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The Impact of Financial Innovation on Environmental Protection:

Literature Review and Case Study

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Abstract:

This study explores the relationship between financial innovation and environmental protection, focusing on how financial innovation can contribute to sustainable development and ecological conservation. Through a comprehensive literature review, this paper identifies various forms of financial innovation, including green finance, socially responsible investing, and impact investing. These have emerged as significant tools in promoting environmental sustainability. The literature suggests that financial innovation plays a crucial role in directing capital towards environmentally friendly projects and companies, thereby reducing the funding of polluting industries. The implementation of green bonds, green banks, and other financial instruments has been instrumental in channeling investments towards renewable energy, clean technology, and other eco-friendly initiatives. These financial mechanisms not only encourage corporate responsibility but also stimulate innovation in clean technologies by providing necessary funding and risk management solutions.

The Case study is presented to exemplify the practical application of financial innovation in environmental protection. The case focuses on the development and impact of a green bond issuance by a major financial institution, highlighting the positive environmental outcomes achieved through the financing of specific sustainable projects. The analysis reveals that such financial products have led to measurable reductions in greenhouse gas emissions and improvements in resource efficiency. By synthesizing theoretical insights and empirical evidence, this research contributes to a deeper understanding of the nuanced interplay between finance and environmental preservation, suggesting that financial innovation can be a powerful ally in the global effort toward ecological conservation and sustainable development.

Keywords: Financial Innovation; Environmental Protection; Carbon Emission; Green Finance

1. Introduction

Financial innovation has a positive impact on environmental protection, which is reflected in various fields such as green credit, green bonds, green insurance, and carbon finance. These innovations not only promote the diversification of green finance products but also contribute to the sustainable development of the environment.

In terms of financial technology, China has effectively identified and supported the development of green projects through technologies such as big data and artificial intelligence. For example, since its launch in 2019, the Green Finance Information Management System of the People's Bank of China has achieved accurate information statistics and management of all banks within its jurisdiction, improving the efficiency of reporting green credit data. The Huzhou Green Finance Comprehensive Service Platform has also added credit guarantee and judicial protection functions to help a large number of small and micro enterprises obtain green loans.

In terms of green credit, as of the end of June 2022, China's green credit market has become one of the largest markets in the world. Green credit is mainly aimed at green projects such as energy conservation and emission reduction, clean energy, etc. Through low interest rates and guarantee-based credit products, it supports the green innovation and development of enterprises. This not only provides financial support for enterprises but also reduces environmental risks and promotes a win-win development between the economy and the environment.

In terms of green bonds, China has become the second-largest market in the world. Through government support and strict supervision, green bonds attract investors to buy at a lower coupon rate, providing low-cost financing for enterprises issuing bonds. This mechanism not only solves the financing difficulties of enterprises, especially small and medium-sized enterprises, but also promotes their green innovation activities, and enhances enterprise value and environmental performance.

In terms of green insurance, although it is still in its infancy, it has begun to play a role in some fields such as catastrophe insurance and environmental liability insurance. These insurance products help alleviate economic losses caused by environmental issues and enhance the motiva-

tion of businesses to take environmental measures.
In addition, China has made certain progress in transforming its financial policies, standards, and product areas. For example, the formulation of the G20 Transition Financial Framework and the launch of innovative financial products such as sustainable development-linked bonds have further promoted the low-carbon transformation of enterprises, especially high-carbon emission industries.
In summary, financial innovation not only enriches the products and services of green finance but also promotes environmental protection and sustainable economic development through various mechanisms. In the future, with the continuous advancement of technology and the continuous improvement of policies, financial innovation will play a greater role in environmental protection.
So how will the effect and underlying mechanism of the impact of financial innovation on environmental protection?
Financial innovation is the process of creating new financial products, services, or processes. Financial innovation has come via advances in financial instruments, technology, and payment systems. Digital technology has helped to transform the financial services industry, changing how we save, borrow, invest, and pay for goods.
Environmental protection is the practice of protecting the natural environment by individuals, groups,and governments. Its objectives are to conserve natural resources and the existing natural environment and, where it is possible, to repair damage and reverse trends.

