The Interaction between Government Guidance Mechanisms and Regional Economies

Yiran Chang
Department of Finance, Tianjin University of Finance and Economics, Tianjin, China

Abstract: Green finance plays a vital role in ensuring adequate and effective financial support for the broad green transition of China's economy and society. Nevertheless, the degree of success in this transformation differs considerably across provinces. Using data from 20 provincial-level regions covering the years 2010 to 2020, this study incorporates seven control variables and applies a difference-in-differences (DID) model to examine the influence and pathways of green finance policies on regional low-carbon development. The findings indicate that such policies have made a clear contribution to advancing low-carbon economic growth. Further analysis shows that improvements in innovation capacity and adjustments in the energy mix are the main channels through which the policies exert their effects. The heterogeneity test demonstrates that the positive impacts are most evident in eastern provinces and areas with more developed financial systems. Accordingly, it is suggested that differentiated green finance strategies be designed for regions with varying economic conditions and levels of financial development, placing greater focus on supporting innovative industries and improving the energy structure.

Keywords: Green Finance Policy; Low-Carbon Transformation; Regional Differences; DID Model

1. Introduction

In pursuit of carbon peaking and neutrality, China has strengthened its green financial framework, issuing policies that guide capital toward low-carbon industries while safeguarding energy security.

On March 5, 2025, the General Office of the State Council issued the "Guiding Opinions on Doing a Good Job in the 'Five Major Articles' of Finance," requiring the provision of high-quality financial supply for the comprehensive green transformation of economic and social development and the construction of a Beautiful China, and coordinating support for green development and low-carbon transitions. Furthermore, a series of policies, including the "Guiding Opinions on Doing a Good Job in the 'Five Major Articles' of Finance for the Banking and Insurance Industries" (Jinfa 〔2024〕 No. 11), the "Guiding Opinions on Further Strengthening Financial Support for Green and Low-Carbon Development" (Yinfa〔2024〕 No. 70), the "Opinions on Leveraging the Role of Green Finance in Serving the Construction of a Beautiful China" (Yinfa〔2024〕 No. 181), the "Guidance on Green Finance in the Banking and Insurance Industries" (Yinbaojianfa〔2022〕 No. 15), and the "Implementation Plan for High-Quality Development of Green Finance in the Banking and Insurance Industries" (Jinbanfa 〔2025〕 No. 15), have actively guided the financial industry to actively develop green finance, increase support for the green, low-carbon, and circular economy, and gradually establish a multi-tiered, broad-based, diversified, and sustainable green financial service system, effectively supporting the orderly and phased progress of carbon peak in key areas and regions.

At the same time, the country is launching pilot projects for low-carbon cities and low-carbon industrial parks, encouraging local governments and businesses to explore green transformation practices. For example, Huzhou City is exploring green finance models, with the proportion of green loans steadily increasing, and innovative products such as "Green Mining Loans" and "Photovoltaic Loans" have been launched (Huzhou Municipal People's Government, 2024). Guangdong Province is using green credit to support ecological agriculture and rural wastewater treatment, helping farmers increase their income (Guangdong Provincial People's Government, 2023). Caofeidian District in Tangshan, Hebei Province, is leveraging green bonds and carbon trading mechanisms to create a "zero-carbon industrial park" to attract new energy companies (Hebei Provincial People's Government, 2025) .

While green finance policies are showing initial success in promoting the transition to a low-carbon economy, numerous problems and shortcomings remain. On the one hand, due to varying economic foundations, industrial structures, and technological levels across provinces, some regions have achieved significant success under green finance policies, while others, lacking appropriate policy support or resource investment, have seen slower progress in their low-carbon transition. Furthermore, He Dexu and Miao Wenlong found that green finance policies also face challenges such as an imperfect regulatory system, insufficient liquidity, and a need to improve risk management capabilities[6].

Therefore, to enhance the role of green finance policies in promoting low-carbon transition and narrow regional disparities, this paper selected 20 provincial-level administrative regions in China between 2010 and 2020 as a research sample. This timeframe fully covers the key stages of China's low-carbon transition and the deepening of green finance policies (excluding data from 2021-2024, which was characterized by significant economic volatility). All sample regions participated in the development of national green finance reform and innovation pilot zones or were directly impacted by major green finance policies, such as the Green Bond Endorsement Project Catalog.

