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Does Green Finance Affect Economic Performance? Growth and Crowding-Out Consequences

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ABSTRACT

Green finance is crucial to the achievement of China's dual-carbon goals and its sustainable economic development. Based on the data from 2011 to 2020, This paper employs a double-difference method to examine two effects of green finance on economic growth, namely, its growth and crowding-out effect. The empirical results show that, in general, green finance improves the level of economic growth and doesn't impede the entry of new enterprises, while crowding out the contribution of heavy polluting industries to the economy. Green financial policies effect economic performance mainly through resource allocation and technological innovation. Specially, in comparison to the central and western regions, green finance exerts a more pronounced influence in the eastern region, potentially attributable to disparities in regional development levels, financial system efficiency, and degrees of marketization. In addition, both growth and crowding-out effect are more significant in resource-dependent cities.

KEYWORDS

Green finance; economic performance; growth effect; crowding-out effect

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1. Introduction

With the rapid economic growth, energy constraints and environmental pollution become increasingly severe, which have affected the survival and sustainable development of human beings. According to the annual report released by the US National Oceanic and Atmospheric Administration, global greenhouse gas concentrations, sea level height, ocean heat content and other indicators hit record highs in 2022. Based on the need for sustainable development, green finance is widely recognized as an important approach to deal with environmental problems brought by economic growth.

Green finance, also known as sustainable finance (Hong et al. 2020, 2022) or environment finance, refers generally to financial services provided for economic activities aimed at improving the environment, addressing climate change and promoting resource conservation and efficient utilization. The research conducted by domestic scholars in China on green finance primarily focuses on the impact of green financial policies, thereby highlighting the policy-level nature of the concept (Wang et al. 2019). In August 2016, the People's Bank of China, along with seven other ministries and commissions, jointly issued the Guiding Opinions on the Construction of Green Financial System and provided an official definition of green financial system in China. It emphasizes that the green financial system is an institutional arrangement supporting the economic transition toward sustainability through various financial instruments and policies such as green credit, green bonds, green funds, green insurance, among others. This official definition represents China's first comprehensive articulation of what constitutes green finance. This paper comprehensively analyzes the dual impact of green finance on economic

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performance, so the concept of "green finance" in the following is consistent with the financial services encompassed by the Opinions. Meanwhile, "green credit" refers to the credit products and services provided to support economic activities such as environmental improvement, climate change, resource conservation and efficient use, which is a major component of green finance.

Theoretically, Green finance is an important booster to promote the development of inclusive finance and green economy (Ma et al. 2021). From the view of resource allocation, Lu et al. (2021) found that, the green credit policy has significantly increased the exit risk of high-polluting enterprises and promoted market share growth of incumbent enterprises, indicating that green credit has a positive market selection effect and significant market share reallocation effect. Meanwhile, the credit constraints effect of green financial policy guides enterprises to shift from high-polluting industries to green, low-carbon and recycling industries (Yu and Fan 2022). Moreover, when green finance reaches a certain scale, its promotion effect on green total factor productivity will increase significantly (Shi and Shi 2022), which will lead to a high-quality economic development pattern.

Most countries in the world have begun to adopt green financial policies to alleviate the environmental crisis. At present, developed countries have established relatively mature financial mechanisms for adaptation to climate change. These mechanisms, on the one hand, provide financial support for domestic green innovation, and on the other hand, provide international assistance funds for developing countries to adapt to climate change. In 2020, General Secretary Xi Jinping announced China's "dual carbon" goal at the 75th United Nations General Assembly, namely, CO2 emissions should strive to peak by 2030 and reach to carbon neutrality by 2060. Prior and subsequent to this announcement, China has implemented a series of green financial policies aimed at mitigating carbon emissions and fostering sustainable economic development (Li et al. 2023, 2024; Wu et al. 2024).

To what extent does the implementation of green financial policy truly enhance economic performance in China? Scholars have predominantly examined this issue in terms of its influence on the transformation of industrial structure (Zhang 2019), total factor productivity (Lee and Lee 2022), technological innovation (Wang and Wang 2021), and green innovation (Huang et al. 2022). The prevailing consensus among scholars is that, green financial policies effectively mitigate carbon emissions, and foster green transformation of industries. However, the research on their negative effects is relatively limited, particularly their crowding-out effect on output and entry of emerging enterprises.

According to the data of the green loan scale and net interest rate of China's four major state-owned banks, the crowding-out effect of green credit on other forms of credit is evident within the framework of the green financial policies. As a crucial proponent of green financial instruments, banks can allocate limited loans to the environmental protection sector through the development of green credit business, thereby reducing lending to sectors that can stimulate economic growth more effectively. A decline in banks' net interest income means that loans are not being allocated to the most efficient sectors. Figures 1 and 2 illustrate an increasing trend in the scale of green credit for the four major banks of China, while their net interest yields experienced significant declines between 2016 and 2019. Since 2013, China's large banks have gradually implemented green financial policies and established development goals for "green finance." The data indicate that, during this period, the continuous expansion of green credit has led to a downward trend in overall net interest yield. This suggests that the pursuit of sustainable development may result in a certain extent of performance reduction and reduced lending to more profitable sectors, thereby resulting in a significant crowding-out effect.

Green finance can have dual effects on economic performance, while existing literature primarily focusing on its positive impact on green development. The few studies on the negative consequences of green finance mainly examine the influence of green finance on the financing costs and financing capacity of high-polluting enterprises, which focuses on the impact on capital input and ignores its crowding-out effect on output. Given the significance of green finance for sustainable development, this paper intends to comprehensively discuss the impact mechanism of green financial policy on economic performance from both growth and crowding-out perspectives. The discussion in this paper

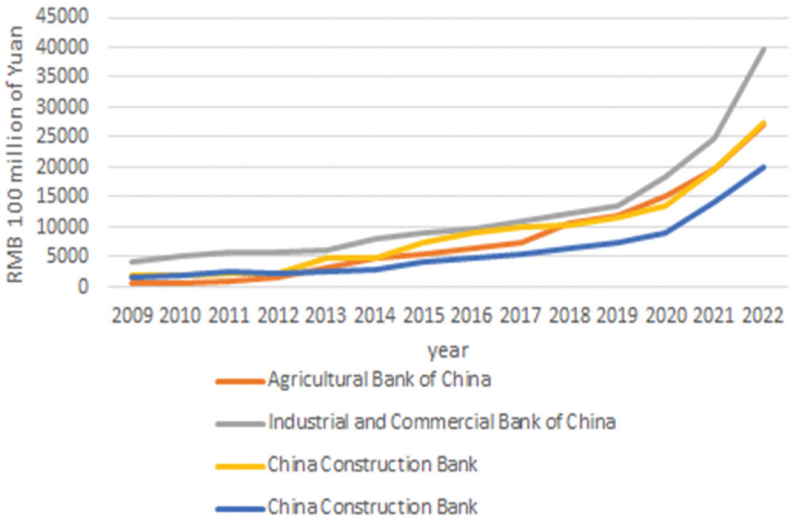

Figure 1. Green credit scale of the four major state-owned commercial banks. Data source: Financial statements of the four major state-owned commercial banks.

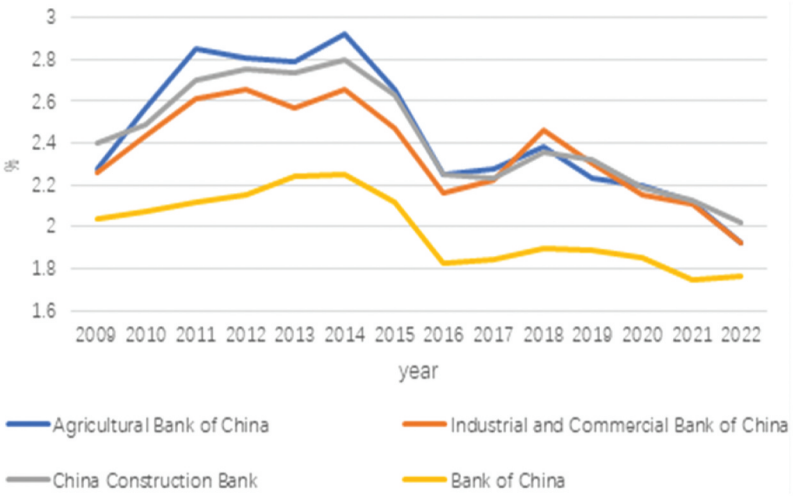

Figure 2. Net interest margin of the four major state-owned commercial banks. Data source: Financial statements of the four major state-owned commercial banks.

expands the research scope of green finance and provides a more comprehensive viewpoint for policy formulation.

