

Research on Empowering the Development of Green Finance in the Yangtze River Delta Economic Belt with Digital Economy

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Abstract

This article constructs a model of the development trend of green finance under the influence of various factors such as big data and the Internet of Things through literature review and personal practice. Based on the pattern of domestic "dual carbon" environment driving the vigorous development of digital economy, it solves the problem of the effect differences under traditional financial system, credit constraint mechanism, and financial supervision on the development of green finance. At present, green finance in the Chinese market is only at a relatively large scale, but it has broad development prospects and can further break through with the development of the digital economy. Therefore, exploring it, finding the right direction and reasonable development strategies can improve the quality and efficiency of China's financial market.

Keywords

"Dual Carbon" Goals; Green Finance; Digital Economy.

1. Introduction

1.1. Research Background

On September 22, 2020, General Secretary Xi Jinping announced at the general debate of the 75th United Nations General Assembly that China's carbon dioxide emissions will strive to reach the peak by 2030, and strive to achieve carbon neutrality by 2060. General Secretary Xi Jinping repeatedly reiterated China's "dual carbon" goal and stressed that it should be resolutely implemented. In March 2021, the "dual carbon" goal was included in the "14th Five Year Plan" and the long-term goals for 2035. At the 20th National Congress of the Communist Party of China (CPC) in 2022, General Secretary Xi Jinping pointed out that "promoting green and low-carbon economic and social development, and promoting the effective improvement of quality and reasonable growth of quantity of the economy".

In recent years, China's green finance has flourished, providing important support for funding needs and resource optimization in related fields. The development of green finance should be in line with the dual carbon work at the macro level, fill the gaps in infrastructure at the meso level, and promote precise matching of financial product supply and demand at the micro level. China will incorporate the development of green finance into the carbon peak and carbon neutrality "1+N" policy system, and the green finance system will continue to improve. Some regions are taking the lead in exploring models that use green finance to assist in optimizing regional industrial structure and improving ecological environment; Many financial institutions are actively developing green financial products.

1.2. Innovation Points and Characteristics

The study considered multiple factors. In order to examine the mechanism of the effect of green finance on the development of the digital economy, various factors such as the degree of

advanced industrial structure, environmental regulations, per capita GDP, urban-rural income gap, and government intervention were considered from multiple perspectives. Then, the comprehensive effect of green finance on the high-quality development of the digital economy was elaborated.

The asymmetry of the research object. Mainly targeting green finance products such as green credit, green bonds, and green funds.

The dynamism of the model. Traditional research often uses static models to analyze, but in reality, there are many factors that affect green finance, which is a dynamic and changing process. This study can more accurately analyze the future direction of green finance by establishing benchmark models and intermediary models, taking into account policy factors, the impact of policy loopholes, and the uncertainty of policy implementation.

Multidimensional measurement considering policy stability. The traditional measurement of policy stability usually only considers the time interval of policy formulation and the consistency of policy implementation. However, in reality, policy stability also involves multiple aspects such as policy predictability, changes in policy background, and transparency in policy formulation. This study can comprehensively consider stability from multiple perspectives and explore multidimensional measurement methods for policy stability.

1.3. Research Significance

1.3.1. Theoretical Significance.

Green finance is an important guarantee for maintaining sustainable economic development. Developing green finance is an inevitable path to promote the current adjustment of China's economic and financial structure, achieve sustainable economic and environmental development, and is the direction of China's future financial development. It is also an innovation and transformation in China's financial field. Green finance has shown great potential and value in promoting the green and low-carbon transformation of the whole society. Looking towards the future, it can empower and increase efficiency for China's high-quality development.

1.3.2. Realistic Significance

Green finance can promote the linkage between the capital market and the carbon market, enabling the capital market to assist the carbon market in improving its price discovery function, enabling the carbon market to assist the capital market in more effectively optimizing resource allocation, and jointly supporting the green, low-carbon, and high-quality development of China's economy and society.

