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How Does Green Finance Empower Green Technology Innovation? — From the Perspectives of Financing Constraints and Technology Spillovers

Xin Tan, Haozhe Huang

International College, Krirk University, Bangkok, Thailand
Guangxi Vocational College of Performing Arts, China
286979910@qq.com, huanghaozhe@hotmail.com (Corresponding author)

Abstract. Amidst the global urgency for carbon neutrality, green finance has emerged as a critical instrument to bridge the funding gap for sustainable development. Using micro-data from Chinese listed companies from 2010 to 2022, this paper investigates how green finance empowers corporate green technology innovation. We construct a comprehensive green finance index using the entropy weight method and employ multi-dimensional fixed effects models, mediation tests, and spatial Durbin models for empirical analysis. The results indicate that green finance significantly promotes corporate green technology innovation. Mechanism analysis reveals that alleviating financing constraints and facilitating technology spillovers are two vital transmission channels. Furthermore, the marketization level positively moderates the empowering effect of green finance. Notably, we identify a significant negative spatial spillover effect, suggesting that green finance development in one region may inhibit innovation in neighboring areas due to a "siphoning effect." These findings provide policy implications for improving the green finance system, optimizing resource allocation, and coordinating regional green development.

Keywords: Green Finance; Green Technology Innovation; Financing Constraints; Technology Spillovers; Spatial Spillover Effects; Marketization Level

1. Introduction

A Global climate change has evolved into one of the most severe challenges facing human society in the 21st century, necessitating decisive action to mitigate its impacts and facilitate economic transformation. In this context, China, as the world's largest developing country, has committed to peaking carbon dioxide emissions by 2030 and achieving carbon neutrality by 2060 (the "Dual Carbon" goals). Achieving these ambitious targets requires a profound systemic transformation of the economic structure, wherein Green Technology Innovation (GTI) serves as a fundamental engine. GTI can significantly improve resource efficiency and reduce emissions, offering a path to synergize economic development with environmental protection. However, GTI activities are inherently characterized by long investment cycles, high initial capital requirements, and significant technological uncertainty. These characteristics create severe financing constraints, as traditional financial systems often hesitate to support such high-risk projects due to information asymmetry and a focus on short-term returns. Consequently, constructing a specialized and efficient green finance system to bridge this funding gap has become a strategic priority for sustainable development.

To address these challenges, Green Finance (GF) has emerged as a new financial paradigm designed to guide social capital toward low-carbon industries and environmental projects. Since the release of the "Guidelines for Establishing a Green Financial System" in 2016, China’s green finance market has expanded rapidly. Despite this progress, the academic understanding of how GF empowers GTI remains incomplete. Existing literature largely focuses on the macro-level impacts of GF or relies on single-dimensional indicators—such as green credit balances or green bond issuance—which fail to capture the multidimensional nature of the green financial system. Furthermore, while the direct alleviation of financing constraints is a recognized pathway, the role of GF in fostering "technology spillovers"—the diffusion of green knowledge and expertise—remains underexplored. Additionally, most studies assume a positive spatial radiation effect of green finance, often neglecting the potential for negative spatial spillovers, or "siphoning effects," where financial resource agglomeration in one region may inhibit innovation in neighboring areas.

To fill this gap, this study constructs a comprehensive green finance development index and systematically investigates its impact on corporate green technology innovation. We utilize a micro-level dataset of Chinese A-share listed companies spanning from 2010 to 2022. Unlike studies relying on subjective weighting or single indicators, we establish a multi-dimensional evaluation system encompassing nine indicators across four core sectors: green credit, green investment, green insurance, and carbon finance. We apply the entropy weight method to objectively assign weights to these indicators, ensuring a scientific measurement of regional green finance development. By matching this macro-index with micro-enterprise patent data, we employ multi-dimensional fixed effects models to rigorously test the causal relationship between GF and GTI.

This study makes three primary contributions to the existing literature. First, regarding Index Construction, we move beyond the limitations of single-indicator approaches by establishing a scientific, comprehensive green finance indicator system weighted objectively via the entropy method. This avoids subjective bias and allows for a more accurate assessment of the true level of green finance development and its micro-level effects. Second, regarding Mechanism, we uncover a dual transmission channel. We demonstrate that green finance empowers GTI not only by alleviating "Financing Constraints" (FC)—providing necessary capital—but also by facilitating "Technology Spillovers" (TS), which promotes knowledge sharing and information exchange. Third, regarding Spatial Insight, we utilize the Spatial Durbin Model (SDM) to explore regional interactions. Contrary to the traditional view of positive radiation, we identify a significant negative spatial spillover effect, indicating that strong green finance development in one region may produce a "siphoning effect" that draws resources away from and inhibits innovation in economically connected neighboring regions. These findings provide nuanced empirical evidence for policymakers to optimize green financial systems and coordinate regional development.