The paper's marginal contributions are primarily manifested in the following three aspects. Firstly, it comprehensively analyzes the dual impact of green finance on economic performance, particularly focusing on the crowding-out effect of green finance from the perspective of impeding new market entrants. Secondly, by considering resource allocation optimization and technological innovation as intermediaries, this study examines the mechanism through which green financial policies influence economic performance, offering a more detailed explanation for its dual effects. Thirdly, regional heterogeneity and disparities between resource-dependent and non-resource-dependent cities are also analyzed to provide a comprehensive perspective for policy formulation. The key findings of this study can be summarized as follows. In general, green finance improves the level of economic growth and

doesn't impede the entry of emerging enterprises, while crowding out the contribution of heavy polluting industries to the economy. Green financial policies effect economic performance mainly through resource allocation and technological innovation. Specially, compared to the central and western regions, green finance has a more significant impact in the eastern region; both growth and crowding-out effect are more significant in resource-dependent cities.

The remaining sections of the study are structured as follows: Section 2 provides a comprehensive review of the relevant literature. Section 3 examines the economic growth and crowding-out effect resulting from the development of green finance, while also proposing hypotheses. Section 4 constructs an empirical model utilizing data from the green finance reform pilot program. Section 5 presents detailed analysis of the empirical results and explores underlying mechanisms. Finally, in Section 6, conclusions are drawn based on the preceding analysis along with policy implications.

2. Literature Review

There are abundant academic studies on the impact of green finance, with a predominant focus on its positive effects such as carbon emissions reduction, promotion of industrial structural transformation, and fostering innovation in green technology. The subsequent summary highlights the impacts of green finance from two perspectives: environmental effects and economic performance.

The primary objective of green financial policy is to address the issue of environmental pollution during economic development. Consequently, early studies on the impact of green finance primarily focused on analyzing its effects on environmental protection and carbon emissions. Theoretically, green financial instruments such as green credit, green bonds, and green insurance can redirect funds toward the environment-friendly industry while reducing overall carbon emissions (Salazar 1998). In this regard, empirical research conducted by Nandy and Lodh (2012) discovered that the implementation of a green financial policy necessitated financial institutions to consider additional requirements such as resource conservation and pollution emission level when granting loans. This policy has effectively directed financial resources toward resource-saving and green industries by imposing credit restrictions on high-polluting and high-emission enterprises. Studies conducted by Wang (2019) and Zhang (2019) have also affirmed that, China's green financial policies can facilitate clean production, with green credit policies playing the most direct and significant role. Guo and Fang (2022) further analyzed the intermediate mechanism through which the effect of green finance operates, and believed that green credit policy can significantly promote environmental investment through financing constraints mechanism, thereby resulting in a reduction in carbon emissions. Additionally, Li and Wang (2021) examined both short-term and long-term effects of implementing green financial policies; their findings indicated that there was an initial increase in SO_2 concentration in the air of pilot areas, but positive effects gradually emerged over time. Lee et al. (2023) investigated the impact mechanisms of green finance on energy efficiency and posited that it enhanced energy efficiency by fostering innovation in green technology and optimizing the energy structure.

Regarding the economic performance of green finance, existing studies primarily examine its correlation with the transformation of industrial structure and the innovation of green technologies. Green financial policies incorporate the principles of environmental protection and sustainable development into industrial planning, which facilitate the transition toward a more environment-friendly industrial structure (Labatt and White 2002; Xu and Xu 2023). Simultaneously, the implementation of the green financial policy has the potential to enhance investments in environment-friendly sectors and facilitate capital allocation toward resource-efficient industries, thereby fostering sustainable industrial development.

With regard to the specific influence mechanism, Pan et al. (2015) proposed that green finance promotes industrial structure upgrading through three mechanisms: capital formation, capital guidance, and capital catalysis. Cai (2015) further analyzed the guiding and exemplary role of green finance in promoting the collaborative transformation of other related industries. As for the impact of different green financial instruments, Wang et al. (2019) believe that green credit discount, targeted

RRR cuts, re-lending and other measures are all effective green financial measures, which can optimize the economic structure and will not have a significant negative impact on total output and total employment. Another important impact of green finance on economic performance is that it promotes green technology innovation of enterprises. By imposing stringent controls on high-pollution projects, green finance compels high-polluting enterprises to engage in green innovation through increasing financial costs (Goetz 2019; Shi et al. 2022) and reducing financial capacity (He et al. 2019; Zhang 2023), thereby effectively mitigating environmental risks in business operations.

Furthermore, scholars have also observed the adverse impact of green finance on economic development. The implementation of green financial policies results in a substantial increase in debt costs and a significant decline in the performance of high-polluting enterprises, indicating that green finance imposes notable financial penalties and investment constraints (Su and Lian 2018). The study of Shi et al. (2022) found that, after the implementation of green financial policies, the proportion of debt finance of high-polluting enterprises decreased significantly, and those enterprises began to adopt equity finance to mitigate the financing constraints brought by the policies. Additionally, Yu and Zhou (2023) revealed that, the green financial policy exerted a significant inhibitory impact on overall development within the pilot area, leading to a substantial reduction in production efficiency of the enterprises.

In summary, green finance may have dual effects on economic performance, while existing literature primarily focusing on its positive impact on green development. The little literatures on the negative consequences of green finance mainly examines the influence of green finance on the financing costs and financing capacity of high-polluting enterprises, which focuses on the impact of policy on capital input and ignores its crowding-out effect on output. In contrast to previous studies, this paper comprehensively considers both the positive and negative effects of green finance, specifically examining its crowding-out effect on emerging enterprises. Additionally, this study explores the mechanism of green financial policy on economic performance by taking resource allocation and technology innovation as intermediaries, while also considering regional heterogeneity as well as differences in resource dependence.

3. Theoretical Analysis and Research Hypotheses

This paper categorizes the impact of green finance on economic performance into growth effect and crowding-out effect. The growth effect refers to the positive influence of green finance on the economy through channels such as optimizing resource allocation and expediting technological innovation. Crowding-out effect, on the other hand, pertain to the possibility that green financial policies may lead to capital misallocation and technological constraints for certain enterprises, thereby restricting their entry and survival. The specific mechanisms of these effects are summarized in Figure 3.

3.1. Growth Effect Induced by Green Finance

3.1.1. Resource Allocation Channel

With the enactment of green financial policies, complementary fiscal policies and financial products have emerged. These policies and products optimize resource allocation both within and outside the industry, thereby promoting sustainable economic growth.

Firstly, with the introduction of relevant fiscal policies, various constraints and incentives will guide resources toward green enterprises, providing support for ecological civilization construction and economic growth (Monasterolo and Raberto 2018). Despite some green enterprises or sectors demonstrating strong growth in the past, generating positive external effects, the limited influx of capital into these sectors was due to market imperfections and credit constraints. Presently, to align with national policies and promote green economic development, the government offers corresponding incentives, subsidies, and tax benefits to the green industry. Banks, when allocating funds, also prioritize the green development of enterprises, appropriately relaxing credit constraints for the clean sector (Zhang

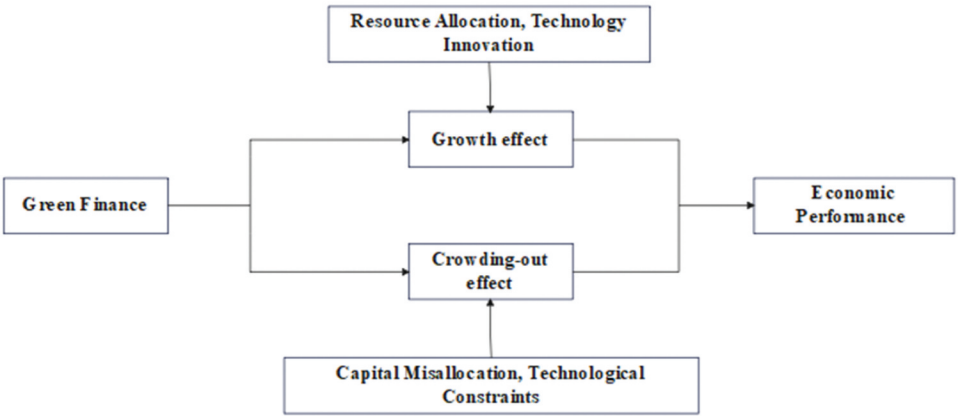

Figure 3. The effect mechanisms of green finance on economic performance.