2. Literature Review

As to the positive effect, studies emphasize the significance of green finance, and green innovation in achieving sustainable development. This research study fills the gap by studying the effect of green finance on trade-adjusted CO2 emissions, particularly in the presence of green innovation, environmental policy stringency, international trade, and economic growth for OECD countries.
The findings reveal that green finance and the innovations' magnitude of impact on carbon emission is higher, specifically at the higher quantiles. Moreover, economic growth and imports tend to have a positive impact on carbon emissions, whereas exports and environmental policy stringency decrease carbon emissions and boost environmental quality. Policymakers and regulators should therefore focus on green finance and green innovation, to mitigate trade-adjusted CO2 emissions and attain the sustainable environmental goals set by OECD countries.
As to the negative effects, so climate change and environmental protection are both significantly impacted by energy use. An urgent global problem is increased COz emissions [1]. World statistics show that carbon emissions from fossil fuels increased threefold, from 11,190 billion tons in 1965 to 34,356 billion tons in 2019 [2]. By 2030, energy-related carbon dioxide emissions are expected to rise by 40-100%, according to the Intergovernmental Panel on Climate Change (IPCC) [3]. Numerous countries actively seek strategies to lower greenhouse gas emissions due to environmental degradation and climate change severity. The "quick zero" and "net zero" schemes, which can ease the transition to a new energy system, protect the environment, and lessen the climate change catastrophe, have grown to depend heavily on renewable energy (RE) [4,5]. Both fossil fuels and RE must be considered when assessing how energy use affects carbon emissions and climate change [6,7]. As a result, the new viewpoint on RE enables the construction of an established theoretical framework for the energy-environment-climate nexus.
The accord mandates that all nations cut carbon emissions and adjust to the impact of climate change. However, the empirical progress towards these objectives has been sluggish at best, and environmental degradation remains a significant worldwide issue. This study is limited to the UAE and Saudi Arabia; further research can be possible by considering the emerging economies through other factors such as environment decentralization, financial development, geopolitical risks, etc [8,9,10].

3. Methodology

3.1 Review Method

The review method involves a systematic examination of existing literature on the subject of financial innovation and its impact on environmental protection. This methodology aims to aggregate, analyze, and synthesize information from various sources to identify key trends, theories, and empirical findings. The review process typically includes searching academic databases, selecting relevant studies based on predefined criteria, and then critically evaluating and summarizing the information to provide a comprehensive understanding of the topic[11,12].

3.2 Case Study Method

The case study method is an in-depth investigation of a particular instance or example, such as a company, an event, or an intervention, to understand complex phenomena within their real-world contexts. In the context of this study, the case study method will be used to examine specific instances where financial innovation has been employed to support environmental protection. This will involve looking at the details of the implementation, the stakeholders involved, the processes followed, and the outcomes achieved. Case studies can provide rich, empirical data that can offer insights into the effectiveness and potential challenges of financial innovations in environ-

mental projects [13,14].

3.3 Statistical Method

The statistical method refers to the use of mathematical techniques and algorithms to analyze numerical data. In the context of this research, statistical methods will be employed to quantify the impact of financial innovation on environmental protection. This may involve analyzing datasets containing information about financial investments in green projects, measuring changes in environmental quality indicators, or assessing the economic performance of sustainable businesses. Statistical tools such as regression analysis, hypothesis testing, and data modeling will be used to conclude relationships and trends in the data, to make predictions or inform policy decisions related to financial innovation and environmental sustainability [15,16].

4. Case Study

4.1 Over descriptions in China

The proposal of China's carbon peak and carbon neutrality goals contains huge potential for economic growth and technological innovation, bringing a historical opportunity for the rapid development of green finance and financial technology. China's 2021 government work report and other important documents have put forward specific work requirements for achieving carbon peak and carbon neutrality targets. The financial supervision departments, including the People's Bank of China, the China Banking and Insurance Regulatory Commission, and the China Securities Regulatory Commission, have listed financial support for carbon neutrality as a top priority for 2021, and have made technological innovation a top priority. The People's Bank will continue to explore the development of green finance using financial technology. The prospect of using big data, artificial intelligence, blockchain,and other financial technology in green finance is very promising.

In 2020, there were 59 financial technology companies active in China's green finance sector, including 41 green finance technology companies and 18 technology service companies under financial institutions or financial investment groups. Through a tracking survey and analysis of the 41 Chinese financial technology companies that primarily serve the green finance sector, we found that: From the perspective of green finance business, the use of financial technology tools is mainly concentrated in green credit, green funds, green energy markets, green bonds and other business areas. Of these, the use of these tools in green credit and green fund business areas is higher, while it is relatively lacking in the environmental rights market, green trust, and green leasing business areas.

From the perspective of application scenarios, financial technology tools are used in a wide range of ESG investment and financing, national carbon market trading, green buildings, green consumption, green agriculture, small and micro enterprises,and other fields.

