The Impact of Green Finance on Industrial Transformation and Upgrading

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Abstract. This study employs a systematic literature review and policy text analysis to explore its mechanism, cases, and dilemmas. From the perspective of capital allocation, technological innovation, policy coordination, and low-carbon transformation, this paper analyzes the logic of green finance to optimize resource allocation, support technology research and development, strengthen policy guarantees, and help low-carbon transformation, and verify its spatial spillover, regional heterogeneity, and synergy with digital inclusive finance and industrial intelligence. The study finds that green finance not only boosts the growth of emerging green industries but also promotes the low-carbon transformation of traditional, high-energy-consuming industries, providing support for the "dual carbon" goal and high-quality development. However, it faces challenges such as an imperfect system and insufficient policy coordination. Finally, the policy directions of system optimization, regional coordination, and innovation integration are proposed, and it is pointed out that long-term effects and micro-behavior analysis can be deepened in the future to provide a reference for the green transformation of the industry.

Keywords: Green finance; industrial transformation; industrial upgrading; sustainable development; policy coordination.

1. Introduction

At present, the global climate governance process is accelerating, and the weight of sustainable development goals in national policies has increased. After China put forward the "dual carbon" strategy, it not only pointed out the direction for the green transformation of traditional industries and the cultivation of emerging low-carbon industries, but also accelerated the implementation of green credit, bonds and other tools through policy dividends, injecting impetus into industrial transformation. However, the transformation of traditional high-pollution and high-energy consumption industries is still in trouble: enterprises need long-term funds for technological transformation but face financing difficulties and high costs. The rise of green finance provides a new path to solve problems, through capital allocation and risk pricing mechanisms, it not only forces the transformation of energy-consuming enterprises but also injects vitality into green industries.

Judging from the existing research, the academic community has carried out preliminary exploration on the relationship between green finance and industrial structure optimization, focusing on three dimensions: improving capital allocation efficiency, driving technological innovation, and strengthening policy orientation. Some studies have confirmed that green finance can guide resources to gather in the fields of energy conservation, environmental protection and clean energy through credit tilt to alleviate environmental pressure; Other studies have pointed out that its spillover effect can drive the optimization of industrial spatial layout in neighboring areas and promote the strategic adjustment of regional economic structure [1]. However, there are still obvious limitations in the current research: the analysis of the internal operation mechanism of green finance is not in-depth enough, especially the comparative analysis of the effects of green finance under the differences in industrial bases in different regions [2]. At the same time, in the context of the rapid development of digital finance and the acceleration of industrial intelligence, the collaborative interaction mechanism between green finance and innovative elements such as digital technology and intelligent production has not been systematically explored, and the research results are difficult to fully support the practical needs of industrial low-carbon transformation.

In view of this, this study proposes to construct a multi-dimensional analysis framework, starting from the four paths of capital allocation, technology update, policy coordination, and industrial low-carbon transformation, and comprehensively deconstructing the internal mechanism of green finance to promote industrial structure improvement. At the same time, combined with the differences in industrial development in the eastern, central and western regions, this paper deeply analyzes the regional heterogeneity characteristics of the effect of green finance, and further relates to the practical background of digital finance empowerment and industrial intelligent upgrading, clarifies the interaction and correlation logic between green finance and various innovative elements, and forms a more targeted theoretical analysis system.

This study has both theoretical and practical significance: theoretically fills the gap in the research of regional differences in green finance and the collaborative research of innovation elements, and enriches the theoretical connotation of high-quality development; In reality, it provides a basis for policy formulation, clarifies the focus and synergy path of regional efforts, provides operational reference for the green and low-carbon transformation of the industry, and helps promote the "dual carbon" goal.

2. Green Finance is A Way to Promote Industrial Upgrading

The core logic of green finance for industrial upgrading through multiple mechanisms lies in using capital as a link, combining technological innovation, policy guidance and low-carbon transformation needs to form a complete path of "resource optimization, risk constraints, and goal coordination". Although the existing research analyzes the single mechanism of action from different dimensions, it is necessary to further integrate the linkage relationship of each pathway, and point out the advantages and disadvantages of the current model in combination with practice.

On the one hand, green finance provides low-cost financing for environmental protection enterprises with green credit, green bonds and other tools to alleviate their financing constraints. According to the data, the average issuance interest rate of green bonds in China is 0.5-1 percentage points lower than that of ordinary bonds, which directly lowers the capital threshold for green projects and promotes more capital flow to the environmental protection field. On the other hand, the financing cost of high-energy enterprises is 1%-2% higher than that of green enterprises through risk pricing. It is worth noting that although the current model of "reward guidance + restriction and suppression" can quickly promote the flow of funds across industries, there are obvious shortcomings: funds are mostly concentrated in short-term visible environmental protection projects, and the support for long-term industrial chain integration and green infrastructure construction is insufficient, resulting in "short-term" resource allocation "It is difficult to support the long-term demand for industrial transformation.