2019). This redirection of funds from non-compliant to compliant emission enterprises not only addresses the financing challenges and high-interest rates faced by relevant green enterprises but also eliminates inefficient, outdated, and socially irresponsible enterprises, optimizing resource allocation (Wang et al. 2019). Through green financial policies, resources can be more effectively allocated to the environmental sector, thereby alleviating dependence on limited resources, and mitigating resource price risks, thus contributing to long-term stable economic growth.

Secondly, green finance has given rise to more market-oriented forms of financial products, providing a more efficient platform for resource allocation. Specifically, green credits, green bonds, and similar instruments require financial enterprises to disclose information such as investment purposes, profit distribution, and social responsibility. Unlike non-green financing enterprises, financial regulatory authorities impose stricter information disclosure requirements on green financing enterprises, promoting transparency for investors to make more informed investment decisions (Zhang and Ge 2021). In such an environment, a competitive pricing mechanism gradually forms, and market-oriented prices facilitate the orderly and autonomous flow of factors, directing them toward advanced productivity, and thereby enhancing resource allocation efficiency.

3.1.2. Technological Innovation Channel

Technological innovation serves as a driving force for high-quality and sustainable economic development, bringing significant benefits and well-being to society. Faced with the situation of resource constraints and shortages, green financial policies can provide diversified funding for enterprises to promote technological transformation.

Firstly, green financial institutions, through financial support, encourage green technology enterprises to conduct research and develop new technologies, facilitating the transformation of production modes. Green enterprises often face the challenge of long research and development cycles and heavy investment, particularly in the early stage of operation, where significant financing risks are typically encountered. Besides, green technologies usually do not yield immediate economic benefits in the initial phase, which further increase the uncertainty associated with its adoption. However, the emergence of financial tools such as green funds and green bonds helps relieve financing difficulties and provides financial support for technology research and development. The introduction of high-tech products meets diverse market demands, enhances the return rate on investment for related projects, and increases profitability for both enterprises and investors, thereby promoting the sustained development of the real economy and financial system.

Secondly, the technological innovation brought by green finance extends to the supply chain of the green industry, and further support and drive the development of a sustainable supply chain. When

green finance brings technological innovation regarding products or services to a particular enterprise, the generated knowledge and technology inevitably spread across organizational boundaries to its collaborative enterprises to further enhance innovation performance and generate positive spillover effects. Additionally, with the implementation of green financial policies, the collaboration between banking enterprises constantly deepens, and they can also share technology and environmental benefits through green finance supply chain initiatives (Shen 2016). A technology-driven sustainable operating model not only provides more reliable development impetus for enterprises but also injects vitality into the overall economy, which serves as a solid foundation for sustainable economic development.

Based on the analysis conducted in sections 3.1.1 and 3.1.2, we suggest the following hypothesis:

HP 1: Green finance will foster economic growth by optimizing resource allocation and enhancing technological innovation.

3.2. Crowding-Out Effect Induced by Green Finance

While, overall, green finance has the potential to exert positive effects on economic performance by promoting resource efficiency and technological innovation, its restrictions on certain businesses in terms of resource allocation and technological innovation may lead to the exit of these enterprises from the market, resulting in crowding-out effect on economic growth. This paper explores the crowding-out effect on business entry and exit.

3.2.1. Perspective on Business Entry

Considering the mechanism of business entry, green financial policies, by raising the threshold of emerging enterprises' resource allocation and technological innovation, have reduced the entry number of those in this sector.

Regarding resource allocation, the risk and green awareness of investors and consumers may affect the efficiency improvement of emerging enterprises (Qiao et al. 2021). Projects related to green finance typically rely on emerging environmental technologies, usually with longer payback periods, and investors are more inclined to collaborate with established brands and trusted companies to mitigate risk (Bai Chen et al. 2022). Compared with well-established enterprises, emerging enterprises lack market experience and brand recognition, have not yet established a reliable consumer base, and lack market reputation and social acknowledgment. Investors may question their commitments to technology, return and environmental protection. As a result, these enterprises find it difficult to secure sufficient resources, and this affect their ability to allocate resources across various operational aspects. Faced with limited resources, emerging enterprises find it challenging to expand market share, keep up with technological trends, and manage market risk, thereby restricting their contribution to driving economic sustainability.

Regarding technological innovation, technical constraints imposed by stringent green finance standards may lead to the exit of emerging enterprises from the market. Green financial policies emphasize controlling investments and operational practices of enterprises, and set rigorous standards in areas such as environmental conservation, safety, energy consumption, technology, and quality. In the highly competitive green finance market, mature enterprises often hold higher market shares and stable partnerships, making it easier for them to attract top talent, foster core technologies, and meet policy standards. However, emerging enterprises, in the initial stage, face resource constraints, and are difficult to invest sufficient time and capital to build broad exposure and credibility. They lack channels to enhance their own technology and struggle to meet the standards set by the green finance market. Even if they meet standards, the high technology costs and risk generate significant operational pressure on early-stage enterprises, which put them at a distinct disadvantage in market

competition and make them easier to be squeezed out by mature enterprises. Under the influence of green financial policies, the enterprises within the industry get a certain level of protection and the awareness of preventing technology from being imitated will increase (Liang 2017). Influenced by the more concentrated green resources, there is also less pressure to operate. However, it also to some extent diminishes industry competitiveness, and hinders the entry and development of emerging enterprises, which hurts enhancing socio-economic benefits.

3.2.2. Perspective on Business Exit

Considering the mechanism of business exit, green finance hinder the rational allocation of resources for high-polluting enterprises through stringent capital restrictions. This reduces their capacity for independent innovation, leading to the exit of some enterprises that struggle to adapt and innovate.

From the perspective of resource allocation channels, on the one hand, under policy guidance, both green financial instruments and related policies advocate constraints on investments and usage of pollutants, as well as polluting projects. For example, regulatory authorities strictly control loans flowing into the "two highs and one remaining" sectors. This squeezes the lending and financing space for high-polluting enterprises, subjecting them to more rigorous approval procedures and higher financing costs when applying for loans (Humayun et al. 2020). At this moment, these enterprises are compelled to abandon optimal capital structures, and difficult to achieve optimal resource allocation efficiency. Distorted resource allocation constrains enterprises' production operations and capital expansion capabilities in market competition, thereby limiting their sustainable development within the economy. On the other hand, the compliance costs brought by green finance for high-polluting enterprises also hinder the efficiency of resource allocation. In the field of environmental protection, China has implemented a series of policies targeting high-polluting enterprises, which includes imposing fines on enterprises that damage the ecological environment, levying environmental protection taxes on those with high energy consumption and carbon emissions, and dispatching special working groups to conduct on-site inspections for those high-polluting enterprises. These policies undoubtedly exert pressure on high-polluting enterprises to correct and reform, as well as raise pollution control costs, including penalties for violations and additional marginal costs incurred to fulfill environmental regulations (Zhang et al. 2011). The additional costs outlays occupy the production resources of enterprises, causing further loss of restricted resources (Gray and Shadbegian 1993). This further curtails these enterprises' ability to speed production and achieve high-quality transformation.

From the perspective of technological innovation channels, certain regulatory policies may impede high-polluting enterprises from engaging in technological innovation, forcing them to exit the market. One of the potential goals of green finance may be to compel high-polluting enterprises to undergo technological innovation through some constraining policies, transforming them from "profit-oriented" to "quality-oriented." However, this is not the case. On one hand, achieving a fully green production mode for high-polluting enterprises requires disruptive technological innovation and much higher innovation costs. On the other hand, faced with the situation of excessive investment in some high-polluting enterprises and a shortage of green investments, more credit funds are inevitably inclined to flow toward green enterprises. In addition to productive investments, some investments in technological upgrading of heavily polluting enterprises have been cut under the green finance policy. Numerous studies indicate that the accessibility of external financing is crucial in the process of enterprise technological innovation (Amore, Schneider, and Žaldokas 2013). Therefore, while green finance increases the motivation for high-polluting enterprises to undergo transformation and upgrades, the lack of discerning measures regarding enterprise motivations hampers the accumulation of research and development capital for high-polluting enterprises, impeding their technological innovation. Over time, heavily polluting enterprises find it challenging to undergo industrial upgrading,

and those unable to adapt to the green economy are inevitably destined to exit the industry, with diminishing production scales and difficult capital circulation (Yan 2021).

Therefore, we suggest the following hypothesis.

