

Research on the development of green finance to promote the transformation and upgrading of economic restructuring

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Abstract. Since entering the new era, China's economic development stage has changed from high-speed growth to high-quality development. As an important part of cultivating new productivity and achieving green development goals, the strategic position of industrial structure transformation has become increasingly prominent. This paper systematically analyzes the core mechanism, promotion mode and existing shortcomings of green finance to promote the transformation of industrial structure, and summarizes four operating mechanisms: guiding the rational flow of capital by means of pricing, forcing low-carbon transformation of enterprises through risk assessment mechanism, providing special funds to accelerate the process of technological upgrading, and relying on the policy system to provide support and guarantee. In this process, three outstanding problems have also been found: significant differentiation of green standards, uneven regional allocation of green financial resources, and conflicts in regulatory measures. Based on this, this paper constructs a three-dimensional solution: first, to solve the problem of unbalanced development of green finance regions and fields; secondly, promote the development of the green financial system in the direction of maturity; finally, with international coordination as the starting point, efforts will be made to enhance the capacity in the governance of green finance. Specifically, conducting in-depth research into the operational mechanisms and implementation pathways of green finance holds substantial significance — not only for maximizing its positive effects in driving industrial transformation in practical scenarios, but also for advancing along a path of sustainable and high-quality development.

Keywords: green finance; economic restructuring; transformation and upgrading.

1. Introduction

The Third Plenary Session of the 20th Central Committee of the Communist Party of China stressed that advancing green development is a pivotal task in building a modern socialist country. Against the "dual carbon" goal backdrop, industrial structure upgrading can effectively cut total carbon emissions and mitigate environmental pollution. On the other hand, it can help the supply-side structural reform to develop to a deeper level, and fundamentally reverse the traditional high-input and low-efficiency extensive high-consumption economic model. This underscores the fact that driving industrial structure upgrading represents both an inevitable trend and the indispensable pathway for green development. Specifically, green finance can guide social resources and funds to converge to green environmental protection industries and enterprises through diversified green financial services, and provide accurate financial assistance for the transformation and upgrading of traditional industries.

In general, industrial structure upgrading denotes the shift of industrial sectors from low-value-added, extensive development models to high-value-added, intensive ones. The core is to shift from factor-driven to innovation-driven, involving multi-dimensional innovations such as technology, structure and mode, which is the key path to achieve high-quality development. The transformation of industrial structure has achieved certain results in China. According to the bulletin of the Bureau of Statistics over the years, the proportion of China's primary industry fell slightly by 2.7%(9.8%→7.1 %); the proportion of secondary industry decreased by 6.1%(45.5%→39.4 %), but it still occupied an important position. The proportion of the tertiary industry increased by 8.8%(44.7%→53.5%), becoming the leading industry.

At present, the " five pillars " of green finance development have been initially formed, and the " three major functions " are emerging, enabling industrial transformation and upgrading and achieve the goal of ' double carbon '. The government report has repeatedly made it clear that it is necessary to vigorously develop green finance, which reflects its important position in national strategic planning. However, green finance still faces problems such as standard differentiation, unbalanced development and immature mechanism. Based on data analysis, this paper theoretically expounds the core mechanism and ways between green finance and industrial transformation, and gives specific suggestions from the practical level, which has important reference value in theory and practice.

2. The mechanism of green finance promoting the transformation of industrial structure

In the process of optimizing and upgrading the industrial structure, green finance plays the role of a multi-dimensional promoter: it is based on market-oriented tools and matches policy guidance means. On the one hand, it limits the inflow of funds into industries with serious pollution and energy consumption, such as heavy chemical industry, which in turn accelerates the tilt of capital to the green and low-carbon field, so as to promote the industrial structure to be updated in the direction of higher quality and environmental protection.