Using a DID model, this paper incorporates seven control variables—industrial structure, industrialization level, openness, technology market development, environmental regulation, energy intensity, and government intervention. The empirical strategy proceeds in four steps: first, conducting baseline regressions; second, performing robustness checks through parallel trend, placebo, variable substitution, and exclusion tests; third, examining the mechanisms of policy impact from the perspectives of innovation and energy structure; and finally, assessing heterogeneity across economic regions and levels of financial development.

2. Literature Review

Currently, Zhou di and Song Hong discovered that scholars are generally interested in how pilot regions can achieve environmental governance goals through special planning, setting emission reduction targets, promoting green technology research and development, and optimizing energy structures [11,13]. As a new financial model, green finance fundamentally differs from traditional finance in its ecological value orientation—the former internalizes environmental costs in investment and financing decisions, supporting environmentally friendly projects and technological innovation to achieve sustainable development. This innovative financial paradigm not only plays a key role in the green transformation of the economy but also promotes the optimization of capital allocation and the achievement of environmental governance goals. As the green financial system improves, its influence in addressing climate change, promoting the upgrading of low-carbon industries, and promoting sustainable development will continue to expand, becoming a crucial support for achieving the "dual carbon" goals[2].

Regarding the mechanism of financial policy action, Acemoglu Daron's theory of technological induction suggests that policy intervention can achieve emission reduction targets by altering the path of technological evolution [1]. In particular, the technological breakthroughs and innovations brought about by green finance policies can accelerate the upgrading of low-carbon industries. In 2022, Chen Shiyi found compared with command-and-control measures, market-based environmental policies are more efficient in resource allocation and can incentivize businesses and social capital to participate in the low-carbon transition [3]. Experience from many countries shows that combining factor optimization with technological innovation, this policy mix has steadily advanced industrial low-carbon development and strengthened the stability of green finance markets.

Studies indicate that China's carbon trading pilot program has enhanced enterprise green innovation, optimized industrial structure, and improved the energy mix. The policy effect is positively linked to regulatory intensity, highlighting the synergy between market mechanisms and government intervention. This shows that combining policy guidance with market incentives can drive low-carbon innovation, support green economic growth, and strengthen confidence in green investment.

Furthermore, in 2021, Hu angang found breakthrough in energy storage technology and the continued decline in storage costs provide key support for energy structure transformation, helping to optimize the energy supply and demand structure and advance the construction of a low-carbon energy system [5]. Advances in energy storage technology will directly enhance the absorption capacity of renewable energy and accelerate the low-carbon transformation of the power market and energy consumption structure. Against this backdrop[4], the deepening implementation of green finance policies will further promote the healthy development of the carbon market, promote sustainable economic development, and contribute to the achievement of the "dual carbon" goals. Currently, China is promoting the development of emerging industries through its "industrial" strategy, achieving breakthroughs in key technologies such as smart grids and clean energy storage. Ping Xinqiao et al have suggested increasing the proportion of low-carbon industries to 20% by a certain year, but policy implementation still faces challenges. [8] The main obstacle lies in the insufficient maturity of the green finance market, manifested in lagging financial product innovation, imperfect market mechanisms, and uneven regional development. In 2019, Kerui Du found underdeveloped regions face excessively high technology diffusion costs in promoting green technologies, necessitating the establishment of a precise, differentiated policy framework [6]. Furthermore, existing research remains largely theoretical, and empirical analysis of the impact of green finance policies on total factor productivity remains lacking. Therefore, it is recommended to improve the top-level design of the "dual carbon" strategy, establish an assessment system covering multiple key indicators, strengthen regional policy coordination and ensure effective policy implementation through dynamic evaluation of the actual effects of carbon intensity constraint policies.

Overall, most research focuses on green finance policy frameworks and financial instrument innovation. However, this research is primarily limited to theoretical development and instrumental innovation, lacking in-depth empirical analysis of the policy's actual effects and mechanisms[9]. In particular, the implementation of green finance policies varies significantly across regions, and there is a lack of systematic research on the challenges and obstacles encountered during policy implementation[10]. Future research should strengthen the dynamic tracking of policy implementation, drawing on regional practical experience to explore more refined and targeted green finance policies to promote the sustainable development of a low-carbon economy.