HP 2: Green finance impedes the resource allocation and technological innovation capabilities of emerging enterprises and high-polluting enterprises, leading to their exclusion from the market and, consequently, exerting adverse effects on the economy.

4. Research Design

4.1. Design of the Basic Model

To assess the economic growth and crowding-out effect of green finance, a double-difference model is adopted to analyze the implementation effects of green financial policies taking the Green Finance Innovation and Reform Pilot Zone as an event. To encourage green transformation and upgrade, in 2017, the State Council decided to establish the pilot zone of green financial innovation and reform and planned to implement it in Zhejiang, Jiangxi, Guangdong, Guizhou, and Xinjiang. The below explanation is the reason why the 2017 green finance pilot is chosen as a "quasi-natural experiment:" firstly, these five provinces exhibit distinct and representative differences in their development statuses. Secondly, the policy has been in place for years. How effective the policy is and whether it can be extended are the issues concerned by the government and scholars. This study takes "Pilot reform of green finance" as an event, gathers relevant data spanning from 2011 to 2020, constructs a double-difference model with each city as a sample, designating the "experimental area" as the experimental group and the "non-experimental area" as the control group. The baseline double difference model is shown as below.

$$lnGDP_{it} = \alpha_0 + \alpha_1 did + \sum \alpha_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{1}$$

$$lnPollution_{it} = \gamma_0 + \gamma_1 did + \sum \gamma_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{2}$$

$$lnGrowth_{it} = \delta_0 + \delta_1 did + \sum \delta_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{3}$$

We use the subscripts i and t to denote city and year, respectively. $lnGDP_{it}$ is the first explanatory variable, representing the economic growth effect. The second explanatory variable, $lnPollution_{it}$ accounts for the crowding-out effect on high-polluting enterprises from the perspective of industry entry thresholds, potentially hastening their exit from the industry. The third explanatory variable, $Growth_{it}$, measures the crowding-out effect on new firms from the perspective of industry entry threshold that reduces the entry rate of emerging enterprises. The principal explanatory variable is $did = Treat^{*}Period$, signifying the influence of implementing or not implementing green financing policies. The control variable is denoted by X_{it}, the individual (regional) and time effects are represented by μ_i andλ_i, respectively, and ε_{it} is the error term.

4.2. Indicator Selection

4.2.1. Explained Variables

GDP quantifies the economic growth of each region and helps us determine whether green finance has an impact on economic growth. As an important indicator of a region's economic development level, a higher GDP signifies a more favorable economic situation in the region and is positively correlated with economic performance. Therefore, in terms of indicator selection, this

paper measures the positive effect on economic performance in terms of the gross domestic product of each region (Qi 2023). Furthermore, this study examines the crowding-out effect of green finance by establishing variables based on industry entry and exit thresholds. With the promotion of financial policies, high-polluting enterprises have to abandon projects profitable but with heavy pollution, negatively affecting economic performance (Chen and Gong 2022). Hence, we use the percentage of profits generated by high-polluting enterprises within each city's economy to gauge the crowding-out effect. Given that the crowding-out impact on associated companies or sectors can be characterized by a decrease in the proportion of related profits, a higher contribution of the enterprise to the city's economy implies the less significant the crowding-out effect is. We calculated the net profits of listed businesses in 16 highly polluting industries for each city, adhering to the Ministry of Ecology and Environment's definition of these industries as outlined in the Guidelines on Environmental Information Disclosure for Listed Companies. The cumulative profits of significantly high-polluting enterprises for each city in a given year (t) was recorded as E_{it}, leading to the formulation of $\text{Pollution}_{it} = \frac{E_{it}}{\text{GDP}_{it}}$ as the second explanatory variable. In assessing the crowding-out effect that the heightened industrial entry threshold has on certain businesses, we adhere to the approach detailed in the literature (Liu et al. 2019) and utilize the net entry rate of enterprises as a proxy indicator. The net entry rate serves as a reflection of the presence of an entrepreneurship and innovative ecosystem within the economy. The higher the net entry rate of firms is, the entry barriers into the industry, and the less significant the crowding-out effect on emerging firms the lower. We calculate the net entry rate as follows: $\text{Growth}_{it} = \frac{NC_{it} - NC_{it-1}}{NC_{it-1}}$, where NC_{it} represents the number of enterprises in city i in year t, and NC_{it-1} represents the number of firms in city i in year t–1.

4.2.2. Main Explanatory Variables

In 2017, the People's Bank of China and seven government departments jointly released a general plan for the construction of a green finance reform and innovation pilot zone in the five provinces as mentioned above. These provinces vary in terms of their economic development levels and industrial structures, making them representative and pertinent areas, showcasing a spectrum of economic development stages. The main explanatory variable in this study pertains to whether the cities are encompassed within the pilot provinces implementing green financial policies. We use *Treat* as a geographical dummy variable, where pilot reform regions are assigned a value of 1, and non-pilot reform areas are designated as 0. Period is a time dummy variable, with a value of 1 in the year following the implementation of the experiment, and 0 in the year before the pilot's implementation. The fundamental explanatory variable in our model is *did* = *Treat*Period*, and its regression coefficient signifies the average treatment effect of the policy implementation on the treatment group.

4.2.3. Variables Under Control

Drawing from pertinent research, this paper selects the following five factors as control variables: (1) The share of secondary industry (*Second*). A higher (lower) share indicates a greater (lesser) economic contribution from secondary enterprises. (2) Financial development index (*FDI*). The level of financial development contributes to environmental pollution reduction, pollution control efficiency improvement, the acceleration of the transition to clean industries, and environmental quality improvement. The index is calculated by comparing the total deposits and loans of each city to the GDP of each region. (3) The rate of urbanization (*Urban*). As industrialization and urbanization advance, there is a growing trend of population migration from rural areas to urban centers and towns. This increased rate of urbanization leads to shifts in people's lifestyles and living environments, which in turn influence production activities. In this research, we calculate the urbanization rate using the ratio of the urban population to the total population. (4) Government environmental governance indicator (Governance). The more and wider the government's means of environmental governance, the more it

can foster sustainable economic growth. This study adopts the methodology from Chen and Chen (2018) to assess the government's environmental governance strength based on the frequency of terms related to environmental governance in government reports.

4.2.4. Intermediary Variable

To examine the mediating effects of technological innovation and resource allocation, this paper utilizes the number of invention patents in each prefecture-level city in the current year to measure the technological innovation capacity (Yu and Zhang 2017). Additionally, it employs the capital mismatch indicator to gauge the resource allocation capacity in each prefecture-level city (Ji, Zhu, and Zhang 2016).

4.3. Data Description and Statistical Analysis

Considering the implementation period of the policy is 2017, this paper compiles panel data for 283 prefecture-level cities in China spanning from 2011 to 2020. The data sources for the main variable include the China Statistical Yearbook and the China Stock Market & Accounting Research (CSMAR) database, while the control variables are extracted from the China Statistical Yearbook, the CSMAR database, the China Urban Statistical Yearbook, the China Energy Statistical Yearbook, and the China Population and Employment Statistical Yearbook. Furthermore, we preprocess the data, samples with missing values were deleted and the monetary value data were adjusted using 2011 as the base period. Table A1 contains the descriptive statistics.

5. Empirical Analysis

5.1. Parallel Trend Test

The parallel trend test is used to verify that the trends for the treated and control groups align before the policy's implementation, which is a prerequisite for applying the double-difference method. In cases where the disparities between the treated and control groups are substantial, the empirical results of the DID method may not accurately capture the net effect of the policy.

Figure 4–6 show the findings from the event trend analysis during the initial 5 periods and the concluding 3 periods of the event. It is evident that, before the policy's implementation, there were no discernible disparities between the $lnGDP_{it}$, $lnPollution_{it}$, $lnGrowth_{it}$ in the pilot area and the non-pilot regions, thereby satisfying the parallel trend assumption. After the launch of green financial innovation and reform pilot areas, the driving effect of the policy gradually appears, especially in the promotion of economic growth. And the crowding out effect brought by the green financial innovation and reform is slower, meeting the parallel trend hypothesis that is not strict. Based on this, this paper conducts further empirical tests.

Based on our findings, it becomes evident that the influence of green finance on economic performance is dominated by short-term effects. In the context of economic growth, the policy's beneficial impact exhibits an inverted U-shaped curve with the extension of time. Concerning the crowding-out effect, the most significant crowding-out impact of green finance on both high-polluting and emerging enterprises is observed in the initial period. Subsequently, the crowding-out effect of green finance on heavy polluters tends to level off, while the effect on emerging enterprises changes from crowding out to improving.