At the level of capital innovation, green finance provides guarantee for green technology innovation through the dual dimension of "capital supply + risk diversification", and at the capital level, venture capital funds, green bonds and other tools have injected long-term capital into long-term R&D projects such as carbon capture and hydrogen energy applications, and the scale of China's green industry fund has exceeded 1.2 trillion yuan in 2023, of which about 30% investing in technology development stage projects, effectively alleviating the financial pressure of green technology research and development; Empirical data shows that for every unit of green finance development, the number of green technology patent applications in the region increases by an average of 5%, highlighting its direct role in promoting technological innovation [3]. However, it should be pointed out that the current support of green finance for technological innovation has the problem of "heavy investment and light transformation": most of the funds are concentrated in the Research and Development (R&D) link, and the support for the commercial application and industrial chain adaptation after the technology is implemented is insufficient, resulting in some green technologies falling into "successful R&D but difficult to industrialize" The dilemma has weakened the actual pulling effect of technological innovation on industrial upgrading.

The government guides the innovation of green financial instruments through policies such as financial subsidies and tax exemptions, such as exempting corporate income tax on green bond interest income, directly incentivizing financial institutions to expand the scale of green credit business [4]. At the same time, carbon emission trading, environmental protection standards are linked to green credit, forming a transmission chain of "environmental regulation-financial constraints-industrial transformation". The energy consumption per unit output value of high-energy-consuming enterprises decreased by about 8% within half a year, which verified the actual effect of the synergy mechanism [2]. However, this collaborative model faces the problem of "policy fragmentation" in practice: there is a "one-size-fits-all" tendency in policy implementation in some areas, and the intensity of regulation is not adjusted in combination with the actual situation of the industry. As a result, some enterprises that are in line with the direction of transformation but have poor short-term environmental performance are overly restrained, which hinders the process of industrial upgrading.

From the perspective of promoting low-carbon transformation, green finance starts from the "energy supply-production process."In 2024, green credit for photovoltaic power generation and wind power in China will account for 60%, directly driving the proportion of non-fossil fuel consumption to 18.5%. For example, the iron and steel industry uses green credit to promote waste heat recovery technology, which reduces unit energy consumption by about 15%, and the chemical industry upgrades sewage treatment equipment through green bonds, reducing pollution emissions by about 20% [1]. However, there is still an "imbalance" problem in the current support of the whole chain: the support for the energy supply side is much greater than that of the production side, especially the low availability of financing for the green transformation of production equipment for small and medium-sized enterprises, resulting in the fault phenomenon of "fast upstream and slow downstream" in the low-carbon transformation of the industry, affecting the overall transformation efficiency [5].

In summary, the four directions of green finance to promote industrial upgrading have their own focuses but are interrelated, with capital allocation as the foundation, technological innovation as the core, policy coordination as the guarantee, and low-carbon transformation as the goal. Although all directions have shown results, there are common problems such as "short-term", "fragmentation", and "imbalance", and it is necessary to further strengthen the linkage mechanism of all directions in the future to promote the optimization and upgrading of the industrial structure more efficiently.

3. The Impact of Green Finance on Industrial Structure Upgrading

3.1. Spatial Spillover Effect

The development of green finance in the core area optimizes the local industrial structure, and also has a radiating impact on the surrounding areas through technology transfer, capital flow and other mechanisms. When the Guizhou Green Fund supports the development of Guiyang's new energy industry, it uses the extension of the industrial chain to drive the coordinated development of related industries in Zunyi, Anshun, and other places, and gradually forms a regional green industrial system [6].

3.2. Regional Heterogeneity

There are obvious spatial differences in the role of green finance in promoting regional industrial transformation. The eastern region has a relatively complete financial market system. The update and iteration of green technology in the eastern region is faster. This makes the effect of green finance in promoting industrial upgrading in the eastern region more intense. According to the data obtained from the literature, by 2024. The promotion rate of green credit in the eastern region to its tertiary industry is as high as 25%.

The situation is different in the Midwest. The proportion of traditional high-energy consumption enterprises in the central and western regions is much higher than that in the eastern region. Green finance funds in the central and western regions are more concentrated in the transformation and

upgrading of existing enterprises. The central and western regions do not have sufficient support for emerging green industries. There is such a phenomenon in Guizhou Province. More than two-thirds of Guizhou's green finance funds have gone to old industrial energy-saving projects.

The situation in Guangdong Province is different from other regions. Guangdong Province is more inclined to invest green finance funds in the field of new energy. Guangdong Province also focuses on investing funds in areas related to digital environmental protection. Thus. Different regions show obvious differences in green finance resource allocation strategies.