This paper, through empirical analysis, reveals the mechanisms by which government-led green finance policies promote low-carbon transitions in regional economies. This not only addresses the shortcomings of existing literature in analyzing policy interactions but also embodies the integration of theory and practice. The study finds that green finance not only provides financial support but also, through instruments such as credit, tax incentives, green bonds, and carbon markets, guides industrial restructuring, promotes low-carbon technological innovation, and boosts the development of clean energy and green manufacturing. The policy effects vary significantly across regions, suggesting that differentiated policies should be formulated based on economic development levels and industrial structures. Furthermore, green finance can help mitigate the impact of high-carbon industries on the financial system, enhance economic resilience, and support responses to global climate change and the "dual carbon" goals.

The novelty of this study lies in adopting a multi-dimensional empirical approach to evaluate the regional impacts of green finance policies. It highlights how differences across regions significantly shape policy outcomes and further investigates the ways in which such policies foster low-carbon economic transformation, particularly through pathways such as industrial restructuring, technological progress, and related mechanisms.

3. Study Design

3.1 Sample and Data Sources

This article uses 20 provincial-level administrative regions (including municipalities and autonomous regions) in China from 2010 to 2020 as a sample, covering the three major economic regions of east, central, and west. This sample encompasses developed regions such as Beijing, Shanghai, and Guangdong, as well as traditionally industrialized and ecologically vulnerable provinces. The sample period fully encompasses the key phases of the 12th and 13th Five-Year Plans (2010-2020), precisely corresponding to the period of China's low-carbon transition and the deepening of green finance policies. The regional selection takes into account both economic diversity and policy impact, encompassing both provinces hosting green finance reform pilot zones and non-pilot regions directly affected by the policies, ensuring policy coverage and regional representativeness of the research conclusions.

To ensure result stability, data from 2021–2024 are excluded due to pandemic-related macroeconomic volatility and policy uncertainty. This study draws on authoritative sources: macroeconomic data from the National Bureau of Statistics, financial data from the PBOC, CBIRC, and Guotai An CSMAR, environmental and innovation data from the Ministry of Ecology and Environment, the National Intellectual Property Administration, and CERDS, and green finance policy documents issued by the State Council and relevant departments (2016–2020).

3.2 Research Hypothesis

Based on the above literature and theoretical analysis, this paper argues that government-guided green finance policies are crucial for driving the low-carbon transition. Green finance not only channels capital to green industries but also encourages traditional industries to upgrade through institutional constraints and market signals, forming a dual push from policy and market forces. Accordingly, the following hypotheses are proposed:

H1: Green finance policies indirectly facilitate low-carbon transition by improving financial resource allocation efficiency, directing funds toward sustainable projects and reducing reliance on high-energy, high-emission industries.

H2: The effects of green finance policies vary regionally due to differences in economic bases, industrial structures, technology levels, and policy enforcement, leading to disparities among eastern, central, and western regions.

3.3 Indicator Selection

3.3.1 Explained variable

The primary objective of this study is to examine the impact of the release of green finance policies on the low-carbon transformation of provincial and municipal economies. To measure the performance of low-carbon transformation, this study uses green total factor productivity (GTFP) as a proxy for regional transformation and upgrading.

Total factor productivity refers to the comprehensive productivity of production units (mainly enterprises) as various factors in the system, as distinguished from factor productivity (such as technical productivity). Total factor productivity (TFP) is a variable that is conducive to economic growth (the value may be negative, zero or positive), including economic policies, the role of the government in the economy, work attitudes, positive external effects caused by educated labor, technological learning, etc. The main tool for measuring green total factor productivity is MLPI, and then four common and effective calculation methods have been extended and developed, namely two-period MLPI (BMLPI), global MLPI (GMLPI), sequential MLPI (SMLPI) and common frontier MLPI (MMLPI). This article mainly uses the two-period Manquist-Ruhnberg productivity index, that is, the two-period MLPI (BMLPI) method to measure green total factor productivity. The global MLPI (GMLPI) is used for robust regression in the following text. The calculation formula of BMLPI is as follows.

$$\mathrm{BMLPI}=\frac{D(x_t,y_t,b_t)}{D(x_{t-1},y_{t-1},b_{t-1})}=\mathrm{GEC}*\ \mathrm{GTC} \tag{1}$$

Where $x_t$and $y_t$represent the input and expected output of the period, respectively, brepresents the non-expected output of the period, $D(x_t,y_t,b_t)$and is the directional distance function of the evaluation object $t$under the period technology t. This paper uses DEA to solve this function.

$$D(x_t,y_t,b_t)=\max\{\theta|f(\lambda)\geq y+\theta b\} \tag{2}$$

The indicators used in estimating the GTFP of provinces and cities are:

Input variables: Labor (L): number of employees at the end of the year; Capital (K): capital stock; Energy consumption (E): total standard coal consumption after conversion.