5.2. Baseline Regression Description

In this study, the growth and crowding-out effects are calculated and compared through the underlying regressions using the double-difference method, and the regression results are reported in Table 1. The primary explanatory variable in the growth effect model exhibits significance at the

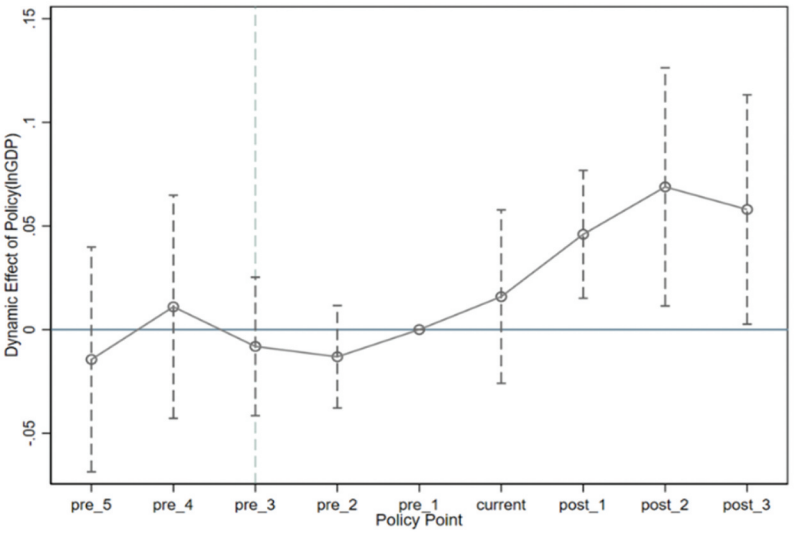

Figure 4. Parallel trend test for growth effect.

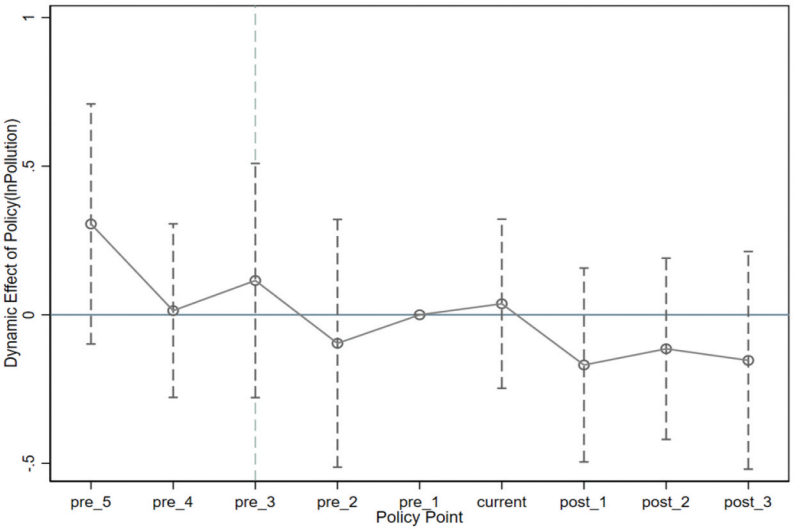

Figure 5. Parallel trend test for crowding-out effect – heavy polluters.

5% level, with a noteworthy coefficient of 0.0573, demonstrating that green financing effectively contributes to fostering economic sustainability. Green finance provides personalized financial services to different green enterprises through a combination of financial instruments and products, providing capital and production factors for sustainable economic growth (Xie and Yan 2021). In the crowding-out effect model, the coefficient for lnPollution is notably negative at a 10% significance level, showing that the advancement of green finance prompts high-pollution firms to withdraw from the market. It is evident that green finance, by steering credit resources, implementing green bonds, and other targeted policy measures, can successfully channel financial market funds toward new energy, energy conservation, environmental protection, and other green industries. As a result, it raises the financing costs for enterprises and projects associated with high

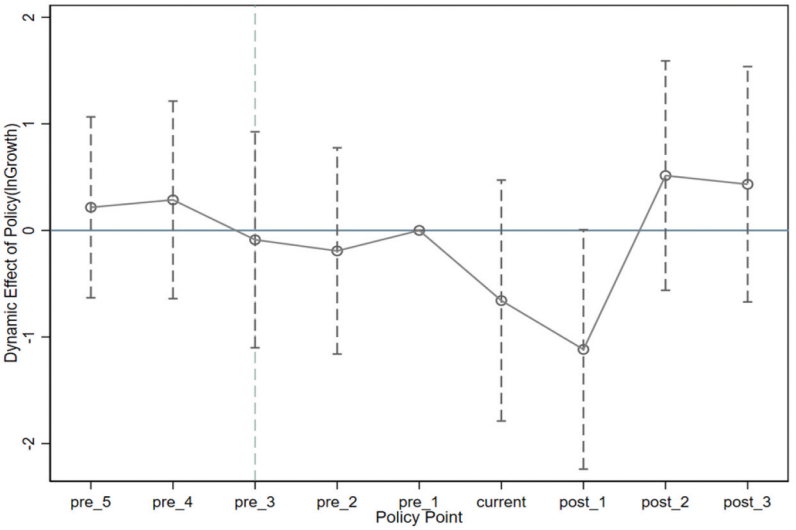

Figure 6. Parallel trend test for crowding-out effect – growing companies.

Table 1. Baseline regression results.

Variables	lnGDP	lnPollution	lnGrowth
did	0.057**	−0.212*	−0.215
	(0.028)	(0.111)	(0.254)
lnSecond	0.556***	0.025	−1.649**
	(0.121)	(0.404)	(0.691)
lnFDI	−0.325***	0.351**	−0.422
	(0.096)	(0.147)	(0.270)
lnUrban	−0.036	−0.813	0.313
	(0.095)	(0.540)	(0.677)
lnGovernance	−0.018	0.150	−0.067
	(0.018)	(0.256)	(0.249)
Constant	14.860***	−4.049	3.794
	(0.632)	(3.582)	(4.099)
Time fixed effects	Control	Control	Control
Regional fixed effects	Control	Control	Control
N	1,072	1,072	1,072
R^2	0.988	0.738	0.302

The symbols *, **, and ***indicate significance at the 10%, 5%, and 1% levels, respectively; standard deviations are in parentheses. This note also applies to subsequent tables.

energy consumption, high pollution, and overcapacity. Ultimately, this strategy facilitates the transformation of the industrial structure toward greener, more rational, and high-end sectors, as discussed in Ding, Jin, and Chen (2021). This is consistent with the green financial development concept, which focuses on high-quality economic growth while protecting the environment and saving energy. Green financial development also involves a commitment to fostering a low-carbon and circular economic system, which advances harmonious economic and social progress. It prioritizes the support and growth of clean and environment-friendly quality industries over pursuing crude growth that may have adverse environmental repercussions. The inconsistency with the results lies in the fact that green financial innovation reforms do not exert a substantial impact on crowding out of growth-oriented firms. This may be attributed to the following reasons. After the implementation of the pilot policy for green financial reform and innovation, there has been a heightened degree of optimization within the green financial organizational system in the

pilot areas. Banking and other financial institutions, considering the higher probability of loan defaults among high-pollution and high-emission enterprises, might reduce their loan issuance to such entities. The credit funds saved from this adjustment are redirected toward low-pollution, low-emission, and high-value-added emerging enterprises, enabling these businesses to secure sufficient funding for their innovative activities (Liu Li et al. 2023). Consequently, there is no crowding-out effect on emerging enterprises.

Among the control variables, the proportion of secondary industries and the financial development index are all key determinants of China's economic growth. The percentage of secondary industry exhibits a noticeably positive effect on economic growth, indicating that particular industries, such as those involved in infrastructure or building, play a pivotal role in driving economic growth. Simultaneously, the economic contribution of the secondary industry to the polluting industry has a negative impact, which also reflects that the current secondary industry is more inclined to green production methods. In the economic growth model, the financial development index exhibits a negative effect at the 10% significance level, contrary to the expected outcome. The financial development index is primarily used to assess the economic development level of provinces and municipalities. The result may be explained by the fact that provinces and municipalities with higher economic development level have already reached a more advanced stage of economic growth, potentially leaving them with fewer growth opportunities when compared to other regions that are currently in a phase of rapid development. In the crowding-out model, the financial development index exhibits a significant negative impact at the 1% significance level. Neither the level of urbanization nor the government's environmental governance capacity demonstrates a significant effect on economic growth or crowding-out phenomenon. The possible explanations for this are as follows. Urbanization may bring economic growth factors such as population mobility, employment opportunities, and market expansion, but it may also be accompanied by environmental pressures and resource depletion, resulting in more intricate and multifaceted effects. There might be a time delay in the government's environmental governance capacity, and it could require some time for improvements in economic and environmental conditions to materialize. Similarly, it may take time for the government's environmental governance measures to ameliorate conditions. This time temporal discrepancy may explain why substantial economic effects are not readily observable in the short term.