2.1. Differential pricing guides capital flows

The core mechanism by which green finance drives industrial transformation lies in reallocating the environmental costs and benefits associated with economic activities through financial instrument innovation. From the perspective of theoretical logic, green credit policy 'internalizes' environmental externalities into internal costs of enterprises in the form of differentiated pricing. Launched officially in 2012, China's 'Green Credit Guidelines' has not only led to a substantial reduction in the scale of interest-bearing debt available for financing among heavily polluting enterprises, but also driven up the cost of their debt obligations. and inhibited over-investment of heavily polluting enterprises [1,2]. The green financial policy of the central bank guarantees the credit spreads of green bonds and brown bonds to form financing incentives and transformation pressures for green and brown enterprises, thus playing a price signal guiding role of ' rewarding the good and punishing the bad ' and promoting capital flows to green industries [3].

From the perspective of capital flow, the problem of " profit-seeking mismatch " in traditional finance is obvious. Funds and resources are concentrated in heavy chemical industries such as mining and smelting with high environmental costs but fast returns, resulting in high-carbon overcapacity, green industry ischemia, and structural contradictions. Green finance combines differentiated credit policies and market tools to redistribute capital to a certain extent by economic means. Green credit is used to set environmental entry thresholds, prevent high-pollution projects and industries from entering development, and force financial institutions to tilt credit in a low-carbon direction. Taking China as a case in point, following the rollout of the country's 'Green Credit Guidelines', the loan growth rate for six categories of high-energy-consuming industries fell by 12% over a three-year period, whereas the average annual growth rate of loans for the energy conservation and environmental protection sector stayed at approximately 18%. For one thing, adjustments to the credit structure exert a fundamental check on the growth of industries categorized as 'two high and one surplus' to a certain degree; for another, they furnish capital to support the large-scale expansion of green industries through the targeted allocation of credit resources.

2.2. Risk assessment mechanism constrains enterprise decision-making

From the perspective of risk control, green finance reconstructs the risk assessment system of financial institutions with the help of environmental pressure test and market signal transmission mechanism. Commercial banks use scenario simulation to quantify the risk exposure of high-carbon assets. Taking the carbon price pressure test carried out by Industrial and Commercial Bank of China

for thermal power industry as an example, it shows that when the carbon price increases by 10%, the related loan non-performing rate will increase by 2.3%. This risk pricing mechanism urges financial institutions to consciously adjust the asset allocation plan, and green insurance has become a risk buffer after being introduced into industries with high environmental risks. After the implementation of environmental pollution liability insurance in the Yangtze River Delta region, the environmental violation rate of enterprises decreased by 40 %, which indirectly reduced the possibility of credit default of financial institutions. The strengthening of price signals in the carbon trading market amplifies the risk constraint effect. The EU carbon price has skyrocketed from 20 euros / ton in 2020 to 90 euros / ton in 2023. Steel, cement and other industries have been forced to accelerate the process of technology substitution, and the unit carbon emission intensity has decreased by 18 %. Under the mechanism of risk pricing and transmission, environmental risk has become an important decision-making variable for enterprises, and promotes the industrial structure to move towards low-carbon development.

2.3. Green fund helps technological innovation

Technological innovation functions as the pivotal link that connects green finance and the upgrading of industries—specifically, it is through this link that green finance drives industrial upgrading. Additionally, scholarly investigations into this field have demonstrated that green finance serves a twofold function in the process of propelling technological advancement. On the one hand, it can provide accelerated impetus for the technological R & D and application process of various enterprises by comprehensively integrating the internal and external resources of the industrial chain and scientifically allocating the flow of funds. On the other hand, for the specific group of heavily polluting enterprises, green finance can rely on appropriate policy tools to guide them to break through the technical bottleneck and realize the update and iterative upgrading of production technology. [4]. After obtaining green financial support, enterprises can invest more effectively in environmental innovation, better cope with environmental challenges, and promote green technology innovation [5]. R & D support and market stimulation are two ways to promote technological innovation. The national green development fund supports the R&D of photovoltaic and energy storage technology through equity investment, and promotes its R&D investment. Guangdong 's carbon market pilot has reduced the unit consumption of the power industry, and its technology spillover effect is more obvious, while the combination of green finance and financial subsidies has reduced the risk of R&D. Internationally, after the implementation of the EU's sustainable financial classification scheme, the number of green patent applications in member countries has increased by an average of 14% per year, and the proportion of investment in cutting-edge technologies such as carbon capture has increased to 35%. This is not only the improvement of industrial competitiveness brought about by technological upgrading, but also the birth of new formats. For example, the new industrial chain of new energy vehicles has quadrupled the number of employed people in the decade, for example, the new industrial chain of new energy vehicles has increased by 4 times in ten years, showing the ability of green finance to shape the innovation ecology.

