

Green Finance and Green Technological Innovation: The Synergistic Effect of Social Capital

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Abstract: Against the backdrop of global warming, green technological innovation has become the key to enterprises' green transition and sustainable development. Green finance supports this process by optimizing resource allocation and providing financial backing for green technological innovation. This study reviews the theoretical foundations of green finance and corporate green technological innovation, analyzes both the direct and synergistic effects of green finance and social capital, and further explores the mechanisms underlying their synergy. The findings offer theoretical insights and practical guidance for optimizing green finance policy design and improving the coordination mechanism between green finance and social capital.

Keywords: Green finance, Social capital, Green technological innovation, Synergistic effect, Impact mechanism

1. Introduction

Global warming, as a pressing global challenge, has garnered widespread attention from the international community, prompting the search for effective response strategies. The Sustainable Development Goals (SDGs) proposed at the 2015 United Nations Sustainable Development Summit have guided the global transition toward a green, low-carbon development pathway, reshaping economic growth models [1]. Against this backdrop, green technological innovation has emerged as the key to breaking away from traditional high-energy consumption and high-pollution growth models and is regarded as a core driver of sustainable development [2]. However, enterprises, as key market participants in green technological innovation, face significant challenges. The externality characteristics of green technological innovation reduce firms' incentives to engage in such activities, while its high risks and long investment payback periods weaken its attractiveness to financial markets, resulting in insufficient and unstable resources for sustained development. To address this issue, green finance has emerged as a crucial mechanism, optimizing resource allocation and providing financial support to ensure funding for corporate green technological innovation, thus holding significant practical relevance.

China has actively explored and implemented green finance policies. The introduction of the Green Credit Policy in 2012 aimed to regulate green credit operations and promote green finance development. However, a significant funding gap remains. Relying solely on green finance is insufficient to meet the growing financial demands. Moreover, green finance primarily focuses on compliance and environmental objectives in capital allocation, with limited direct involvement in firms' research and development activities, offering little beyond financial support for green

technological innovation. In contrast, social capital presents unique advantages. Financial institutions and small- and medium-sized investors can not only provide additional funding to bridge financial gaps but also offer strategic guidance and play a supervisory role, facilitating more effective green project outcomes. Recognizing this, the Chinese government issued the *Guiding Opinions on Establishing a Green Finance System* in 2016, emphasizing the development of green financial instruments and the mobilization of social capital to achieve synergistic effects and drive corporate green transition. However, the actual policy effects of the *Guiding Opinions* remain unclear.

Therefore, an in-depth investigation into whether green finance and social capital can generate a synergistic effect of "1+1>2" and the underlying mechanisms is crucial for optimizing green finance policy design and improving the green finance policy framework.

2. The Direct and Synergistic Effects of Green Finance and Social Capital on Corporate Green Technological Innovation

2.1. The Direct Effect of Green Finance

Since the emergence of green finance, economies worldwide have continuously innovated various forms of green financial instruments to support enterprises in achieving sustainable development. From a practical perspective, green finance provides preferential credit policies for green enterprises or projects while imposing restrictions on polluting enterprises and projects [3]. Theoretically, by linking the external costs incurred by enterprises for environmental protection with their financing costs, green finance can strengthen external financing constraints on heavily polluting enterprises, thereby compelling them to engage in green technological innovation [4].

Although green finance is theoretically expected to promote green technological innovation, its actual effectiveness is subject to various complex constraints. The financing restrictions imposed by green finance policies may lead to a crowding-out effect, where firms reallocate funds originally designated for R&D to meet operational demands, thereby hindering green innovation activities [5]. Additionally, some enterprises may exploit information asymmetry by selectively disclosing information about pollution emissions and environmental governance to obtain low-interest green credit. This practice, often referred to as "greenwashing", can divert resources away from genuine R&D efforts, ultimately undermining the environmental objectives of green finance in fostering green technological innovation [6].

2.2. The Direct Effect of Social Capital

As a crucial channel for enterprises to acquire external resources, social capital primarily manifests in the form of financial support obtained through financial institutions, investor networks, and strategic partnerships. Theoretically, social capital can stimulate corporate innovation by alleviating financing constraints, providing risk-sharing mechanisms, and facilitating knowledge spillovers [7]. However, the unique characteristics of green technological innovation—including high risk, long investment cycles, and strong externalities—create significant uncertainty regarding future returns, potentially weakening investors' willingness to participate.