Output variables: expected output, actual regional GDP (Y); undesired output, carbon dioxide emissions (CO2).

3.4 Explanatory Variables

The key explanatory variable in this study is the implementation of green finance policies. It is defined as a binary indicator: a province or municipality is assigned a value of 1 if it is a high-energy-consuming region, and 0 otherwise. A time dummy is also included, taking the value

1 after the policy is enacted and 0 before. Following Vig (2013), this paper classifies regions into treatment and control groups according to their energy intensity (energy consumption per unit of GDP). Regions in the top third of energy intensity are designated as the treatment group, whereas those in the bottom third form the control group.

3.5 Control Variables

To more accurately assess the impact of green finance policies on regional low-carbon transformation, it is essential to include a set of control variables to mitigate the influence of other factors and enhance the scientific rigor, reliability, and generalizability of the research findings. In order to more accurately identify the actual impact of green finance policies on regional low-carbon transformation, it is necessary to include a series of control variables to reduce the interference of other factors and improve the scientificity, reliability and generalization of research conclusions.

Table 1. Specific Meanings of Control Variables

Serial number	variable name	Abbreviation	definition
1	Industrial structure	IS	Output value of the tertiary industry/output value of the secondary industry
2	Industrialization level	IL	Industrial added value/regional GDP
3	Degree of external development	OP	(Total import and export value of goods*USD to RMB exchange rate)/GDP
4	Technology market development level	TM	Technology market turnover/regional GDP
5	Environmental Regulation	ER	Completed investment in industrial pollution control/industrial added value
6	Energy consumption per unit of GDP	EC	Total energy consumption/regional GDP
7	Degree of government intervention	GI	Fiscal expenditure/regional GDP

3.6 Descriptive statistics

Table 2 shows that the standard deviation of green total factor productivity (GTFP) is 0.0116, indicating small regional differences, but low-carbon transition is not uniform. The standard deviation of industrial structure (IS) is 0.7749, indicating that some regions have significantly upgraded their industries, while others still rely on high-energy-consuming industries. The standard deviation of energy consumption per unit of GDP (EC) is 0.7743, further confirming regional differentiation in energy efficiency. In contrast, the standard deviation of industrialization level (IL) is relatively small, indicating a relatively stable industrial base across regions. The standard deviations of technology market development (TM) and environmental regulation (ER) are relatively small (0.0323, 0.0039) , indicating a certain degree of consistency in policy implementation and technology diffusion.

However, policy effects vary across regions. In less developed regions, the lack of risk compensation mechanisms leads to higher costs for promoting green technologies, hindering the advancement of low-carbon transitions. Overall, the data reveals regional imbalances in low-carbon transitions, influenced not only by industrial structure and energy consumption patterns but also by policy implementation and the efficiency of technology diffusion.

Table 2. Descriptive Statistics of Variables

Stats	N	Mean	Std.dev	Min	Max
GTFP	220	0.9990	0.0116	0.9664	1.0340
DID	220	0.1818	0.3866	0.0000	1.0000
IS	220	1.2122	0.7749	0.4996	5.2968
IL	220	0.3129	0.0757	0.1179	0.5563
OP	220	0.2215	0.3169	0.0076	1.5482
TM	220	0.0167	0.0323	0.0002	0.1750
ER	220	0.0042	0.0039	0.0001	0.0310
EC	220	1.3780	0.7743	0.4590	5.3390
GI	220	0.2757	0.1080	0.1058	0.6430

4. Empirical Analysis

4.1 Model Setting

This study takes the Guiding Opinions on Building a Green Financial System, jointly issued by the People's Bank of China and several ministries in 2016, as a quasi-natural experiment, and applies a difference-in-differences (DID) model to assess how the introduction of the green financial policy framework has influenced the economy's low-carbon transition. Liu Desheng and Xie Yina existing research often uses a classification system based on high- and low-pollution enterprises to divide the treatment and control groups [7]. Alternatively, it uses a classification based on supportive and restrictive sectors for green finance. However, this paper focuses on the effectiveness of green finance policies at the provincial and municipal levels, so using industry or enterprise groupings is not appropriate.