5.3. Robustness Tests

5.3.1. Placebo-Controlled Study

We conduct a robustness test by randomly selecting cities to further evaluate whether the empirical conclusions of this paper are affected by factors other than policy. The specific approach is as follows. In the dataset, the treatment group comprises cities in the five provinces. Due to potential missing data each year, the sample size varies annually, with an average of 28 cities in the treatment group. Therefore, we randomly select 28 cities as the "pseudo-processing group," assuming these selected cities are pilot cities for green financial policies. This process was performed 200 times to generate a matrix of *p*-values, estimated coefficients, and t-values for 200 regression results. Finally, the distribution of the 200 "pseudo-policy dummy variables" was plotted. If the actual values deviate significantly from the concentrated distribution of estimated coefficients, it suggests that the empirical results are not influenced by other unobservable factors in the placebo test.

As shown in Figures A1 and A2, most of the predicted coefficients for the economic growth effect are concentrated around 0 after 200 pseudo regressions, while the actual coefficients align with the red line perpendicular to the x-axis. This indicates a substantial disparity between the estimated values are and the actual ones. Additionally, the red dashed line, which signifies a *p*-value is 10%, reveals that the scatterplot of the vast majority of the estimated coefficients in this figure exceeds 0.1, showing that the influence of the placebo group on the explanatory variables is insignificant. Moreover, following 200 randomizations, the *t*-values are clustered around 0 and do not significantly deviate from the actual

t-value (2.03). This suggests that the estimates in this study are not a product of chance and are unlikely to be influenced by other factors.

Similarly, as shown in Figures A3 and A4, the estimated coefficients and *t*-values about the crowding-out effect caused by firm exit thresholds are near 0 and carry minimal significance (most *p*-values have significance levels exceeding 10%). The values significantly deviate from the actual values, suggesting that other factors are improbable to influence the estimated findings.

5.3.2. Solving the Sample Self-Selection Problem —— PSM-DID

Theoretically, if the selection of green finance pilots is completely randomized, a straightforward comparison of the differences in economic performance between pilot and non-pilot areas could capture the impact of green finance on economic performance. However, the choice of green finance pilot regions might be influenced by factors such as geographic location and economic development status, rather than being the result of random allocation. Considering this, this paper employs Propensity Score Matching (PSM) and utilizes nearest-neighbor matching (Rosenbaum and Rubin 1983; Shipman et al. 2017) for the pilot regions of green financial reform. This approach reconstructs samples that approximate random allocation and subsequently employs the matched samples for re-estimation.

The results of the balance test obtained with Nearest-Neighbor matching are shown in Table A2. We find that, firstly, the means of each covariate are not significantly different before and after matching (Mean Treated). Secondly, after matching, the standard errors of each covariate in both the control and treatment groups are significantly reduced. Specifically, the bias of lnSecond, lnFDI, lnUrban, and lnGovernance are reduced by 92.8%, 77.7%, 93.7%, and 81.5%, respectively. The mean deviations of the matched covariates are essentially less than 10% (%bias), which indicates that the two sets of variables are very similar in overall characteristics. Thirdly, after matching, the p-values of all covariates are greater than 0.05 so that none of them rejects the original hypothesis that "there is no systematic bias in covariate values between the two groups." Therefore, our empirical evidence passes the balance test. This is consistent with the hypothesis of double-difference equilibrium.

Table A3 shows the re-estimation results of the matched sample with Nearest-Neighbor matching, and the outcomes for the main explanatory variable are generally consistent with the baseline regression. After propensity score matching, the effect of green financial policies on economic growth decreases by 16.57%, the crowding-out effect on the economic contribution of heavy polluters increases by 16.04%, and the crowding-out effect on growth-oriented firms remains insignificant. This suggests that the green financial policy effect remains robust after using a more precise matched sample.

To show the reliability of the results, we additionally used Radius matching for the test. The results of the test pass the balance test and the final results remain robust. See Appendix A4 and A5 for specific tables.

5.3.3. Removing the Impact of Other Policies and Events

To mitigate the influence of policies such as <The Green Credit Banking Guidelines (2012) >, <The State Council's Guiding Opinions on Resolving Serious Overcapacity Contradictions (2013) >, and the 2020 epidemic shock on the policy identification of this study, we have chosen to conduct a robustness test using samples from 2014 to 2019 (Liu Peng et al. 2023). Table A6 displays the regression results. The results show that the sign and significance of the coefficients for the core explanatory variables are consistent even after accounting for the effects of other policies and events. This underscores the robustness of the findings.

5.3.4. Crowding-Out Effect —— Heavy Polluters Vs. Non-Heavy Polluters

To provide further evidence of green finance crowding out the contribution of heavy-polluting industries to the economy, the study compares the sample by categorizing it into heavy-

polluting industries and non-heavy-polluting industries. In this paper, we use $unPollution_{it}$ to denote the contribution of non-heavy polluting industries to the economy in each city. Table A7 displays the regression results. The comparison reveals that green finance does not diminish the extent of contribution from non-heavy-polluting industries to the economy, whereas it significantly reduces the contribution of heavy-polluting industries. The results further reinforce the notion that green finance specializes in crowding out heavy-polluting industries.

5.4. Expanded Analysis

5.4.1. Intermediate Mechanism

The findings of the preceding analysis indicate that green financial policies play an important role in fostering economic growth while also demonstrating their crowding-out effect on certain firms. As noted, green financial policies can influence economic growth through mechanisms such as technological advancement and effective resource allocation, as well as through lowering the fraction of heavily polluting firms via resource allocation and technology constraints. To delve deeper into the channels of influence, we employ Jiang's (2022) improved mediation effect as an additional examination.[1] The model for exploring the economic growth mechanism is formulated as follows:

$$lnGDP_{it} = \alpha_0 + \alpha_1 did + \sum \alpha_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{4}$$

$$lnPollution_{it} = \gamma_0 + \gamma_1 did + \sum \gamma_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{5}$$

$$lnPatent_{it} = b_0 + b_1 did + \sum b_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{6}$$

$$lnCapital_{it} = c_0 + c_1 did + \sum c_2 X_{it} + \mu_i + \lambda_i + \varepsilon_{it} \tag{7}$$

As depicted in Table A8. The coefficient $b_1$is significantly positive, indicating that the green financial policy has a promotional effect on technological advancement; c_1 is significantly negative, indicating that the green financial policy will mitigate the status quo of capital mismatch, facilitating the optimal allocation of resources. In terms of the growth effect, green finance, by providing credit support to green enterprises and issuing green bonds, alleviates the financial constraints on companies' research and development funds, thereby encouraging technological innovation and serving as a significant driver for enhancing economic development (Li 2023). In the path of economic development, the capital allocation effect of green financial activities can effectively mitigate the issue of excessive resource consumption and environmental damage associated with the public goods nature of resources of resources. Finally, it promotes the environmentally sustainable development of the economy (Wen et al. 2022). The faster the technological progress and the more efficient of resource allocation, the greater the benefits for economic growth (Feng, Feng, and Zheng 2022). Hence, green finance can promote economic growth by enhancing both technological innovation and resource allocation efficiency. Regarding the crowding-out effect, green finance serves as a mechanism for redistributing social resources. Green enterprises supported by green financial policies will receive more government and social capital support to improve technological innovation (Yu and Fan 2022). On the contrary, the physical operation of heavy polluters will be impacted by credit constraints, making it difficult to establish a more sustainable industrial ecosystem. Therefore, green finance can also squeeze out the contribution of heavily polluting industries to the economy through technological progress and optimal allocation of resources.

5.4.2. Regional Heterogeneity

China is vast, resource rich, and densely populated, with significant regional variations in economic and social development, resources, and environmental conditions. The role of green financing may cause significant regional imbalance, leading to regional heterogeneity to some degree. Given this, the sample is further divided into eastern, central, and western regions for regression analysis. The eastern region includes Beijing, Tianjin, Hebei, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan; the central region comprises Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan; the western region includes Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shanxi, Gansu, Ningxia, Qinghai, Xinjiang, Inner Mongolia and Guangxi (Source: National Bureau of Statistics of PRC).