Studies suggest that the profit-driven nature of capital markets leads financial institutions and investors to favor projects with clear short-term returns and manageable risks, while often lacking confidence in the long-term value of green technological innovation [8]. Additionally, the insufficient endogenous motivation of enterprises may further constrain the role of social capital. Due to short-sighted behavior or a weak sense of environmental responsibility, some firms tend to allocate external financing toward traditional business expansion rather than green R&D initiatives.

Even when social capital flows into enterprises, the absence of effective supervision and strategic guidance may result in resource misallocation, where funds are diverted to non-green activities,

reducing the efficiency of resource allocation. More critically, green technological innovation involves complex technological pathways and market validation processes, exacerbating information asymmetry problems. Investors may struggle to accurately identify high-quality green projects, reinforcing conservative investment decisions and limiting the impact of social capital on innovation [9].

Therefore, while social capital has the potential to empower green technological innovation, its independent influence remains constrained by multiple structural barriers.

2.3. The Synergistic Effect of Green Finance and Social Capital

To fully leverage the guiding role of green finance and encourage the participation of social capital in green investments, the Chinese government has implemented a series of policies, including the *Guiding Opinions*. In terms of information sharing, these policies advocate for banks to establish green evaluation mechanisms, guiding financial institutions to engage in green finance activities and strongly encouraging green investment [10]. According to signaling theory, the official endorsement from the government and banks sends a strong signal to the financial market, indicating support for green development, which attracts financial institutions and small and medium-sized investors to actively participate in green investments. The policy proposes the establishment of a Green Development Fund to support the introduction of the Public-Private Partnership (PPP) model in the green industry, mobilizing social capital. The policy emphasizes that investment management should follow a market-oriented approach, while ensuring that green development goals remain unchanged [11]. By collaborating with the government, financial institutions can share the risks involved, and resource complementarity can be achieved, making it more effective in selecting high-quality green projects and ensuring successful investments. Moreover, a market-oriented investment management model aligns with the profit-seeking nature of capital, ensuring a balance between supporting green development and guaranteeing investment returns for social capital [12]. This, in turn, enhances the enthusiasm of social capital to invest in green projects.

3. The Impact Mechanism of the Synergistic Effect between Green Finance and Social Capital

3.1. Intermediation Effects of Financing Constraints

Green technology innovation is characterized by novelty and radicalism, and the whole link is characterized by high uncertainty, so more resources are needed to hedge the technological risk, and the financing needs of enterprises are greater [13]. However, enterprises usually face a greater degree of financing constraints in green technology innovation, which is due to the high-risk, long-cycle and uncertainty characteristics of green technology innovation projects, making it difficult for enterprises to obtain funds from traditional financial channels. And green financial policy has an important role in alleviating the enterprise financing constraints. Firstly, green finance guides financial institutions to optimize resource allocation, gives more credit support to green enterprises and projects, and reduces the financing cost of enterprises by lowering the interest rate of green credit and extending the loan period [14]. Secondly, green finance promotes the development of the green bond market, and enterprises can attract a wider group of investors and raise a large amount of funds for green technological innovation by issuing green bonds [15]. In addition, green finance is also committed to improving the environmental information disclosure system and enterprise environmental information sharing mechanism. By improving the transparency of corporate environmental information, it reduces the information asymmetry in the financial market, enabling investors to more accurately assess the risks and benefits of corporate green projects, thus enhancing investment

confidence in green technology innovation enterprises and further alleviating the financing difficulties of enterprises [16].