From the basis of data and tools, financial technology is widely used in environmental data, ESG data and evaluation, environmental benefits calculation and risk monitoring, information sharing systems,and financial institutions' green credit information management systems. The application of financial technology in green asset identification and tracking, environmental and climate financial risk quantitative evaluation,and credit risk management has become the next demand.

From the perspective of application subjects, green financial technology mainly serves government agencies, financial supervisory departments, financial institutions, enterprises, and individual users. In terms of project numbers, local financial regulatory authorities account for around 50% of the total, while central financial regulatory authorities and individual users have only one project each, namely, providing green financial regulatory services to central financial regulatory authorities and targeting individual carbon footprints and carbon credits.

In terms of technology application, big data, artificial intelligence, and cloud computing are still the three main technologies driving green finance development in China. Blockchain and IoT applications are relatively fewer, but it is foreseeable that they will see rapid development and application in the future as they are used for full-process real-time information collection.

In terms of regional distribution, the green finance technology enterprises in Beijing and Shanghai have significant clustering effects. Among them, Beijing has 16 enterprises, ranking first nationwide; Shanghai's registered capital ranks first nationwide, exceeding 1340 million yuan; about 80% of green finance technology professionals are concentrated in Beijing and Shanghai.

In terms of capital flow, the attention of international capital to China's green finance technology is increasing. In this survey, nearly a quarter of green finance technology companies are foreign-funded or joint ventures, including six technology companies registered overseas that provide green financial services in China, such as green funds, green energy markets, and carbon finance.

Based on a survey and analysis of 41 Chinese financial technology companies that specialize in green finance services, this graph presents the distribution of their main financial technology applications, green finance business areas, application scenarios, service targets, and company registration regions.

The "Green Credit Card" project, launched by China's Agricultural Bank in 2018, aims to promote green finance

in rural areas by providing financial incentives for environmentally friendly agricultural production. The project has been expanded to cover more counties and has seen a significant increase in the number of participating farmers and enterprises. In addition, the project has been replicated in other provinces, and the bank has launched a new version of the "Green Credit Card" to provide more comprehensive services.

The "Green Credit" project, launched by China's Industrial and Commercial Bank in 2019, provides financial support for small and medium-sized enterprises (SMEs) to promote green finance. The project has expanded to cover more cities and counties, and the number of participating SMEs has increased significantly. In addition, the bank has launched a new version of the "Green Credit" to provide more comprehensive services.

The "Green Credit" project, launched by China's Construction Bank in 2019, provides financial support for real estate developers to promote green finance. The project has expanded to cover more cities and counties, and the number of participating real estate developers has increased significantly. In addition, the bank has launched a new version of the "Green Credit" to provide more comprehensive services. Since the system was officially launched in August 2019, the People's Bank of Huzhou Branch has achieved precise information statistics, comprehensive information management, and performance evaluation for all banks in its jurisdiction. In 2020, the green credit data reporting interface of all banks that had accessed the system was upgraded, ensuring consistency with the green loan statistics of the People's Bank of China. Currently, the branches of the People's Bank of all prefecture-level cities in Zhejiang Province are also using the system. The next stage will be to widely apply and promote it in the Yangtze River Delta region.

Since the platform was launched at the end of 2018, by the end of 2020, it had accumulated nearly 30,000 small and micro enterprises, twice that of 2019; it helped over 20,000 green small and micro enterprises obtain bank credit of over 200 billion yuan, an increase of 25% over 2020; and it facilitated financing for nearly 90 projects and investment institutions totaling 8.644 billion yuan, an increase of 30% over 2020. In 2020, the platform also added credit guarantee and judicial guarantee functions, upgraded the ESG rating function for enterprises, and replicated and promoted it in other regions of China.

Huzhou Bank Green Credit Management System has identified and tagged approximately 40,000 credit transactions as green and intelligent, driving credit scale to prioritize support for environmentally beneficial green projects by the end of 2020. It has also at least cut the data reporting cycle by two-thirds. By leveraging big data to generate warning alerts and enhance post-loan management, the system has helped Huzhou Bank effectively improve its environmental risk management level. In 2020, the system further improved its green identification efficiency, environment benefit calculation, and ESG evaluation capabilities, and was replicated and promoted in other small and medium-sized banks in China.

After nearly five years of pilot promotion and continuous improvement, People's Property Insurance's remote disaster insurance claim settlement system has been widely promoted in Ningbo, Zhejiang Province, with significantly improved coverage, digitalization level, and data management capabilities, playing an important role in enhancing the company's ability to provide disaster risk insurance services. Two new case studies are the ESG scoring system developed by Harvest Fund using financial technology and the carbon emission management information system established by Huadian Group to support carbon trading:

As one of the ten largest and earliest established fund management companies in China, Harvest Fund is committed to in-depth ESG data mining and research in China. Its ESG research team, in partnership with Harvest Fund's Data Lab, utilized artificial intelligence, machine learning, and natural language processing technologies to develop a domestic ESG scoring system independently. The system is aligned with internationally accepted ESG frameworks and standards while fully considering and reflecting the current market situation and characteristics in China.