2. Literature Review & Hypotheses

2.1. Green Finance and Green Technology Innovation

Green Technology Innovation (GTI) is characterized by "double externalities"—positive spillovers of knowledge and environmental benefits—alongside high risks and long investment cycles (Porter & van der Linde, 1995). These characteristics often lead to market failures where traditional financial systems, driven by short-term profit maximization, underinvest in green R&D. According to the Theory of Economic Development, the financial system plays a pivotal role in technological innovation by mobilizing savings (Schumpeter, 1911). Furthermore, Resource-Based Theory suggests that a firm's ability to acquire scarce capital determines its competitive advantage (Barney, 1991). Green finance (GF) addresses these needs by directing financial flows toward sustainable projects (UNEP, 2021).

From the perspective of Signaling Theory, the development of a regional green finance system conveys a strong policy commitment to sustainability (Spence, 1973). This signal reduces policy uncertainty for enterprises, encouraging them to engage in long-term R&D activities. Recent empirical studies have confirmed that green finance policies significantly boost corporate patent output by optimizing credit resource allocation (Jiang et al., 2022; Wang & Li, 2024). Based on this, we propose:

Hypothesis 1 (H1): Green finance has a significant positive impact on corporate green technology innovation.

2.2. The Mediating Roles: Financing Constraints and Technology Spillovers

This study identifies two primary transmission channels: the alleviation of financing constraints and the promotion of technology spillovers.

Financing Constraint Alleviation Channel Information Asymmetry Theory suggests that external investors often lack information about the quality of corporate R&D projects, leading to a "lemon premium" and severe financing constraints (Myers & Majluf, 1984). This issue is particularly acute for green innovation due to its technical complexity (Hall & Lerner, 2010). Green finance institutions alleviate this by acting as specialized information intermediaries. They utilize environmental risk assessment tools to screen projects, thereby reducing information asymmetry between banks and enterprises (He et al., 2022). Moreover, diversified instruments like green bonds broaden financing channels beyond traditional bank loans, reducing reliance on internal cash flow (Zhang, Y. et al., 2023; Li, Y. et al., 2024). When financing constraints are eased, firms are more likely to invest in high-risk green technologies (Yu et al., 2021). Thus:

Hypothesis 2 (H2): Green finance promotes green technology innovation by alleviating corporate financing constraints.

Technology Spillover Channel Endogenous Growth Theory emphasizes that knowledge accumulation and spillovers are engines of technological progress (Romer, 1990; Arrow, 1962). Green finance fosters technology spillovers through two mechanisms. First, the Agglomeration Effect: Financial resources tend to concentrate in specific sectors, guiding green enterprises to cluster. This proximity facilitates the flow of tacit knowledge and human capital (Marshall, 1890). Second, the Network Effect: Financial institutions act as "knowledge brokers." In the process of due diligence, they transfer best practices across portfolio companies, accelerating the diffusion of green technologies from leading firms to followers (Cheng et al., 2023; Xie et al., 2024). Recent studies also highlight that green finance cooperation promotes international technology transfer (Sampene et al., 2024). Therefore:

Hypothesis 3 (H3): Green finance promotes green technology innovation by fostering technology spillovers.

2.3. Moderation and Spatial Effects

The Moderating Role of Marketization Institutional Theory posits that the efficiency of resource allocation depends on the institutional framework (North, 1990). In China, the degree of marketization varies significantly across regions. In regions with high marketization, price signals are clearer, property

rights are better protected, and government intervention is less distortionary (La Porta et al., 1998). High marketization reduces transaction costs and enhances the efficiency of financial intermediaries in identifying high-quality green projects (Zhang, K. et al., 2021). Therefore, a market-oriented environment acts as an "amplifier" for the efficacy of green finance.

Hypothesis 4 (H4): The marketization level positively moderates the empowering effect of green finance on GTI.