2.4. Policy coordination makes up for the short board of development

The policy coordination mechanism complements each other through environmental regulation and financial policies, and amplifies the transformation results. After the announcement of China 's dual carbon policy, the PBC released data showing that by the end of the fourth quarter of 2024, China 's domestic and foreign currency green loan balance was 36.6 trillion yuan, an increase of 21.7 % year-on-year, and an increase of 6.52 trillion yuan throughout the year. Among them, loans to projects with direct and indirect carbon emission reduction benefits are 12.25 trillion yuan and 12.44 trillion yuan, respectively, accounting for 67.5 % of green loans. It becomes a closed loop of ' financial support-technical support-policy protection '. It is worth noting that the policy synergy effect has obvious regional differences. Through in-depth data analysis, it has been identified that green finance exerts a verifiable inhibitory impact on industrial carbon emissions—with this impact being

particularly pronounced in the central region. Meanwhile, the eastern region also experiences such an inhibitory effect driven by green finance, while the western region ranks third in terms of the strength of this carbon emission-reducing impact. It is evident that green finance exhibits notable disparities in its inhibitory impact on industrial carbon emissions across China's three major regional blocks—eastern, central, and western China[6], and need to rely on policy support according to local conditions.

3. The existing problems in the development of green finance

The establishment of a green financial system is the institutional guarantee for the formation of the above mechanisms. In theory, a sound green financial system needs to shift social funds from high-polluting areas to green industries by enhancing the return on investment in green projects, enhancing corporate social responsibility, and increasing diversified financial products to achieve 'green for green' [7], such as the vigorous development of green bonds can not only directly transport low-cost funds for green projects, but also the classification of projects involved in green bonds and information disclosure standards. It reduces the information asymmetry between investors and environmental risks and improves the market's recognition of green assets [8,9] Achieve internalization of environmental costs, greening of capital allocation and normalization of technological innovation through financial innovation.

3.1. The green standard system is not uniform.

The inconsistency of the green standard system hinders policy coordination. The fragmentation of standards is reflected in the poor convergence of multi-sectoral policies in practice. At present, many regulatory and industry authorities, such as the Central Bank. In combination with their own responsibilities, the NDRC and the ecological environment section have issued a catalogue for the identification and identification of green projects. Although these catalogues overlap in core areas, there are obvious differences and conflicts in specific technical standards, industry coverage, and environmental benefit indicators, which bring additional costs to the compliance operation of enterprise green projects. For investors and financial institutions, there are obvious deficiencies in the unity of the green financial standard system, and the national unified standard has not yet been established. In this case, on the one hand, it is difficult to identify green projects and the positioning of real green financial entities is hindered. On the other hand, it is difficult for investors to accurately assess the environmental value and risk of projects, which ultimately makes financial institutions lack effective grasp and unable to carry out accurate support.[6].

3.2. The imbalance of green financial resource allocation

The researches show that in China, although green finance can significantly promote industrial energy efficiency, this effect is differentiated in different regions: the eastern and central regions show a positive promotion effect, while the western region shows a negative impact. This phenomenon not only reflects the imbalance of green finance in promoting the improvement of industrial energy efficiency in different regions, but also indirectly proves that the development of green finance is constrained by multiple core elements of a region, including economic base, industrial structure layout and resource endowment, which leads to the obvious heterogeneity of its development among regions. [10].