3.2. Moderating Effects of Environmental Regulation

Environmental regulation, as a typical external regulatory pressure, reshapes the green innovation behavior of enterprises through a mandatory constraint mechanism. Based on the innovation compensation effect of Porter's hypothesis, strict environmental regulations not only directly increase the cost of pollution, but also force enterprises to reconfigure the production function through dynamic pressure transfer. On the one hand, the compliance barriers formed by emission limits and violation penalties force enterprises to incorporate green technological innovation into their survival strategy, replacing end-of-pipe management with technological leap [17]; on the other hand, the stepped-up improvement of the resource efficiency standard promotes the enterprises to realize cost reduction and efficiency through process innovation and process optimization [18]. achieve cost reduction and efficiency through process innovation and process optimization [18]. Under the synergistic framework of green finance and social capital, the regulatory pressure of environmental regulation presents a double enabling effect. Green finance policies incorporate environmental compliance into the credit assessment system, prompting financial institutions to impose financing constraints on high-environmental-risk enterprises, while providing low-cost financial support for enterprises that meet the standards, establishing a link between regulatory pressure and financing incentives [19]. Under the background of tightening environmental regulations, social capital prioritizes the injection of capital into enterprises with excellent environmental performance, and this market selection behavior resonates with regulatory pressure, accelerating the agglomeration of resources to the field of green innovation [20].

3.3. Moderating Effects of ESG

ESG, as an important indicator system for measuring the sustainable development capability of enterprises, has a direct impact on the competitiveness of enterprises in the market selection mechanism. Based on the market selection theory, enterprises with excellent ESG performance usually demonstrate superior environmental governance ability and can accurately respond to the green finance policy guidance, thus occupying an advantageous position in the allocation of credit resources by financial institutions [21]. By embedding the logic of market selection, green finance requires financial institutions to take ESG performance as a key screening criterion for credit approval, and implement loan prioritization and interest rate preference for high ESG-rated enterprises, prompting funds to focus on high-quality environmental protection subjects through market-oriented paths. From the perspective of signaling, enterprises with good ESG performance can strengthen market recognition by sending signals, and are more likely to gain the trust and capital injection of social capital by virtue of their good sense of environmental responsibility and soundness of operation [22]. At the same time, ESG-driven brand reputation premium can attract long-term value-oriented investors, forming a positive "reputation-capital" cycle, further amplifying the optimization effect of market selection on resource allocation. From the perspective of corporate governance, ESG performance pushes the market selection mechanism to develop in depth by forcing enterprises to upgrade their internal governance. High ESG enterprises often incorporate sustainable development into the core of their strategies, optimize the efficiency of their innovation management system and resource integration, build differentiated competitive advantages, and accelerate technological research and development and transformation of results under the dual support of green finance and social capital.

4. Conclusion

Green finance is a key force in promoting enterprise green technological innovation, but its policy effects are affected by a variety of factors, and its synergy with social capital is of profound significance to enterprise green technological innovation. Green finance provides financial guarantee for green technological innovation by optimizing resource allocation and providing financing support, but its effect is limited by the possible crowding-out effect and “greenwashing” behavior of enterprises. Although social capital can alleviate financing constraints, share risks and promote knowledge spillover, its individual role is limited by the high risk, long cycle and strong externality of green technological innovation. The synergistic effect of green finance and social capital can overcome these limitations, and government policies can guide social capital to participate in green investment and play a leading role in green finance through measures such as information sharing, setting up a green development fund, and introducing the PPP model.

The mechanism of synergistic effect is mainly reflected in three aspects: first, the intermediary effect of financing constraints, green financial policies through optimizing resource allocation, reducing financing costs, promoting the development of the green bond market and perfecting the information disclosure system, to alleviate the enterprise financing constraints, and to enhance the investment confidence of social capital; second, the adjusting effect of environmental regulations, strict environmental regulations by raising the cost of pollution and the efficiency of resource utilization standards, forcing enterprises to carry out green technological innovation, and to improve the efficiency of resource utilization. Secondly, the regulating effect of environmental regulation, strict environmental regulation by raising the standard of pollution cost and resource utilization efficiency, forcing enterprises to carry out green technological innovation, while green financial policy will incorporate the level of environmental compliance into the credit assessment, social capital prioritizes the investment in enterprises with excellent environmental performance, and accelerates the agglomeration of resources to the field of green innovation; Thirdly, the regulating effect of ESG, ESG performance of enterprises with excellent performance is more competitive in the market selection, and the green financial will be used as a criterion for credit approval, prompting the funds to concentrate on high-quality environmental protection subjects. At the same time, good ESG performance can attract long-term value-oriented investors, forming a positive cycle, promoting the upgrading of internal corporate governance, accelerating technology research and development and transformation of results.

Future research should focus on the optimal design of green finance policies and explore the internal mechanism of synergy between green finance and social capital, so as to more effectively promote green technological innovation of enterprises and help achieve the goal of sustainable development.

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