Harvest Fund was the first fund management company in China to build and launch an independently developed and domestically applicable ESG scoring system. It has undergone in-depth verification and practice at the investment research and product strategy levels. The system has significantly improved the quality, coverage, timeliness, investment relevance, and effectiveness of ESG fundamental data. With the proposal and implementation of China's carbon peak and carbon neutrality goals, ESG investing will receive more policy support and market attention, and its scope will gradually expand to broader areas such as climate change and biodiversity. It will also further align with international sustainable development and investment frameworks.

As the world's third largest power generation group and one of China's five major power groups, China Huadian Group has established a digital, intelligent, and visual carbon emissions management system for power enterprises based on real-time data, which has achieved functions such as carbon emissions data management, national voluntary emission reduction (CCER) project management, carbon quota compliance management, carbon trading management, intelligent analysis and decision-making,

and supervision and evaluation management.

The system has greatly improved the speed and reliability of the company's carbon emissions data acquisition, and empowered the company's carbon trading management and compliance trading strategies, not only complying with the rules of different pilot carbon markets, but also meeting the requirements of the registration and trading system for the national carbon market, providing China Huadian Group with more initiative to actively participate in the national carbon market, conduct carbon emissions right compliance trading, and manage carbon assets, thus providing strong technical support for the green and low-carbon transformation and upgrading of the enterprise. With the launch of the national carbon market, the building materials, steel, and non-ferrous metal industries will gradually be included. The system will provide reference and learning for local power enterprise groups and other large enterprise groups in other industries to participate in the national carbon market. It will also empower enterprises to manage their carbon assets through innovative technologies, utilize the price signal of the carbon market, and encourage enterprises to make green investments and undergo low-carbon transformation and upgrading.

4.2 Forestry Carbon Sinks Support Environmental Improvement and Precision Poverty Alleviation

Since June 2017, the Green Finance Reform and Innovation Pilot Zone in China has been boldly innovating and taking the lead in trying out new approaches, forming some good experiences and practices that are ready to be replicated and promoted. Forestry carbon sinks refer to the absorption of carbon dioxide in the atmosphere by plants and its fixation in vegetation or soil, thereby reducing the concentration of the gas in the atmosphere. To uphold the development concept of "Green Mountains and Clear Waters are Gold and Silver Mountains," Guangdong Province's Huadu District has taken various measures to support enterprises and the general public to participate in the development of forestry carbon sinks, forming a government-led, enterprise and public participation, market-based operation, sustainable ecological protection compensation mechanism. This mechanism promotes the effective combination of carbon emission rights trading, precision poverty alleviation, and market-based ecological compensation mechanisms, and coordinates the solution of the two major challenges of "emission reduction" and "income increase," thereby stimulating the active participation of the whole society in ecological protection and forming a virtuous cycle of ecological compensation.

Based on forestry carbon sinks, ecological compensation includes the processes of project development, emission reduction volume calculation and issuance, emission reduction volume trading, and carbon emission rights compliance. First, in combination with Guangdong's pilot work on the carbon credit system[1], qualified pilot institutions are selected to carry out project development; Secondly, calculate the carbon offset reduction volume of forest protection and forest management based on the methodology issued by Guangdong Province, and issue a certified report of carbon offset reduction volume by a third-party institution; thirdly, the pilot institution submits the project filing application and carbon offset reduction volume application, and the provincial carbon offset management department approves the provincial carbon offset reduction volume; finally, the project owner entrusts the Guangzhou Carbon Emission Right Trading Center to trade the carbon offset reduction volume, and conducts the reduction volume registration according to the trading result. After the transaction is completed, the project owner obtains the carbon sink benefit, and the control-emission enterprises can use the carbon offset reduction volume to offset their carbon emissions.

Realizing the successful reporting of the first forest carbon offset project. In February 2018, 30,000 mu of ecological afforestation in Tifamen Town, Huadu District was selected to develop PHCER (certified carbon offset reduction volume) and successfully traded. The total PHCER was 13,319 tons, with a final transaction price of about 227,200 yuan, becoming the first successful reporting forest carbon offset project in Guangzhou and achieving a win-win situation of ecological protection and rural economic development.