1.4. Literature Review

The concept of green finance was first proposed in 1991, and the United Nations Conference on Environment and Development adopted the Rio Declaration on Environment and Development and Agenda 21 (1992). Environmental protection and emissions reduction became the focus of attention, and green finance was promoted. Guo Shuhua et al. (2003) believe that issuing green bonds is beneficial for improving the green finance system, and empirically analyze the factors affecting the interest rate of green bond issuance in Chinese enterprises by using weighted least squares method to construct a multiple regression equation. Lietal (2015) reviewed the progress and achievements of green finance research in recent years, including the concept and definition of green finance, policy and institutional environment, market development, and green finance products, providing reference for green finance research. Cao et al. (2022) studied the market performance of green financial products and the investment decisions of institutional investors, and found that green financial products have good investment returns and risk control capabilities. Zhang Xiufan et al. (2023) studied ways to promote the development of the digital economy and support China's transition to a low-carbon economic

development model, based on China's active promotion of the dual carbon goals of "carbon peaking" and "carbon neutrality", and proposed countermeasures and suggestions for further developing the digital economy.

2. Overview of Research on Green Finance

2.1. Proposed Problem Solving

2.1.1. How to Solve the Problem of Imperfect Green Finance Policy Framework and Governance System

Our country's green financial products have not received macro guidance or recognized shares from the government. On the other hand, the state does not strictly define the responsibilities and obligations between major departments, nor does it have clear boundaries of jurisdiction. Our country's green financial products lack overall strategic planning guidance, relying solely on national theoretical promotion, which is completely unable to meet the overall development of green financial products. In order to achieve development, it is necessary to carry out some detailed industrial chain planning, and if the entire industrial chain can cooperate directly.

2.1.2. How to Strengthen China's Financial System

Our country's green finance system has developed and has inherent fragility. Since the International Monetary Fund officially evaluated our country's financial sector for the first time and announced some data reports, the International Monetary Fund stated in the report that although our country's financial system is in a stable state, some drawbacks are constantly being exposed, and fragility is also constantly emerging. Under the influence of global economic globalization, the financial system is becoming increasingly complex, and the global economy is becoming more unstable and risky. At the same time, China's financial reform has not been able to keep up with the pace of major international changes, which puts higher demands on the transformation of China's financial system. It is necessary to increase the commercialization of the financial sector. At the same time, utilizing its financial regulatory measures to maintain the stability of China's financial system and promote the development of China's financial sector.

2.1.3. How to Strengthen Policy Signals

Our country's green finance has not yet formed a complete system, and the government has not clearly introduced relevant policies, and the policy signals are not clear enough. Even if the government has some policies, these policies are not fully in line with the actual situation, which will lead to these financial institutions not having the enthusiasm to produce. These factors ultimately lead to insufficient implementation of national policies. At present, the government has not been able to introduce some incentive policies, which is very unfavorable for improving the production enthusiasm of financial institutions. It is precisely these green financial products that have been hindered in the market, thus seriously hindering the green and environmentally friendly economy.

How to enhance the role of financial institutions in green finance?

In order to guide the people to establish the concept of green development, protect the environment, and reduce pollution, China has established green insurance. Green insurance, as an internationally recognized insurance, can enable these enterprises to purchase insurance in advance for the damage caused to the environment, if these enterprises cause significant damage to the environment during their production process. So there will be insurance companies to compensate. However, for some large enterprises, green insurance may not be able to solve their pollution problems. So, it is necessary to establish a responsibility system for pollution and improve China's green finance management system. We should also actively learn from foreign systems. However, we must not copy foreign systems, we should take their essence. Adopting a system suitable for China's national conditions, we can make new attempts

on some enterprises with severe pollution, or implement punitive measures on these enterprises with relatively high pollution. For those that cause significant environmental damage, we should implement a liability compensation system for them.

Until now, China has not fully implemented the pollution responsibility system, and it has only been implemented first in a small number of regions. It is also very difficult to promote the pollution responsibility system comprehensively in China. We need to work together with the environmental protection department to contribute our efforts to the development of green finance in China. Our financial institutions must strictly implement the principles of the Scientific Outlook on Development and continuously implement measures for energy conservation and emission reduction.