As can be seen from Table A10, green financial policy significantly enhances the level of economic growth in the eastern region at the 1% level. Simultaneously, it significantly inhibits the contribution of non-compliant emission enterprises to the eastern region's economy at the 1% significance level. However, its effect on the central and western regions is not significant. The reasons for the emergence of regional heterogeneity are as follows. Firstly, regional development levels. The eastern region possesses relatively advanced technologies and a more diversified industrial structure. Consequently, the eastern region is more adaptable to the guidance of green financial policies, creating new focal points for green economic growth. In contrast, the central and western regions rely more on traditional resource-dependent city industries, resulting in a relatively homogeneous economic structure. Economic lag hampers their ability to conform to green financial policies and enhance the competitiveness of green industries. Secondly, differences in financial system efficiency. The eastern region exhibits higher efficiency in its financial system, as reflected in more effective mechanisms for green risk management and the swift implementation of measures such as green credit and green bonds. Efficient financial support contributes to the flourishing development of the green economy in the eastern region. Conversely, the financial systems in the central and western regions typically face challenges of inadequate risk management and inefficient capital circulation, which hinders the implementation of green financial policies. Thirdly, differences in marketization degrees. The eastern region has a more market-oriented economic system that can fully leverage resource allocation guidance, thereby promoting the green transformation of regional economic structures (Deng 2023). In comparison, the central and western regions may have a relatively lower degree of marketization, leading to issues such as industry over-reliance and inflexible resource allocation. Consequently, green financial policies encounter difficulties in effectively driving enterprise green transformation in these regions, limiting the impact of green financial policies on economic performance.

5.4.3. Resource-Dependent City and Non-Resource-Dependent City

Concerning < the National Sustainable Development Plan for Resource Cities (2013–2020)>, our study examines resource-dependent and non-resource-dependent cities separately. Table A11 displays the regression results. Our empirical findings reveal that the coefficients of green finance affecting the economic performance of resource-dependent cities are larger in absolute value and significance compared to non-resource-dependent cities. The possible reasons are as follows. Firstly, the economic development of the original resource-dependent cities may be affected by factors such as resource depletion, price fluctuations and geopolitical risks, all of which contribute to significant development uncertainties. And the proposal of green finance will force these enterprises to embark on technological innovation, leading to the attainment of stable economic growth. Secondly, resource-dependent cities are commonly linked to natural resource extraction and energy production (Bai Han et al. 2022). Green finance exposes resource-dependent cities to increase environmental regulations and regulatory pressures, potentially constraining their production capacity and market access.

6. Conclusions

This study examines the economic growth and crowding-out impacts of green finance from both theoretical and empirical angles. Theoretically, green finance can boost economic growth through two channels: coordinating resource allocation and accelerating technological R&D. Simultaneously, the implementation of green financial policies may potentially impede the entry of merging enterprises and the exit of polluting ones through a crowding-out effect. The empirical results show that, in general, green finance improves the level of economic growth and doesn't impede the entry of merging enterprises, while crowding out the contribution of heavy polluting industries to the economy. Green financial policies effect economic performance mainly through resource allocation and technological innovation. Specially, compared to the central and western regions, green finance has a more significant impact in the eastern region; both growth and crowding-out effect are more significant in resource-dependent cities.

Based on our theoretical and empirical research findings, we propose several policy recommendations. Firstly, the government should maintain its commitment to a market-based approach in green financial policies, avoiding excessive administrative intervention that may distort resource allocation. Empirical results demonstrate that the current green financial policy optimizes resource allocation structures and fosters sustainable economic growth. Therefore, it is crucial to further implement market-based green financial policies to ensure the autonomy of market players such as enterprises and financial institutions. Simultaneously, the government needs to continuously enhance the design of green finance-related systems by improving the incentive assessment system for green finance, enhancing mechanisms for preventing green finance risks, guiding commercial banks toward independent and effective engagement in green finance operations, and ensuring the orderly development of green financial policies. Secondly, the government must improve the market-oriented environment for the implementation of green financial policies in the central and western regions. Our empirical findings indicate that the growth impact of green financial policy on the central and western regions, as well as its crowding-out effect on high-polluting enterprises, do not exhibit statistical significance. This outcome may be attributed to differences in regional development levels, financial system efficiency, and marketization degrees. Therefore, it is crucial to enhance market-oriented reforms in the central and western regions, optimize their capital circulation channels, and augment investments in innovative funds, thus creating a more conducive overall environment for the effective implementation of green financial policies. Thirdly, the government should enhance green financial support for resource-dependent regions to facilitate the transformation and upgrading of heavy industrial cities. In comparison with non-resource-dependent cities, resource-dependent cities require more urgent attention toward green development, as empirical evidence demonstrates that the impact of green financial policies is particularly significant in these areas. Therefore, it is imperative to enhance policy support for resource-dependent cities and comprehensively employ innovative incentive mechanisms and pollution penalty mechanisms to facilitate their transformation and sustainable development.

Note

1. According to the reviewer's perspectives, we further investigated the impact of two mediating variables on the dependent variable, and the findings exhibited substantial statistical significance. Please refer to the attached Table A9 for the results.

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References

Amore, M. D., C. Schneider, and A. Žaldokas. 2013. Credit supply and corporate innovation. *Journal of Financial Economics* 109 (3):835–55. doi:10.1016/j.jfineco.2013.04.006.

Bai, J., Z. Chen, X. Yan, and Y. Zhang. 2022. Research on the impact of green finance on carbon emissions: Evidence from China. *Economic Research-Ekonomska Istraživanja* 35 (1):1–20. doi:10.1080/1331677X.2022.2054455.

Bai, X., J. Han, Y. Ma, and W. Wang. 2022. ESG performance, institutional investors' preference and financing constraints: Empirical evidence from China. *Borsa Istanbul Review* 22:S157–68. doi:10.1016/j.bir.2022.11.013.

Cai, H. J. 2015. Research on the impact of green credit on China's industrial transformation and upgrading under the new normal. *Friends of Accounting* 13:16–19.

Chen, S. Y., and D. K. Chen. 2018. Air pollution, government regulations and high-quality economic development. *Economic Research* 52 (2):20–34.

Chen, Z. G., and Y. F. Gong. 2022. Analysis of the impact and mechanism of green finance on corporate performance. *Economic and Management Review* 38 (5):72–85.

Deng, L. 2023. Green financial reform, innovation and high-quality development of enterprises: Incentive constraint effect or crowding-out effect? *Financial Economy* 06:32–43.

Ding, P., W. H. Jin, and N. Chen. 2021. Green finance development, industrial structure upgrading and sustainable economic growth. *Southern Finance* 02:13–24.

Feng, R. Y., G. F. Feng, and M. B. Zheng. 2022. Study on impacts of regional strategic emerging industry policy and capital market resource allocation on regional economic growth. *Journal of Xi 'An Jiaotong University (Social Science Edition)* 42 (6):64–76.

Goetz, M. 2019. Financing conditions and toxic emission. SAFE Working Paper, No. 254. doi:10.2139/ssrn.3411137.

Gray, W., and R. Shadbegian. 1993. Environmental regulation and manufacturing productivity at the plant level. NBER Working Paper, No. 4321.

Guo, J. J., and Y. Fang. 2022. Green credit, financing structure and corporate environmental investment. *World Economy* 45 (8):57–80.

He, L., R. Liu, Z. Zhong, D. Wang, and Y. Xia. 2019. "Can green financial development promote renewable energy investment efficiency?". A consideration of bank credit. *Renewable Energy* 143:974–84. doi:10.1016/j.renene.2019.05.059.

Hong, H., G. A. Karolyi, and J. A. Scheinkman. 2020. Climate finance. *The Review of Financial Studies* 33 (3):1011–23. doi:10.1093/rfs/hhz146.

Hong, H., N. Wang, J. Y, and S. Giglio. 2022. Welfare consequences of sustainable finance. *NBER working paper, No.28595*.

Huang, Y., C. Chen, L. Lei, and Y. Zhang. 2022. Impacts of green finance on green innovation: A spatial and nonlinear perspective. *Journal of Cleaner Production*: 1325–48. doi:10.1016/j.jclepro.2022.132548.

