data, improving the decision-making ability of enterprises, and increasing the transparency of information. Big data and cloud computing technologies also facilitate the development of financial inclusion. Inclusive finance can reduce the cost and threshold of financial services, promote the transformation of the consumer structure, and empower enterprises in green innovation. It expands the participating subjects of the carbon financial market, increases the types of carbon financial products, and provides a new platform for enterprise project financing. Coupled with big data and cloud computing technology, it conveniently acquires customer information for risk analysis and enhances confidence in carbon financial investment [9].

Although big data and cloud computing technology greatly facilitate the process of acquiring data, the throughput of large amounts of data and the computing process requires a large amount of energy consumption, which generates a large carbon footprint.

The technology's capability to acquire vast amounts of valuable data also attracts the attention of attackers. For instance, during data transmission and sharing within an enterprise, imperfect data encryption methods can provide hackers with opportunities to attack databases and compromise crucial data. Additionally, if effective protection measures are not implemented after user data is inputted into the cloud platform, hackers can potentially access the data through remote control [10]. Big data and cloud computing technology also still need to continue to improve development and increase the protection of data security.

4. Recommendations

Although blockchain has many advantages and can be used to help the development of carbon finance, the governance mechanism for blockchain technology is not yet perfect. There is still a need to strengthen the research on blockchain governance and regulatory mechanisms, as well as to continuously improve the legal and regulatory systems to avoid the emergence of a situation where there is no applicable legal basis for blockchain. Currently, countries are actively enhancing the development of blockchain security standards. Unified security standards can significantly alleviate blockchain security issues and mitigate security risks in smart contracts through third-party intelligent security auditing contract service companies [7].

Big data and cloud computing technology are conducive to the high-quality development of carbon finance. The government and regulatory authorities should promote data sharing, and improve the corresponding laws and regulations. And also encourages enterprises to develop production through advanced technology.

At the same time, big data and cloud computing technology have a high demand for infrastructure. In places with underdeveloped infrastructure, the construction of the data market should be supported first. At the same time, it is necessary to study how to reduce the large carbon footprint generated by the application of big data and cloud computing technology. This is essential to prevent the application of this technology from diminishing the marginal benefits of promoting carbon finance. The government and enterprises should strengthen data security management regulations and establish an effective data isolation mechanism. This ensures that operators strictly comply with regulations and requirements during data operations, thereby enhancing data access security. Moreover, efforts should be made to develop technologies such as data encryption and data sharing security to further bolster data security [10].

5. Conclusion

This paper introduces in detail the definition of financial technology and carbon finance, and introduces in detail the definition of blockchain and big data cloud computing affiliated with financial technology, firstly, it elaborates that carbon finance has the problems of long project time, large price fluctuation, opaque information and other development obstacles, and then, in the first part, it introduces how to make use of blockchain's characteristics of decentralization, traceability and openness to solve the problem of carbon finance in the process of trading over and tracking the flow of carbon funds, and how to use smart contracts to prevent the problem of hoarding of carbon credits. The trading process of credits over and tracking the flow of carbon funds problem, how to use smart contracts to prevent the problem of carbon credit hoarding. Then in the second part, describes how to use big data and cloud computing to obtain information favorable to the carbon financial market from massive data, improve the investment confidence of enterprises and reduce the investment risk, and help enterprises make better decisions, as well as using inclusive finance to expand the main participants in the carbon trading market, inject vitality into the carbon financial market, and provide a new platform for carbon financial project financing. Finally, suggestions are made for the application of financial technology in carbon finance, such as strengthening the regulation of

blockchain technology, improving the development of security standards, and studying how to reduce the large carbon footprint generated by the operation of big data cloud computing technology.

Currently, the use of blockchain technology can't handle small-scale transactions well because verification takes a long time. But in the future with the development of technology, consumer-level tracking can be added to the system to increase the carbon financial market at the individual level. The current research on the application of big data and cloud computing in carbon finance largely stays at the macro level, such as the impact of the total factor productivity of the application of big data, etc., and the specific application has to be further studied. This paper mainly provides an overview of the application of blockchain and two parts of big data and cloud computing in carbon finance alone. Without summarizing the integration application of different IT technologies, such as how cloud computing can enhance the computing power of blockchain or how the Internet of Things can provide abundant data inputs for blockchain.

References

[1] Liu J, Xin K, Wei W. Fintech's impact on green total factor productivity of high carbon enterprises. Emerging Markets Finance and Trade, 2024, 60(4): 744–68.

[2] Xiangning L. Application of financial technology in carbon finance and risk management of thermal power enterprises. Central University of Finance and Economics, 2022.

[3] Yafei W, Zihan Z, Shiqiu Z, Ya S. Research on the impact of digital inclusive finance on regional carbon emissions: Based on the sustainable green innovation of small and medium-sized enterprises. Journal of Cleaner Production, 2023, 428(139513), 0959-6526.

[4] Patel D, Britto B, Sharma S, Gaikwad K, Dusing Y, Gupta M. Carbon credits on blockchain. 2020 International Conference on Innovative Trends in Information Technology (ICITIIT), Kottayam, India, 2020, 1-5.

[5] Shen P, Li S, Huang M, Gao H, Li L, Li J, Lei H. A Survey on Safety Regulation Technology of Blockchain Application and Blockchain Ecology. 2022 IEEE International Conference on Blockchain (Blockchain), Espoo, Finland, 2022, 494-499.

[6] Alia A S, Batool M, Sara S, Malick N, Ghassan A L. A comprehensive hierarchical blockchain system for carbon emission trading utilizing lockchain of things and smart contract, Technological Forecasting and Social Change, 2021, 173(121124), 0040-1625.

[7] Liu B, Fang T, Fu Y. Research on optimization of block chain security testing. 2020 IEEE International Conference on Smart Cloud (SmartCloud), Washington, DC, USA, 2020, 19-22.

[8] Wang L, Yuhan W, Zeyu H, Yanan W. How big data drives green economic development: Evidence from China. Frontiers in Environmental Science, 2022, 10: 1055162.

[9] Kelin M. Digital inclusive finance and corporate green technology innovation. Finance Research Letters, 2023, 55(104015), 1544-61235.

[10] Tang Z. A preliminary study on data security technology in big data cloud computing environment. 2020 International Conference on Big Data & Artificial Intelligence & Software Engineering (ICBASE), Bangkok, Thailand, 2020, 27-30.