Major financial institutions in China also need to implement a green credit responsibility system for their enterprises, which puts higher environmental requirements on these modern enterprises. They need to supervise all aspects of their production, and reject those that do not meet the standards with one vote. China should increase its support for new energy enterprises. At the same time, it is necessary to investigate the fundraising of enterprises, promote strict adjustment of industrial structure, and continuously eliminate some outdated processes.

2.1.4. How to Expand the Innovation Power of Green Financial Products

The coverage of green financial products is small and the innovation level is not high. There is a characteristic in the design of green finance products in our country that only focuses on financing channels and neglects financing targets, mainly targeting large environmental protection enterprises and large clean energy, energy conservation and emission reduction projects. There are very few green finance products targeting small and medium-sized environmental protection enterprises, individuals, and households, which makes it difficult for green finance products to penetrate various fields of society and limit their influence. In the context of dual carbon, the development of green finance has ushered in very favorable opportunities. How to seize the trend of "dual carbon" and innovate green finance; How to perfectly integrate green finance with the digital economy is a question worth exploring and researching, as the digital economy can better empower and improve the quality and efficiency of green finance.

2.2. Wide Development Prospects

2.2.1. The Empowering Role of the Digital Economy

In October 2021, the State Council issued the Action Plan for peaking carbon emissions before 2030, proposing to promote the integrated development of digitalization, intelligence, and greenery in the industrial sector. The digital economy, with its precision, promotes the high-quality development of green finance. The digital economy can form a network like open ecosystem through digital technologies such as big data and cloud computing, providing upstream and downstream linking platforms for green finance, establishing information sharing mechanisms, ensuring information security and effectiveness, improving investment and financing matching efficiency, reducing the risk of information mismatch, thereby increasing investment and financing scale, and helping green finance better integrate into the industry chain and value chain.

The digital economy promotes high-quality development of green finance with its "inclusiveness". The innovation of digital technology can lower the threshold for data acquisition, enhance the universality of financial investment and financing, and enable groups with limited financial professional knowledge to access more high-quality financial services. Relying on the inclusiveness of the digital economy, financial institutions can integrate and gather more idle social funds and high-quality financial resources, and invest these resources into economic operation, which provides the possibility of rational use of more social capital

for the high-quality development of green finance. Only by solving the problem of long tail groups accessing financial services can the problem of uneven economic development be solved; Only by obtaining financial support can we provide an economic foundation for the development of more underdeveloped areas and create conditions for the formation of a more reasonable industrial system. The integration of digital economy and green finance can improve the efficiency of enterprise financing.

2.2.2. Promoting Effects under the "Dual Carbon" Environment

Green development is the fundamental solution to environmental problems and an inevitable requirement for building a modern economic system. In the context of green development, the transformation and development of traditional industries may become a key point in achieving carbon peak, and the transformation of traditional industries provides application scenarios and goal orientation for industrial digitization. Ultimately, through the integration and development of green finance and digital economy, the "green finance+digital" structure is achieved. The transformation of green finance is a systematic engineering problem that China needs to solve in the process of achieving the dual carbon goals of "carbon peak" and "carbon neutrality".

2.3. Research Fundamentals

2.3.1. Data Foundation

Collect and organize carbon emission data from the past few years, benchmark the development of green finance, and identify the influencing factors between the two. By constructing a differential sliding window model, utilize its advantages to capture the nonlinear characteristics of the data; Determine parameters such as window size and step size, perform sliding calculations on the data, and obtain the output of the differential sliding window model; Compare the performance of differential sliding window model and other traditional models (such as OLS model) in predicting carbon emissions.

2.3.2. Model Foundation

By creating a benchmark model:

$$ED_{it} = C + \alpha_0 GF_{it} + \sum_{j=1}^n \alpha_j \text{control}_{it}^j + \varepsilon_{it}$$

Study the quantitative relationship between the digital economy and green finance, and evaluate the comprehensive effect of the digital economy on the high-quality development of green finance under control variables such as the degree of industrial structure upgrading, environmental regulation, big data, digital financial system, and government intervention, using an intermediary model derived from the benchmark model.