3.3. Research on the Synergy Effect of Digital Inclusive Finance

According to relevant statistics, by 2024, the proportion of small, medium and micro enterprises in the digital green credit business will reach 40%, an increase of about 15 percentage points compared with the traditional method. Studies have shown that in areas with a high level of digital inclusive financial development, the effect of green finance in promoting industrial structure improvement has increased by 20%-30% [7].

3.4. Integration Effect with Industrial Intelligence

According to statistics, by 2024, the proportion of green finance financing in related fields will exceed 35%. After receiving green credit assistance, the energy consumption level of an automobile manufacturing enterprise is about 20% lower than the traditional practice, and the issuance interest rate of the green bond issued by the enterprise has also decreased by 0.8 percentage points compared with the normal level, which highlights the key effect of the dual-phase blessing mechanism on sustainable development [8].

4. Discussion on Green Finance to Promote Industrial Upgrading

4.1. Core Logic: Research on the Three-dimensional Linkage Mechanism of Capital, Technology, and Policy

The mechanism of green finance to help industrial transformation and upgrading has multi-dimensional characteristics, which is mainly manifested in the organic integration of capital allocation, technological innovation and policy cooperation, the supply of funds to give material support to industrial transformation, technological innovation has become the main driving force for industrial upgrading, and policy guidance provides institutional guarantee for the integration of capital and technology, and the whole process can be summarized as follows. Take China's photovoltaic industry as an example, with the support of green credit, enterprises have increased their investment in the research and development of high-efficiency battery technology, and rely on the financial subsidies and grid connection policies given by the government to reduce the risks faced in technology transformation, thereby promoting the transformation of the industry from traditional manufacturing to a high-end R&D direction. Its share in the international market has grown rapidly from about 60% in 2015 to nearly 85% in 2024 [9].

4.2. Practical Case Verification: Differentiated Practice between Regions and Industries

The practical operation of different regions and industries clearly shows the importance of green finance. From a regional point of view, Guizhou promotes the coordinated development of eco-tourism and clean energy industries through green finance, and the added value of green industries in 2024 will account for 12% of GDP, an increase of 5 percentage points compared with 2020. The new energy vehicle industry relies on green finance to achieve the upgrading and optimization of the whole chain, receives financial support from green funds in the research and development of batteries, uses green credit to solve capital needs during the manufacturing of vehicles, and promotes the construction of charging pile infrastructure by green bonds, forming a complete green industrial chain, and by 2024, the global market share has exceeded 60% [10].

4.3. Synergy of Innovation Elements: the Empowerment of Digital Intelligence

After the close integration of digital inclusive finance and industrial intelligence, the application scope of green finance has been greatly expanded, with the "accurate portrait" technology to solve the problem of information asymmetry of green projects, so that small and medium-sized enterprises can get green financing support, industrial intelligence improves the economic benefits of green investment by improving operational efficiency, and then stimulates the enthusiasm of financial institutions to devote themselves to green finance business, taking Zhejiang Province as an example, The "Digital Green Credit Platform" integrates the environmental protection data and financial information of enterprises, reduces the approval time of green loans from 15 working days to 3 days, relies on smart factories to achieve real-time monitoring of energy consumption data, and ensures that the use of funds complies with regulations, and by the end of 2024, the non-performing rate of green loans on this platform is 1.2 percentage points lower than the industry average.

5. Conclusion

This study shows that green finance is a key mechanism to promote industrial transformation and upgrading and effectively accelerates the process of industrial structure optimization and upgrading through the synergy of financial support, resource optimization and allocation, innovation incentives, policy regulation and environmental supervision. Its role shows significant spatial spillover characteristics and shows obvious heterogeneity due to the difference in regional economic level, and its function and value can be further enhanced when combined with digital inclusive finance and industrial intelligence. Green finance not only helps the growth of emerging industries such as new energy but also promotes the transformation of traditional high-energy-consuming industries to low-carbon, becoming an important force supporting the "dual carbon" goal and high-quality development. However, green finance still faces challenges such as an imperfect system, insufficient policy coordination, a lack of green technology innovation capabilities, and unbalanced regional development in helping industrial transformation.

To better play the role of green finance, policy design needs to focus on "system optimization, regional coordination, and innovation integration." Optimize the path by establishing a unified green evaluation index system, improving the regulatory mechanism, implementing differentiated support for the central and western regions, and promoting the deep integration of green finance with the digital economy and intelligent manufacturing. Future research can further explore the long-term effect mechanism and micro-subject behavior response of green finance, use panel data to analyze the effect of policy tools, select typical industries such as steel and chemical industry to carry out empirical research to put forward more targeted suggestions, and explore the impact of international green finance standards on China's industrial structure upgrading, broaden the scope of research and improve practicability.

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