As the Guiding Opinions on Establishing a Green Finance System applies uniformly across the country, this study, drawing on Vig's approach, differentiates regions by their sensitivity to the policy and further classifies them based on economic development levels.[12]. Regions with a high concentration of energy-intensive industries are typically associated with higher energy consumption and carbon emissions. Due to the uneven regional distribution of these industries, the restrictive effects of the green finance policy are most directly felt in these regions. Therefore, this paper calculates energy consumption per unit of GDP for each province and city and categorizes the sample into three groups: high, medium, and low. Finally, regions with the highest 33% energy consumption per unit of GDP are assigned to the treatment group, whereas those with the lowest 33% are assigned to the control group. This division highlights the spatial exogeneity of the policy and helps mitigate potential sample self-selection bias. To reduce the impact of heteroskedasticity, some variables in the model were logarithmized. Furthermore, to eliminate the potential interference of extreme values on the research results, continuous variables in the model were winsorized at the 1% and 99% quantiles. Based on this, this paper constructed the following benchmark model:

$$GTFP_{i,t}=\beta_0+\beta_1\times Post\times Treat+\rho lnX_{i,t}+\delta_t+\lambda_i+\varepsilon_{i,t} \quad (3)$$

Where $GTFP_{i,t}$ represents the green total factor productivity of each province or municipality at time t. It serves as a proxy for the level of regional transformation. PostIt is a time dummy variable for the period before and after the policy was released. Post=1 represents the period after the green finance policy was officially implemented nationwide, and Post=0 represents the period before the policy was implemented. Treat=1 indicates that the region is financially developed and more directly affected by the green finance policy, i.e., the treatment group, while Treat =0 represents the control group, representing regions with lower financial development and less affected industries. δ_t is a time fixed effect, controlling for common characteristics of the sample over time. λ_i is a location fixed effect, and $\varepsilon_{i,t}$ is a random error term.

The empirical analysis with Stata 17 includes baseline regression, robustness checks, mechanism analysis from innovation and energy structure perspectives, and heterogeneity analysis across regions and financial development levels.

4.2 Benchmark Regression

The baseline regression examines the direct impact of the policy, and then incorporates control variables to eliminate other interfering factors and control regional differences and time trends through fixed effects. Finally, clustered standard errors are used to improve the robustness of the estimation. Table 3 shows that, under different model settings—including controls, fixed effects, and clustering—the coefficients remain significantly positive, confirming that green finance policies promote regional economic transformation and upgrading.

Table 3. Benchmark Regression Results

	GTFP			
	(1)	(2)	(3)	(4)
DID	0.0071***	0.0082***	0.0076**	0.0076***
	(3.2195)	(2.9613)	(2.3494)	(3.2580)
lnIS		0.0008	0.0115	0.0115
		(0.1370)	(1.6087)	(1.7008)
lnIL		0.0042	0.0051	0.0051
		(0.4405)	(0.5760)	(0.8302)
lnOP		0.0047	0.0051	0.0051*
		(1.3906)	(1.6013)	(1.9293)
inTM		0.0005	-0.0007	-0.0007
		(0.3035)	(-0.4294)	(-0.4337)
lnER		-0.0025*	-0.0005	-0.0005

		(-1.7236)	(-0.2919)	(-0.1450)
lnEC		0.0058	0.0302***	0.0302*
		(0.9406)	(3.5631)	(1.9401)
lnGI		-0.0219**	0.0019	0.0019
		(-2.1317)	(0.1799)	(0.1076)
_cons	0.9977***	0.9694***	1.0044***	1.0044***
	(1.2e+03)	(50.7977)	(51.7901)	(50.5804)
Province fixed effects	yes	yes	yes	yes
Time fixed effects	no	no	yes	yes
Double clustering	no	no	no	yes
N	220	220	220	220

4.3 Robustness Test

4.3.1 Parallel trend test

In order to examine the dynamic impact before and after the policy is released in more detail, we further split the single time dummy variable "post" into multiple time dummy variables, including pre_5, pre_4, pre_3, pre_2, pre_1, current, post_1, post_2, post_3, and post_4. These time dummy variables are interacted with the treatment variable "treat" and re-incorporated into model (3) for regression analysis in order to more accurately capture the effects of different stages before and after the policy implementation.

As shown in Figure 1, the dynamic effects at several time points before policy implementation fluctuated roughly around zero, with no discernible trend. This indicates that before policy implementation, the underlying outcome trends for the treatment and control groups were parallel, and that they did not fluctuate around zero in subsequent periods, thus satisfying the parallel trend hypothesis. This parallel trend hypothesis was effectively verified. This analytical method helps reveal the temporal nature and gradual changes in policy effects, further confirming the research findings on the effectiveness of green finance policy implementation.