Promoting the integration of forest carbon sink model and precision poverty alleviation. For example, in June 2018, the Development and Reform Commission of Guangdong Province approved the registration and issuance of 30.78 million tons of emission reductions generated by forest management and forest protection carbon offset projects in 4 counties (cities) of Shaoguan City, including Yongxian County, South Xing County, Ruyuan County, and Wengyuan County. The same month, at the request of the project owners, the Guangzhou Carbon Emissions Exchange held an auction for the 30.78 million tons of emission reductions, with all of them sold, generating a transaction amount of 5.02 million yuan. This successfully increased the income of the village collectives and villagers in the 36 poverty-stricken villages and the ethnic minority villages. The ecological compensation mechanism based on forest carbon sequestration effectively combined with precision poverty alleviation, increased the income of the village collectives and villagers while safeguarding people's livelihoods, and effectively raised the villagers'

awareness of protecting forest resources. It promoted environmental protection and sustainable development.

Realize the effective combination of carbon trading, carbon offset, and ecological compensation mechanisms. The ecological compensation mechanism based on forest carbon sequestration effectively integrated the emission reductions generated by forest resources into the carbon market, effectively combining the carbon emissions right trading system, carbon offset system, and ecological compensation mechanism, protecting green mountains and rivers while achieving economic benefits.

Leverage the synergistic effect of ecological compensation and precision poverty alleviation. According to the distribution of resources in our country, forests, grasslands and wetlands that sequester carbon are mostly located in economically less developed regions. Integrating forestry carbon sequestration into ecological compensation and incorporating forest carbon offset quota into the mechanism of carbon reduction, a market-based, long-term compensation mechanism has been formed between high-energy consumption and high-emission regions and economically underdeveloped ecological functional areas, effectively combining ecological compensation with targeted poverty alleviation and playing an important role in improving the efficiency of targeted poverty alleviation.

Enhance forest resource protection capacity. The ecological compensation mechanism based on forest carbon sequestration has explored an effective pathway to realize the value of forest ecological benefits, which is conducive to further stimulating the enthusiasm of forestry operators to carry out afforestation of protected forests and develop forest-based economy, thereby reducing deforestation and enhancing forest carbon sequestration capacity.

4.3 Practice the green development concept and systematically advance green finance implementation

At present, financial institutions are following the national policy and embedding green development into their overall strategies. Commercial banks, securities companies, trust companies, and publicly traded funds are actively practicing the green development concept and systematically advancing the construction of a green financial system, forging and strengthening distinctive green financial service capabilities. ICBC has made green finance a development direction for the bank, continuously conducting innovation in green finance and using the "1+N" approach, which involves various financial tools such as loans, bonds, equity, agency, leasing, and consulting, to provide comprehensive financial support for green industries and effectively expand the width and breadth of financial services and ecological environmental protection.

The Industrial and Commercial Bank of China (ICBC) has gradually formed and improved its organizational structure and institutional mechanism for green finance after years of innovative exploration, and has built a group-wide green financial product and service system that includes green loans, green bonds, green leasing, green trust, and green funds.

ICBC has formulated a five-year plan for green finance and launched four categories of products, namely "Green Investment Access, Green Financing Access, Green Supply Chain Access, and Green Camping Access," to comprehensively build the "Fenghe" green financial product system. In addition, the bank has actively served the national carbon market by strengthening carbon finance exploration. Jiangsu Bank has made green finance a key direction of specialized operation and established an environmental and social risk management mechanism. It has also built a relatively complete specialized organizational structure, making it the only city commercial bank in China to have adopted both the Equator Principles and the United Nations Principles for Responsible Banking. Suzhou Bank has continued to strengthen its comprehensive management of environmental and social risks, issuing the "Suzhou Bank Green Finance Credit Implementation Opinion" to guide credit funds towards green industries and assisting in the development of the Suzhou Green Low-Carbon Integrated Financial Service Platform. Hangzhou Bank has implemented a green finance work coordination mechanism, established a three-in-one green finance organizational structure at the head office and branches, and promoted the construction of a carbon-neutral bank, as well as enhanced product and service innovation, with the successful implementation of the first carbon emission quota mortgage loan project for listed city commercial banks.