Humayun, M., N. Z. Jhanjhi, B. Hamid, and G. Ahmed. 2020. Emerging smart logistics and transportation using IoT and blockchain. *IEEE Internet Things Magazine* 3 (2):58–62. doi:10.1109/IOTM.0001.1900097.

Ji, S. B., Y. M. Zhu, and X. Zhang. 2016. Research on the improvement effect of industrial agglomeration on resource mismatch. *China Industrial Economics* 06:73–90.

Jiang, T. 2022. Mediating effects and moderating effects in causal inference. *China Industrial Economics* (5):100–20.

Labatt, S., and R. R. White. 2002. *Environmental finance: A guide to environmental risk assessment and financial products*. New York: John Wiley and Sons Ltd.

Lee, C. C., and C. C. Lee. 2022. How does green finance affect green total factor productivity? Evidence from China. *Energy Economic* 107:105863. doi:10.1016/j.eneco.2022.105863.

Lee, C. C., C. S. Wang, Z. He, W. W. Xing, and K. Wang. 2023. How does green finance affect energy efficiency? The role of green technology innovation and energy structure. *Renewable Energy* 219:119417. doi:10.1016/j.renene.2023.119417.

Li, B., J. Wang, A. A. Nassani, R. H. Binsaeed, and Z. Li. 2023. The future of green energy: A panel study on the role of renewable resources in the transition to a green economy. *Energy Economics* 127:107026. doi:10.1016/j.eneco.2023.107026.

Li, C. G. 2023. The impact of green finance on high-quality economic development. *Journal of Zhongnan University of Economics and Law* 67 (02):65–77.

Li, C. X., and X. Y. Wang. 2021. Research on policy effect of green finance on environmental pollution. *Journal of Hebei Institute of Environmental Engineering* 31 (2):1–5.

Li, X., Y. Jiang, X. Xin, A. A. Nassani, and C. Yang. 2024. The asymmetric role of natural resources, fintech and green innovations in the Chinese economy: Evidence from QARDL approach. *Resources Policy* 90:104731. doi:10.1016/j.resourpol.2024.104731.

Liang, F. H. 2017. Does foreign direct investment improve the productivity of domestic firms? Technology spillovers, industry linkages, and firm capabilities. *Research Policy* 46 (1):138–59. doi:10.1016/j.respol.2016.08.007.

Liu, H. W., L. Peng, and S. L. Zheng. 2023. Can green finance reform and innovation pilot zones enhance corporate capacity utilization? *Journal of Zhongnan University of Economics and Law* 05:134–48.

Liu, Y. B., J. Ge, and S. L. Guo. 2019. Does upstream overcapacity affect downstream business performance? An empirical study based on panel data of Chinese industrial enterprises. *Industrial Economic Research* 100 (3):63–76 +126.

Liu, Z. M., J. Li, and H. Shen. 2023. Green finance policies and high-quality development of urban economy: Evidence from the green finance reform and innovation pilot zone. *Financial Theory and Practice* (05):38–52.

Lu, J., Y. Yan, and T. J. Wang. 2021. The microeconomic effects of green credit policy-from the perspective of technological innovation and resource reallocation. *Chinese industrial economy* 01:174–92.

Ma, J., H. B. Meng, D. Q. Shao, and Y. D. Zhu. 2021. Green finance, inclusive finance and green agriculture development. *Financial Forum* 26 (3):3–8+20.

Monasterolo, I., and M. Raberto. 2018. The EIRIN flow-of-funds behavioral model of green fiscal policies and green sovereign bonds. *Ecological Economics* 144:228–43. doi:10.1016/j.ecolecon.2017.07.029.

Nandy, M., and S. Lodh. 2012. Do banks value the eco-friendliness of firms in their corporate lending decision? Some empirical evidence. *International Review of Financial Analysis* 25:83–93. doi:10.1016/j.irfa.2012.06.008.

Pan, A., Y. J. Liu, and G. C. Xiang. 2015. Research on industrial transformation and upgrading and overcapacity control: An overview of academic views of the '2014 annual meeting of China society of industrial economics'. *China Industrial Economy* 01:89–94.

Qi, Y. K. 2023. Green finance, technological progress and economic growth-theoretical analysis and empirical test based on general equilibrium model. *Lanzhou Journal* 03:16–30.

Qiao, A., S. H. Choi, and Y. Pan. 2021. Multi-party coordination in sustainable supply chain under consumer green awareness. *Science of the Total Environment* 777:146043. doi:10.1016/j.scitotenv.2021.146043.

Rosenbaum, P. R., and D. B. Rubin. 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70 (1):41–55. doi:10.1093/biomet/70.1.41.

Salazar, J. 1998. Environmental finance: Linking two world. A Workshop on Finance Innovations for Biodiversity Bratislava, Bratislava,Slovakia; 2–18.

Shen, H. 2016. Exploration of SME environmental project financing under the path of green finance – based on game theory. *Time finance* 23 (2):90.

Shipman, J. E., Q. T. Swanquist, and R. L. Whited. 2017. Propensity score matching in accounting research. *The Accounting Review* 92 (1):213–44. doi:10.2308/accr-51449.

Shi, D. M., and X. Y. Shi. 2022. Green finance and high-quality economic development: Mechanism, characteristics and empirical study. *Statistical Research* 39 (1):31–48.

Shi, J. Y., H. Yu, X. Li, and T. Wang. 2022. Does green financial policy affect debt-financing cost of heavy-polluting enterprises? An empirical evidence based on Chinese pilot zones for green finance reform and innovation. *Technological Forecasting and Social Chang* 179:1216–78. doi:10.1016/j.techfore.2022.121678.

Su, D. A., and L. L. Lian. 2018. Does green credit affect the investment and financing behavior of heavy polluting enterprises? *Research on Finance* 12:123–37.

Wang, R. 2019. Analysis of the effects of China's green finance policies based on the DID model. *Economic Developments & Commentary*: 35–48, 206–7.

Wang, Y., D. Y. Pan, Y. C. Peng, and X. Yang. 2019. China's incentive policies for green loans: A DSGE approach. *Financial Research* (11):1–18.

Wang, X., and Y. Wang. 2021. Research on the green innovation promoted by green credit policies. *Journal of Management World* 37 (6):173–88, 11.

Wen, S. Y., Z. F. Lin, and X. L. Liu. 2022. Green Finance and economic growth quality: Construction of general equilibrium model with resource constraints and empirical test. *Chinese Management Science* 30 (3):55–65.

Wu, B., F. Chen, L. Li, L. Xu, Z. Liu, and Y. Wu. 2024. Institutional investor ESG activism and exploratory green innovation: Unpacking the heterogeneous responses of family firms across intergenerational contexts. *The British Accounting Review*: 101324.

Xie, X. S., and S. P. Yan. 2021. The spatial spillover effect and path machine of green finance driving high-quality economic development system research. *Wuhan Finance* (10):22–34.
Xu, X., and R. Xu. 2023. Role of green financing and stability in the development of green resources in China. *Resources Policy* 85:1039–54. doi:10.1016/j.resourpol.2023.103954.
Yan, K. F. 2021. *Impact path and effect evaluation of green credit on industrial structure optimization and upgrading*. Shandong: Shandong University.
Yu, B., and C. L. Fan. 2022. Green finance, technical innovation and high-quality economic development. *Nanjing Social Sciences* 09:31–43.
Yu, X. L., and Y. Zhou. 2023. Green credit policy and green transformation of high-polluting enterprises: From the perspective of emission reduction and development. *The Journal of Quantitative & Technical Economics* 40 (7):179–200.
Yu, Y. Z., and S. H. Zhang. 2017. Urban housing prices, purchase restriction policy and technological innovation. *Chinese industrial economy* 06:98–116.
Zhang, B., Y. Yang, and J. Bi. 2011. Tracking the implementation of green credit policy in China: Top-down perspective and bottom-up reform. *Journal of Environmental Management* 92 (4):1321–27. doi:10.1016/j.jenvman.2010.12.019.
Zhang, L. 2019. Research on the effect of green finance on industrial structural adjustment. *Journal of Tianjin University of Commerce* 39 (5):34–41.
Zhang, T. 2023. Can green finance policies affect corporate financing? Evidence from China's green finance innovation and reform pilot zones. *Journal of Cleaner Production* 419:1382–89. doi:10.1016/j.jclepro.2023.138289.
Zhang, X. K., and J. Ge. 2021. Green finance policies and optimization of resources allocation efficiency in China. *Industrial Economics Research* 20 (06):15–28.