The reason is that in terms of green credit access, the eastern region and large enterprises have natural advantages in obtaining green credit. The eastern region has a higher level of financial development, a strong green industry foundation, and new energy, energy conservation and environmental protection. The development of industrial clusters is more mature, and the financial market is active, which provides convenient conditions for the eastern region to obtain green credit; the development of green industry in the central and western regions is lagging. Many green projects, such as ecological restoration and rural environmental protection facilities construction, often have

the characteristics of long investment cycle and unstable income, which are difficult to attract the attention of financial institutions. Large enterprises usually have a high credit rating, sufficient mortgage assets, and relatively stable operating conditions. Financial institutions have a lower risk of lending to them, so it is easier to obtain green credit support. Small and micro enterprises are small in scale and weak in anti-risk ability. Their business information and financial information are not transparent enough. It is difficult for financial institutions to accurately assess their credit risk. Therefore, they will be more cautious when issuing green credit, resulting in small and micro enterprises facing financing difficulties [11].

3.3. The regulatory incentive mechanism is not coordinated

Both external policies and internal policies can effectively stimulate the green credit delivery of commercial banks. However, when the policies are superimposed together, it will increase the marginal effect and lead to the complexity of policy superposition. The policies issued by different departments may be different in objectives, requirements and implementation methods. Banks need to spend a lot of time and energy to coordinate and adapt to these policies in the implementation process, which increases the difficulty of operation and management costs. Some policies pay too much attention to risk control. According to the research results, when local governments' environmental regulatory measures exceed the critical threshold, their original driving effect on the deepening of green finance will turn into an inhibitory effect; at the same time, excessive environmental regulations will also occupy the resources that green finance uses to support industrial enterprises in carrying out green technological innovation. [5]. This limits the innovative exploration of commercial banks in green financial products and service models to a certain extent, which is not conducive to the vitality of green financial markets.

4. Recommendations

4.1. Give full play to the advantages according to local conditions and strengthen the circulation of factors.

Based on the heterogeneity of regional resource endowments and development comparative advantages, the government needs to break through the homogenization planning paradigm, build a differentiated development strategy system that is compatible with regional endowments, and guide each region to focus on the cultivation and upgrading of comparative advantage industries. This differentiated feature is particularly prominent in the industrial development practice of the Yangtze River Economic Belt : the eastern region relies on the first-mover advantage, has achieved a phased breakthrough in the upgrading of the industrial structure, and the high-end transformation of the industry has achieved remarkable results ; however, the two other regions are still in the catch-up stage of industrial structure optimization due to the constraints of economic foundation, industrial foundation and other factors, and the upgrading process is relatively slow. From the perspective of regional coordinated development, the eastern region can take the high-end industry of the value chain as the priority development direction and build a high-end and intensive industrial layout with the help of the double dividend of geographical location and industrial scale. In contrast, the central and western regions have abundant low-cost labor factor reserves, which make them have natural adaptability in the development of labor-intensive industries. For the central and western regions, it is necessary to promote the deepening of green finance and the empowerment of technological innovation, accurately grasp the strategic opportunity of industrial gradient transfer in the eastern developed regions, and gradually realize the cultivation, development and upgrading of the local competitive industrial system based on the path of efficient undertaking. [12].