Securities companies, publicly traded funds, and trust institutions have also been actively taking action to promote green development. Guotai Junan Securities has built a comprehensive carbon finance service system that leads the securities industry, implementing the "Guotai Junan Action Plan for Achieving Carbon Peak and Carbon Neutrality"; it has also established the first carbon finance business team in the securities industry and conducted a series of innovations in carbon finance transaction business. Shanghai Trust has promoted green development through green trust and leveraged its leading advantage in asset securitization business to provide in-depth support for green transportation and new energy vehicle industries, issuing the first green auto loan ABS project in the entire market and the largest green auto loan ABS project in the country. At present, China has formed a multi-layered green finance product and market system, including

green loans, green bonds, green insurance, green funds, green trusts, and carbon financial products. Financial institutions, as the main participants in green finance, have continuously explored innovative paths for green financial products based on their unique characteristics and have achieved significant progress.

Green energy industries and carbon reduction projects are the key areas of focus for financial institutions in their representative green financial practices. Among them, Nanjing Bank has targeted hot areas such as carbon emissions and carbon trading and innovatively launched the first national financial product that links the carbon quota of controlled emission enterprises with loan interest rates - "Xin Jianan", which uses the loan interest rate adjustment mechanism to encourage controlled emission enterprises to increase technological upgrading and reduce carbon emissions. Jiangnan Rural Commercial Bank launched "Chun Fu Low-carbon C2111 Period 01" to support the development of new energy technology and infrastructure, aiming to promote energy conservation and emission reduction, and provide financial support for enterprises and projects that improve the environment.

Chang'an Bank's "Xi'an High-tech Zone Tramway Test Line Project Debt Financing Plan" has helped improve the level of public transportation services and regional quality in the area, and is the first enhanced control merger and acquisition debt financing plan in the country. The "Xingshan County Zhaojun Town Tanping Village Sanlihua Photovoltaic Power Station" project of Hubei Bank focuses on the environmental protection industry and its development and construction will fully utilize solar power generation to support the energy supply and economic development of Hubei Province. The "High-standard Residential Green Building Performance Insurance" launched by China Property Reinsurance Company provides a full set of product solutions and reinsurance capacity support for direct insurers, helping the Beijing High-standard Residential Green Building Performance Insurance project to run smoothly.

Supporting the high-quality development of green industries in a supply chain finance form is also one of the effective means to achieve the "dual carbon" goal. Shanghai Rural Commercial Bank is positioned as "the bank with the greenest development background in the Yangtze River Delta region" and takes the Jinongleidai product as the lever to provide systematic financial services to users on the supply chain, with loan funds specifically used for purchasing green organic agricultural inputs and biological organic fertilizer packages that meet the requirements of the "Double Reduction Project". China Post creates a green supply chain ecosystem model for shoe and clothing enterprises and guides more industry enterprises to implement eco-textile strategies, aiming to explore a new path of green high-quality development for the shoe and clothing industry and promote the overall improvement of the operating level and core competitiveness of shoe and clothing enterprises.

Strongly promoting ESG investment to build a solid foundation for green high-quality development ESG is one of the key reform approaches to developing social responsibility investment and improving the business environment. With increasing attention from domestic and foreign markets on ESG, financial institutions are actively promoting ESG-responsible investment, continuously improving their ESG product lines and deepening their ESG investment research capabilities.

Jiashi Fund fully leverages its investment research expertise to develop its "Jiashi ESG Scoring System" and actively promotes financial resources to flow towards quality enterprises. Huaxia Wealth Management, as a signatory to PRI, continues to disseminate sustainable investment concepts in the domestic financial market and integrates ESG factors into the entire investment decision-making process. XinYin Wealth Management, in partnership with Zhongzheng Index, has launched the "Zhongzheng XinYin Coastal Core Economic Belt ESG Select 100 Index", which is the first cross-market ESG equity index designed and customized by a bank wealth management subsidiary in China. Huaxia Fund, in partnership with its strategic partners, has launched the world's first cross-border responsible investment fund investing in China's equities, which is the world's first UCITS product with an ESG strategy managed by a Chinese fund management company. Nanfang Fund continuously improves its ESG management organizational structure, promotes and monitors the implementation of ESG investment strategies, and continuously launches innovative products including green investment and technology investment to enrich the ESG product supply. The report of the 20th CPC National Congress stresses that "green development should be promoted to achieve harmony between man and nature." Financial institutions and enterprises are fully committed to green development concepts and are making their due contributions to the construction of ecological civilization. The "Water Conservancy and Environmental Protection Water Treatment Fee Revenue Right Changjiang River Ecological Protection Green Asset Support Special Plan" established by Huatai Securities Asset Management as the special plan manager is an exchange-traded green asset securitization product, providing a successful and replicable case for central enterprises to carry out green financial practices. Xiamen Airlines launched the country's first "carbon neutral" flight tickets, with each ticket sold being offset by a certain portion of "ocean carbon sinks" and the