Baker et al. (2021) studied the market performance of green financial products and the investment decisions of institutional investors, and found that green financial products have good investment returns and risk control capabilities, and are also increasingly favored by institutional investors. Zhang Xiufan et al. (2023) studied ways to promote the development of the digital economy and support China's transition to a low-carbon economic development model, based on China's active promotion of the dual carbon goals of "carbon peaking" and "carbon neutrality", and proposed countermeasures and suggestions for further developing the digital economy. The "Research Review on Domestic Green Finance Based on Bibliometrics" (Deng Wenyi, 2023) focuses on themes such as financial development, economic green transformation, green financial products, and green credit. The research content evolves along five paths in four directions, and the forefront of the research shows a trend of theme fusion. At

the same time, it indicates that inclusive finance and green finance reform and innovation pilot zones will be important directions for future research.

2.3.3. Environmental Foundation

The development of green finance in the Yangtze River Delta Economic Belt ranks among the top in the country. Green finance has significant development in the Jiangsu, Zhejiang, Shanghai, and Anhui regions, and various indicator data has been increasing year by year. It is a good research object and source of data, information, and information.

Under the "dual carbon" environment, the development of green finance is conducive to enhancing the sustainability of economic development by reducing future compensation costs; Promote the allocation of financial resources to tilt towards environmental protection, and enhance the ability of the entire society to resist risks; At the same time, it helps financial enterprises cope with environmental risks and provides them with business opportunities.

2.4. Impact Mechanism

2.4.1. Macro Impact Mechanism

In the process of achieving the goals of "carbon peak" and "carbon neutrality", the low-carbon economic transformation of green finance is an important means and approach that integrates both aspects, and it is necessary to fully utilize and coordinate these two important levers. Based on panel data from provincial-level administrative regions in China, a spatial simultaneous equation model is established to examine the endogenous interactive effects and spatial spillover effects of green finance and digital economy.

There is a two-way promoting effect between green finance and the digital economy, and the development of the digital economy can effectively promote the transformation of green finance, and vice versa. Cross regional green finance has a crowding out effect on the development of green finance in other regions, and the low-carbon economic transformation in neighboring areas has also brought adverse impacts on the development of local green finance. The development of green finance in neighboring areas has a promoting effect on local low-carbon economic growth, and the expansion of the digital economy in neighboring areas has a positive promoting effect on local green finance development.

2.4.2. Micro Impact Mechanism

The imperfect green finance system limits the development of green finance. China's financial reform has not been able to keep up with the pace of major international changes, which has put forward higher requirements for the transformation of China's financial system. It is necessary to increase a reform of the commercialization of the financial sector. The financial regulatory mechanism has drawbacks that affect the development of green finance. The country has not provided macro guidance or recognized its shares. On the other hand, the state does not strictly define the responsibilities and obligations between major departments, nor does it have clear boundaries of jurisdiction. Policy information and signals affect the digital economy, which in turn has an impact on green finance. Our country's green finance has not yet formed a complete system, and the government has not clearly introduced relevant policies, and the policy signals are not clear enough. The coverage of green financial products is not broad and still needs to be further expanded. There are very few green financial products targeting small and medium-sized environmental protection enterprises, individuals, and households, which makes it difficult for green financial products to penetrate various fields of society and limit their influence. The lack of innovation power makes green finance lack the driving force for sustainable development. Under the constraints of traditional financial models, the development of green finance requires the courage to innovate and creatively transform.

The pattern of universal participation has not yet been established, and there are difficulties in promoting green finance. In the context of dual carbon, the development of green finance has

ushered in a very favorable opportunity. How to seize the trend of "dual carbon", perfectly combine green finance with the digital economy, and better empower the digital economy to improve the quality and efficiency of green finance by driving the participation of the whole population.