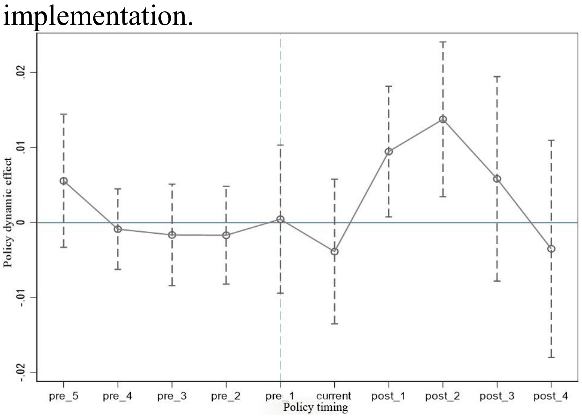

Figure 1. Parallel Trend Test Results

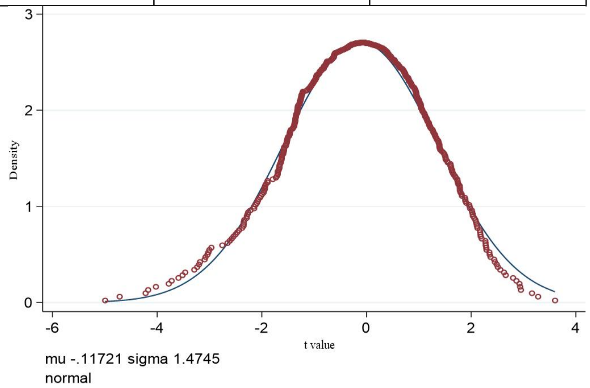

Figure 2. Placebo Test Results

4.3.2 Placebo test

A placebo test was conducted to assess the influence of unobserved factors on the effect of green finance policies. Figure 2 shows that, across 500 random simulations of policy timing, estimated coefficients cluster near zero, indicating minimal impact from unobserved factors. These results confirm the robustness of our findings and the effectiveness of green finance policies in promoting low-carbon transformation.

4.3.3 Eliminate other influences

During the policy shock period studied in this paper, the central government launched four rounds of environmental inspections (2016-2018). These initiatives not only targeted pollution control and the elimination of excess production capacity but also strengthened oversight of local governments and enterprises, prompting them to increase environmental investment in production processes and promote structural reforms. These environmental inspection policies effectively promoted the rational allocation of resources, reduced pollution emissions, and achieved significant environmental benefits. To accurately assess the effect of green finance policies while controlling for concurrent policies, the baseline regression includes a dummy variable for the environmental inspection policy (env_policy).

This allows a clearer estimation of the independent impact of green finance policies on low-carbon transformation. Regression results are reported in Table 4.

Even controlling for environmental supervision, green finance policies significantly promote low-carbon transformation, with supervision policies playing a complementary role (Table 4).

Table 4. Baseline Regression with the Addition of the Environmental Inspection Policy Dummy Variable

	GTFP	
	(1)	(2)
DID	0.0071***	0.0080***
	(3.0860)	(2.8348)
env_policy	0.0000	0.0014
	(0.0130)	(0.7298)
lnIS		0.0007
		(0.1253)
lnIL		0.0044
		(0.4682)
lnOP		0.0051
		(1.4725)
lnTM		0.0005
		(0.2806)
lnER		-0.0026*
		(-1.8002)
lnEC		0.0052
		(0.8320)
lnGI		-0.0226**
		(-2.1854)
_cons	0.9977***	0.9684***
	(1.1e+03)	(50.5252)
N	220	220

4.3.4 Replace the explained variable

Previous studies measured green total factor productivity (GTP) using a binary grouping approach. To improve robustness, this paper replaces the explanatory variable with GTP calculated via the Global Malmquist-Luenberger (GML) index and includes it in the regression. The GML index accounts for environmental factors and effectively captures changes in resource efficiency, providing a more accurate measure of policy effects on green productivity.

As shown in Table 5, the results remain significant across different green productivity measures, confirming the robustness of the findings. This demonstrates that green finance policies consistently promote low-carbon transformation, enhance green total factor productivity, and support sustainable economic development.