carbon offset payment being used for mangrove ecological restoration projects and biodiversity protection. Shanghai Water Group creatively leveraged the advantages of water conservancy engineering by constructing the "Shanghai Chongming Dongtan Bird National Nature Reserve Interflowing Miscanthus Ecological Control and Bird Habitat Optimization Project," providing a typical case and beneficial experience for domestic and international coastal wetland ecological restoration. The "Low-carbon Park and Energy Consumption Management Platform Construction Project" launched by Shenzhou Information aims to provide carbon emission calculation, low-carbon consulting, finance, and technology support services to emission control units by building a carbon asset comprehensive management system, thus maximizing the role of carbon asset management in enterprise management.

Climate governance has become a universal consensus globally, and the dual-carbon goal has further guided all sectors of society to transition towards a green and low-carbon direction. In the process of green development, financial institutions have been exploring green financial models and development paths, constantly seeking the optimal balance between social effects and economic benefits for sustainable development; real enterprises, on the other hand, have been using "financial water" wisely, leveraging financial power to accelerate their own green transformation and upgrading.

The organizer of the Green Finance 60 Forum, a leading think tank on green finance, stated that the current period is a crucial time for the comprehensive green transformation of economic and social development, and that green finance is well-timed. We sincerely hope that financial institutions and industrial companies can better leverage their product and service innovation advantages and low-carbon technology R&D capabilities, and that the Green Finance 60 Forum will work together with all sectors to promote industry standards and deepen industrial-financial synergy, contributing more Chinese cases and wisdom to sustainable development.

5. Discussion and Policy Suggestions

5.1 Discussion

With the rapid development of the green finance market, financial institutions are increasingly applying financial technology in scenarios such as innovation of green finance products, identification of climate and environmental risks, process management and integration, and the demand for financial technology is becoming more and more urgent. At the same time, the development of green finance with the support of financial technology still faces many challenges from policy, market and technology perspectives. The main manifestations are as follows:

There is a lack of specific policy guidance supporting financial technology in the field of green finance. The relevant departments have not yet carried out a systematic summary and promotion of the existing successful application cases.

There is no regulatory sandbox for green finance innovation. China has set up regulatory sandboxes in Beijing, Shanghai,and other places, but there is no support for green finance. There are almost no green finance products that have entered the regulatory sandbox, and no specific measures for financial technology services supporting green finance products have been proposed by the regulatory sandbox pilot areas.

The data supporting green finance technology is not traceable and is of poor quality. Despite the fact that government departments have done a lot of work on the open and sharing of public data, there are still problems with outdated data, lack of traceability, and low data quality, which have led to high costs, low efficiency, and poor reliability in the use of green finance and technology. In the future, because data cannot be traced, relevant financial technology products will not be able to provide good support for the monetary tools and regulatory accountability of the central bank.

Financial institutions rarely have clear and specific strategic development goals for using financial technology for green and low-carbon transformation. Financial institution decision-makers have an insufficient understanding of using and coordinating financial technology for green and low-carbon transformation.

Financial institutions have insufficient resources allocated to green finance technology. In promoting the deep integration of financial technology and green finance, financial institutions' strategic planning, organizational structure design, and human and financial resource allocation are crucial.

There is a shortage of specialized personnel in green finance technology, and related training is lacking. The lack of dual-skilled professionals who are proficient in both green finance and financial technology is a prominent problem facing the development of green finance technology. The lack of professional talent will lead to a series of problems in the design, application, and innovation of green financial technology products, which cannot guarantee the implementation effect of the green financial development strategy and the green financial technology development plan. At the same time, there is a lack of vocational skills education, and training for green financial technology.

Green technology enterprises have relatively less investment in the research and development of blockchain,

IoT, etc. in green finance. The research group observed that the main investment of technology companies was concentrated on solving efficiency problems in scenarios such as applying big data, artificial intelligence, and cloud computing to improve green standards, project identification, environmental benefits calculation, and ESG index compilation. However, there is a lack of innovation and application of technologies such as blockchain and IoT that can solve the problems of information transparency, reliability, and traceability.

5.2 Policy Suggestions

Given the problems and bottlenecks faced by green financial technology, we propose the following suggestions from different perspectives of regulatory authorities, financial institutions, and financial technology enterprises:

Establish a regulatory sandbox to support green financial technology. The sandbox can encourage innovative use of blockchain technology to establish project pools for green bonds and green asset securitization products as underlying assets, providing real-time disclosure of project risk situations and environmental benefits to investors, thereby reducing third-party verification costs, improving bond issuance efficiency, and enhancing information transparency. Utilizing the sandbox regulatory mechanism, support for green asset cross-border transactions can be provided, encouraging the use of blockchain technology for the registration and accounting of foreign funds, and providing for the real-time, low-cost, and tamper-proof monitoring and recording of the returns and changes in investment institutions of foreign funds. At the same time, using blockchain records, the system can provide transaction and return records during the redemption process, enabling quick completion of redemption procedures.