At the same time, promoting the collaborative cooperation and experience exchange among industrial enterprises plays a key supporting role in the coordinated development of regional industries. From a practical perspective, industrial enterprises in the western region can accelerate their own transformation and industrial upgrading by drawing on the advanced experience of the

eastern and central regions in the fields of technology application and green production. In this process, the central region needs to fully perform the bridge function of connecting the east and the west, and promote the efficient flow of industrial factors among regions by building a docking platform for technology transfer and resource allocation. On the other hand, after providing professional services such as operation management guidance and industrial planning suggestions for enterprises in the central and western regions, the eastern region can not only obtain reasonable service income returns, but also expand the development space with the help of regional industrial linkage, and ultimately promote the formation of complementary advantages and mutual benefit and win-win industrial development pattern in the eastern, central and western regions. In addition, strengthening the cooperation of industrial enterprises in the same region will promote the overall industrial eco-efficiency of the region [13]. At the same time, local governments should eliminate regional barriers, further accelerate the free flow of factors, and optimize the allocation of resources between regions [14].

4.2. Policy synergy promotes the qualitative change of green financial system

From a macro perspective, the relationship between green finance and high-quality economic development has nonlinear characteristics. Relevant research shows that for the same region, when its economic development level and green finance level are at different stages of development, the impact of green finance on energy efficiency may be different, and there may be a nonlinear relationship [10]. When the development of green finance is relatively low, its role in driving economic growth depends more on the investment of traditional green projects. As the green financial system gradually matures, the effect of the green financial system on the improvement of total factor productivity begins to emerge [8]. Meng et al. [15] confirmed that green finance and energy efficiency have a positive U-shaped correlation; specifically, when the development level of green finance is low, it exerts an inhibitory effect on energy efficiency improvement. However, with the improvement of the level of green finance, it will significantly promote the improvement of energy efficiency. This conversion process between 'quantity' and 'quality' requires the establishment of a grading standard system to adapt to the needs of different development stages. In the early stage, when faced with the problems of capital and technology difficulties in the transformation of enterprises, the government can cover the frontier technology risks through national insurance funds, revitalize mature technology assets through green asset securitization, and solve the financing dilemma of small and medium-sized enterprises through carbon account credit. Help it to cross the critical point. When the system matures, it should turn to standard optimization and market mechanism deepening.

4.3. International collaborative innovation self-governance model, strengthen external relations

From the perspective of international synergy, the 'mutual recognition of rules' of green finance significantly reduces the cost of cross-border green financing, and 'capacity building' enhances the level of governance in the country. China has participated in the formulation of international green standards, such as joining the "Common Catalogue of Sustainable Finance" of China and Europe. On the one hand, it has exempted the increase in cross-border financing costs due to different standards. On the other hand, it has transmitted some domestic operations on green projects (such as desertification control carbon sink accounting) overseas to promote the development of green financial capacity in developing countries. This not only enhances China's voice in global green financial governance, but also creates good environmental conditions for China's domestic green technology and green products to go to the world [1,9]. At the same time, cross-border green financial cooperation has promoted the continuous expansion of the scope of transformation. Under the Lancang-Mekong River mutual assistance framework, the issuance of China-Laos railway green bonds has tripled the investment in clean energy in Southeast Asia. In the future, we should balance the dynamic relationship between international rules and national sovereignty while taking the international collaborative path of "rule internalization-capacity building".

5. Conclusion

This study systematically reveals the four mechanisms of green finance to promote industrial transformation, including differential pricing to guide capital flow, risk assessment mechanism to restrain enterprise decision-making, green fund to help technological innovation, and policy coordination to make up for the shortcomings of development. It also analyzes the existing problems such as the inconsistency of the green standard system, the imbalance of green financial resource allocation, and the lack of coordination of regulatory incentive mechanisms.

Based on the core mechanism and existing problems of green finance to promote industrial transformation, this paper puts forward a three-dimensional solution of local conditions-policy coordination-international cooperation, and looks forward to the future development of green finance. In the future, on the one hand, we will improve the standard system, improve the incentive mechanism, and solve the problem of market failure. On the other hand, through regional coordination and international coordination, the problem of unbalanced development will be resolved. Finally, a circular path of “price discovery-capital flow-technology innovation-system improvement” will be formed to provide systematic support for high-quality economic development.

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