Table 5. Regression Results after Changing the Explained Variables

	GTFP	
	(1)	(2)
DID	0.0072***	0.0051*
	(3.2459)	(1.8184)
lnIS		0.0044
		(0.7438)
lnIL		0.0083
		(0.8786)
lnOP		0.0029
		(0.8588)
lnTM		0.0005
		(0.3333)
lnER		-0.0039***
		(-2.6815)
lnEC		0.0066
		(1.0755)
lnGI		-0.0167
		(-1.6265)
_cons	1.0003***	0.9728***
	(1.2e+03)	(51.0129)
N	220	220

5. The Impact of Green Finance Policies on the Low-Carbon Transformation of the Economy

5.1 Improved Innovation Level under Policy Guidance

Improving innovation levels is a key driver of regional economic transformation and industrial restructuring. With the continuous advancement of technological progress and industrial innovation, enhancing regional innovation capabilities can not only optimize industrial structures and improve production efficiency, but also significantly enhance the overall competitiveness of the regional economy.

Table 6 shows that the regression results for policy release and innovation level are 0.6693 and 0.1586, respectively, both significantly positive. This indicates that policy release significantly promotes regional innovation, specifically through positive influences such as policy guidance, financial support, and market incentives. By improving the regional innovation environment, policy release encourages enterprises to increase R&D investment and enhance technological innovation capabilities, thereby promoting the optimization of industrial structure and the transformation and upgrading of the regional economy.

Table 6. The Impact of Innovation Level on Regional Transformation and Upgrading

	INN	
	(1)	(2)
DID	0.6693***	0.1586*
	(3.5437)	(1.9102)
LnIS		0.3831**
		(2.4295)
LnIL		0.7006*
		(2.0315)
LnOP		0.0699
		(0.5222)
lnTM		0.0194
		(0.3829)
lnER		0.0868
		(1.5411)
lnEC		1.9962***
		(11.0808)
lnGI		1.2024***
		(3.5878)
_cons	9.0884***	11.9932***
	(54.1788)	(16.9514)
N	220	220

5.2 Green Finance Helps Optimize Energy Structure

Optimizing energy structures plays a crucial role in regional economic transformation and upgrading. With growing global attention to low-carbon development and sustainable development, optimizing energy structures has become a key initiative in promoting the green transformation of regional economies. Reducing reliance on traditional, high-carbon energy sources and increasing the proportion of clean energy use will not only help mitigate the impacts of climate change but also drive regional economic development toward a more environmentally friendly, low-carbon future.

As shown in Table 7, the regression results of policy release and energy structure are -0.0017 and -0.0050, both of which are significantly negative. Policy release promotes the optimization of regional energy structure and drives regional transformation and upgrading.

Table 7. The Impact of Energy Structure on Regional Transformation and Upgrading

	ES	
	(1)	(2)
DID	-0.0017*	-0.0050***
	(-1.8453)	(-5.4690)
lnIS		-0.0035*
		(-1.7387)
lnIL		-0.0010
		(-0.4000)
lnOP		-0.0004
		(-0.4477)
lnTM		-0.0010**
		(-2.3845)
lnER		0.0003
		(0.5903)
lnEC		-0.0182***
		(-7.5910)
lnGI		-0.0123***
		(-4.0388)
_cons	0.0308***	0.0124**
	(108.0240)	(2.2574)
N	220	220

6. Heterogeneity in the Issuance of Local Green Finance Policies

6.1 Analysis of Regional Heterogeneity and the Effects of Green Finance Policies

Using the division of eastern, central, and western regions, this paper examines the impact of green finance policies on industrial structure transformation across provinces. Table 8 shows notable regional differences. Columns (1)–(2) for the eastern region exhibit stronger and more significant effects, while the western region shows weaker effects, with column (5) even negative (-0.0003). This indicates that green finance policies are most effective in the eastern region and least effective in the western region, highlighting substantial regional heterogeneity in policy impact.

Table 8. Different Effects of Green Finance Policies Implemented in Different Regional Economic Zones

	GTFP					
	Eastern Region		Central Region		Western Region	
	(1)	(2)	(3)	(4)	(5)	(6)
DID	0.0070**	0.0216***	0.0023	0.0292**	-0.0003	0.0037
	(2.1740)	(4.9117)	(0.2459)	(2.3643)	(-0.0611)	(0.7347)
lnIS		-0.0287		0.0384		0.0027
		(-1.6308)		(1.1452)		(0.2675)

lnIL		0.0000		0.0161		0.0053
		(0.0001)		(0.4700)		(0.4186)
lnOP		0.0221		0.0208		0.0058
		(1.6560)		(1.5299)		(1.3939)
lnTM		-0.0017		0.0071		-0.0022
		(-0.6123)		(1.1071)		(-0.9664)
lnER		-0.0002		-0.0157**		0.0024
		(-0.1331)		(-2.3262)		(0.9183)
lnEC		0.0356		0.0583*		0.0354***
		(1.6242)		(1.8484)		(2.6981)
lnGI		-0.0202		-0.0572		0.0217
		(-1.4543)		(-1.4303)		(1.1375)
_cons	0.9968***	0.9650***	1.0008***	0.9092***	0.9989***	1.0451***
	(1.1e+03)	(31.5751)	(472.0292)	(11.8039)	(679.9239)	(27.0003)
N	55	55	44	44	121	121