Establish an efficient green financial statistical monitoring and management system. Utilize blockchain technology to record the sources and identification and verification process of green and low-carbon projects and assets, and improve the efficiency of environmental benefits measurement and risk quantification through big data and artificial intelligence methods. Improve the efficiency of green financial business data reporting and statistical analysis while achieving traceability and anti-greenwashing effects.

Establish a complete and effective non-financial data information-sharing platform. We suggest that regulatory authorities further exercise their management department responsibilities by integrating and sharing enterprise and public information. Integrate environmental punishment information, enterprise pollution discharge permit information, green project feasibility reports, credit data, etc. into a unified public data information sharing platform. Standardize and standardize the integrated shared data, and unify the data source annotation to solve the problem of outdated data, and achieve data traceability.

Establish a carbon emissions data-sharing platform. Suggested that relevant departments use blockchain, cloud technology, etc. to establish a carbon emissions data sharing platform to establish an efficient carbon emissions accounting and information disclosure mechanism, including but not limited to national carbon market industry carbon emissions data and enterprise carbon emissions data. Explore carbon emissions data integration and individual/enterprise carbon footprint calculation.

Develop a green financial technology development plan and increase resource allocation to green financial technology. Formulate financial technology-driven green financial development strategies, key tasks, and support measures, and establish corresponding institutional mechanisms, talent teams, and technological reserves.

Utilize financial technology to establish an ESG database and evaluation capacity. It is suggested that financial institutions leverage financial technology to standardize internal data information, and integrate external data resources from various sources such as local big data bureaus, financial comprehensive service platforms, and national carbon market exchanges, to enhance their green identification and environmental risk management capabilities, and to strengthen risk management, green operation, and information disclosure with carbon neutrality as the goal. Utilize big data and AI technologies for the identification and classification of green and brown assets. Utilize big data and cloud computing for the statistical analysis and disclosure of green and brown assets, comprehensively measuring the transformation risks of credit assets. Utilize big data, cloud computing, and AI technologies for ESG evaluation and business process inclusion of enterprises and projects, enabling the application and management of non-financial information-based credit risks. Utilize blockchain technologies for carbon emission calculation and disclosure in investment and financing activities. Calculate and disclose the carbon emissions and carbon footprint of financial institutions themselves, and automatically generate environmental information disclosure reports.

Develop green ESG-themed products using financial technology innovation. It is suggested that financial institutions integrate green ESG strategies into the innovation process of financial products, and improve the green financial product system. 1. Suggestions for financial institutions

Focus on developing green supply chain products and services supported by blockchain technology. Leverage the reliable and traceable features of blockchain to enhance the transparency of green supply chain financing infor-

mation for enterprises, and provide technical and data product services for financial institutions to develop green supply chain-related products. For example, apply blockchain technology to label, trace, and provide convenience for financial regulatory authorities in standard promotion, auditing, and anti-green washing technological application scenarios.

Develop green financial technology products and services for financial institutions using big data and artificial intelligence. For example, generate ESG credit portraits for creditors using big data and artificial intelligence technology, and fully integrate them into the credit management process. In the personal green consumption credit field, use big data and artificial intelligence to form green consumption behavior portraits, and explore innovative applications of personal green credit evaluation.

Focus on developing carbon emission accounting products and services for financial institutions. For example, to tackle the difficulties in carbon emission accounting for financial institutions, artificial intelligence can be used to calculate carbon emissions and trace the carbon footprints of loan applicants, automatically generating environmental information disclosure reports.

Train specialized professionals with comprehensive skills in financial technology and green finance. It is suggested that green financial technology be included in the higher education talent cultivation system to cultivate high-end, cross-disciplinary, composite professional talents. Active social training in green financial technology vocational skills should also be carried out, providing green financial technology and ESG training to supply the market with solidly capable technological talents.

Actively introduce advanced green financial technology from abroad. Actively introduce and popularize internationally advanced green financial technology to solve key problems in green asset identification, transition risk quantification, and data traceability.

Actively promote international capital cooperation in green financial technology. Actively introduce international investors to promote international cooperation in the green financial technology field and drive the rapid and healthy development of the green financial technology industry in China and even globally.

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