3. Building a Model

In order to test the effect mechanism of the digital economy on the development of green finance, a benchmark model is first established to evaluate the comprehensive effect of the digital economy on the high-quality development of green finance under control variables such as the degree of advanced industrial structure, environmental regulations, big data, digital financial system, and government intervention,

$$ED_{it} = C + \alpha_0 GF_{it} + \sum_{j=1}^n \alpha_j \text{control}_{it}^j + \varepsilon_{it} \quad (1)$$

Among them, i represents regional unit, t represents time, ED_{it} is the level of digital economic development of the i -th region at time t , GF_{it} is the level of green finance development of the i -th region at time t , and $(j=1, 2, \dots, m)$ is a series of control variables. By adjusting the coefficients of the core explanatory variables in the benchmark regression equation (1) α Conduct a test to determine if it is significant at the confidence level, in order to determine the comprehensive effect of green finance on promoting the development of the digital economy.

The impact of green finance on the development of the digital economy is achieved through two paths: technological innovation and industrial structure upgrading. In order to test the mechanism of the effect of green finance on the digital economy, the focus is on the intermediary effect, examining the mechanism by which the digital economy promotes the development of green finance through technological innovation (TI) and industrial structure upgrading (IS). On the basis of equation (1), with technological innovation and industrial structure upgrading as mediating variables added to the benchmark model, the following model is formed:

$$ED_{it} = c_1 + \alpha_{01} GF + \sum_{j=1}^n \alpha_{0j} \text{control}_{it}^j + \varepsilon_{it} \quad (2)$$

$$TI_{it} = c_2 + \alpha_{11} GF + \sum_{j=1}^n \beta_{1j} \text{control}_{it}^j + \varepsilon_{it} \quad (3)$$

$$ED_{it} = c_3 + \alpha_{21} GF_{it} + \alpha_{22} TI_{it} + \sum_{j=1}^n \delta_{2j} \text{control}_{it}^j + \varepsilon_{it} \quad (4)$$

$$IS_{it} = c_2 + \alpha_{11} GF + \sum_{j=1}^n \beta_{1j} \text{control}_{it}^j + \varepsilon_{it} \quad (5)$$

$$ED_{it} = c_3 + \alpha_{21} GF_{it} + \alpha_{22} IS_{it} + \sum_{j=1}^n \delta_{2j} \text{control}_{it}^j + \varepsilon_{it} \quad (6)$$

Use the Analytic Hierarchy Process (HRM) method to verify the mediating effect. Draw on the research of Baron and Kenny (2021), as well as Wen Zhonglin et al. (2022) in China.

4. Conclusion and Suggestions

4.1. Conclusion

Through the benchmark model and intermediary model mentioned above, it is not difficult to deduce that there is a strong positive relationship between the development of the digital

economy and green finance. The development of the digital economy will undoubtedly drive the progress of green finance. At the same time, big data, 5G, the Internet of Things, and other factors involved in the digital economy will all be the influencing factors of green finance. The development of green finance cannot be separated from the joint action of various financial products such as green credit, green bonds, green insurance, green funds, etc. Green finance will be the mainstream and direction of future financial development, and the traditional financial industry will undergo green transformation and innovative upgrading.

Green finance is an important guarantee for maintaining sustainable economic development. Developing green finance is an inevitable path to promote the current adjustment of China's economic and financial structure, achieve sustainable economic and environmental development, and is the direction of China's future financial development. It is also an innovation and transformation in China's financial field. Green finance can promote the linkage between the capital market and the carbon market, enabling the capital market to assist the carbon market in improving its price discovery function, enabling the carbon market to assist the capital market in more effectively optimizing resource allocation, and jointly supporting the green, low-carbon, and high-quality development of China's economy and society.

4.2. Suggestions

Firstly, it is necessary to establish a sound green finance policy framework and governance system. Then, it is necessary to strengthen the green finance system, followed by enhancing the innovation and creativity of green finance.

Secondly, it is necessary to expand the coverage of green financial products and strengthen policy support, and finally, to form a pattern of nationwide participation and co construction.

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