6.2 Financial Development Level

The level of financial development is a key factor influencing the effectiveness of green finance policies and is often closely linked to the maturity of a region's financial system. A mature financial system, with well-established financial markets, a rich array of financial instruments, and efficient capital flow mechanisms, can provide more adequate and efficient financing support for green projects, thereby accelerating the low-carbon transition. This article uses the ratio of deposits and loans of urban financial institutions to GDP as an indicator of financial development. This ratio reflects the financing capacity of a region's financial institutions and the breadth of their financial services, indirectly measuring the maturity of the financial system. In the analysis, this article divides the sample into two groups: high and low levels of financial development, exploring the impact of different levels of financial development on the effectiveness of green finance policy implementation.

Table 9. The Impact of Green Finance Reform Policies in Regions with Different Levels of Financial Development

	GTFP			
	Regions with high financial development levels		Regions with low financial development levels	
	(1)	(2)	(3)	(4)
DID	0.0090***	0.0115***	0.0088**	0.0039
	(2.8452)	(2.6612)	(2.4454)	(0.7965)
lnIS		-0.0049		0.0086
		(-0.4816)		(1.0517)
lnIL		0.0091		-0.0003
		(0.4922)		(-0.0161)
lnOP		0.0079		0.0088
		(1.3175)		(1.3560)
lnTM		0.0002		-0.0008
		(0.0780)		(-0.3312)
lnER		-0.0021		-0.0038
		(-1.0459)		(-1.4906)
lnEC		0.0245*		-0.0034
		(1.6627)		(-0.3218)
lnGI		-0.0214		-0.0375**
		(-1.2992)		(-2.1213)
_cons	0.9963***	0.9830***	0.9980***	0.9357***
	(701.2140)	(27.3862)	(1.0e+03)	(30.8668)
N	111	111	106	106

The results in Table 9 show that policy implementation in regions with high financial development levels has significantly outperformed that in regions with low financial development levels. Each pair of columns presents the results of univariate regressions for high and low financial development levels, respectively, and regressions after adding control variables. The regression coefficients and significance are significantly positive at the 1% level for regions with high financial development levels, exceeding those for regions with low financial development levels. This suggests that green finance policies have a more pronounced impact on promoting low-carbon transition in these regions.

7. Conclusion and Policy Recommendations

Using a quasi-natural experiment and a DID model, this study examines the impact of government-led green finance policies on regional low-carbon transitions. Results show that these policies significantly promote low-carbon transformation by enhancing innovation and optimizing energy structures. The findings are robust, supported by parallel trend and placebo tests, controls for environmental inspection policies, and alternative measurement using the GML index.

The effects vary across regions, with a gradient of East > Central > West, and are stronger in areas with higher financial development, suggesting that mature financial markets better facilitate green finance initiatives.

To enhance the effectiveness of green finance in promoting sustainable development, several policy measures are proposed. First, the scope of green financial instruments should be broadened and policy implementation improved through unified standards, transparent disclosure systems, and coordinated regulation. Financial incentives such as preferential interest rates and tax benefits can further direct capital toward low-carbon sectors, supported by regular policy evaluations to ensure ongoing refinement. Second, differentiated regional strategies should be formulated according to local economic structures and levels of financial development. Developed regions may prioritize financial innovation and advanced green technologies, while less-developed areas should focus on improving green finance infrastructure and access to financial resources. Third, innovation should be strengthened by increasing R&D investment, establishing green technology funds, and promoting collaboration among enterprises, universities, and research institutions to accelerate the commercialization of low-carbon technologies. Finally, the optimization of the energy structure requires improving carbon market mechanisms and expanding financial support for renewable energy industries through fiscal incentives and green bonds. Collectively, these actions can strengthen innovation capacity, optimize resource allocation, and accelerate the transition toward a sustainable, low-carbon economy.

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