Spatial Spillover Effects According to New Economic Geography, financial factors are mobile and prone to agglomeration (Krugman, 1991). While some studies suggest positive knowledge spillovers across regions (Li, C. et al., 2022), financial resources are inherently scarce. The "Core-Periphery" model implies that the rapid development of green finance in a central region may attract capital and talent from neighboring regions, creating a "Siphoning Effect" (or Backwash Effect) (Myrdal, 1957). If development is uncoordinated, advantaged regions may grow at the expense of their neighbors (Wang et al., 2025). We posit that this siphoning effect may dominate in economically connected areas.

Hypothesis 5 (H5): Green finance exerts a negative spatial spillover effect on green technology.

3. Research Design

3.1. Data Sources

This study utilizes a sample of A-share listed companies in China from 2010 to 2022. Green patent data are obtained from the Chinese Research Data Services (CNRDS) database, while other corporate financial data and regional macroeconomic indicators are sourced from the CSMAR and Wind databases. To mitigate the influence of outliers, all continuous variables are winsorized at the 1% and 99% levels. After excluding samples with missing values and financial firms, we obtained a balanced panel dataset with 38,570 observations.

3.2. Variable Measurement

Dependent Variable: Green Technology Innovation (GT)

We measure green technology innovation using the quantity of green patent authorizations. Compared to patent applications, authorizations represent a higher standard of innovation quality and actualized output. Specifically, we use the natural logarithm of the number of green patent authorizations plus one ($ln(1+Authorization)$) as the dependent variable.

Independent Variable: Green Finance (GF)

Given the multidimensional nature of green finance, relying on a single proxy (e.g., green credit) is insufficient. We construct a comprehensive Green Finance Development Index covering four dimensions: green credit, green investment, green insurance, and carbon finance. To ensure objectivity, we strictly follow the entropy weight method to assign weights to nine specific indicators and aggregate them into a composite index. The indicator system is detailed in Table 1.

Mediating Variables

Financing Constraints (FC): Following Hadlock and Pierce (2010) and relevant domestic literature, we construct a financing constraint index (FC). A Logit model incorporating firm size, age, and cash dividends is used to estimate the probability of financing constraints; a higher value indicates more severe constraints.

Technology Spillovers (TS): We measure technology spillovers using the natural logarithm of the number of patent citations received by the firm's green patents, which proxies for the diffusion and external usage of technical knowledge.

Control Variables

To isolate the effect of green finance, we control for firm-level and regional-level characteristics: Fixed Asset Ratio (faratio), Tobin's Q (tobin), Book-to-Market Ratio (mbratio), Debt-to-Asset Ratio (daratio), Return on Assets (roa), Firm Age (lnage), Ownership Concentration (topten), Regional GDP per capita (pgdp), and Regional Openness (trade).

Table 1. Indicator System for Green Finance Development

Dimensions	Indicators	Definition / Calculation Formula	Direction
Green Credit	High-energy-consuming interest ratio	Interest exp. of 6 high-energy industries / Total industrial interest exp.	Negative (-)
	Env. protection loan scale	Loans of listed env. firms / Total loans of A-share firms	Positive (+)
Green Investment	Env. protection market value ratio	Market value of env. firms / Total A-share market value	Positive (+)
	High-energy-consuming market value ratio	Market value of 6 high-energy industries / Total A-share market value	Negative (-)
	Pollution treatment investment	Investment in environmental pollution treatment / GDP	Positive (+)
	Energy conservation fiscal exp.	Fiscal expenditure on energy conservation / Total fiscal exp.	Positive (+)
Green Insurance	Agri. insurance scale	Agricultural insurance expenditure / Total insurance expenditure	Positive (+)
	Agri. insurance loss ratio	Agricultural insurance expenditure / Agricultural insurance income	Positive (+)
Carbon Finance	Carbon emission loan intensity	Loan balance / Total carbon emissions	Positive (+)

3.3. Model Specification

Baseline Regression Model

To test the direct impact of green finance on green technology innovation (Hypothesis 1), we construct the following multi-dimensional fixed effects model:

$$GT_{i,c,p,t} = \beta_0 + \beta_1 GF_{p,t} + \sum \beta_j Controls_{j,i,c,p,t} + \mu_p + \mu_c + \mu_i + \mu_t + \varepsilon_{i,c,p,t}$$

Where $GT_{\{i,c,p,t\}}$ represents the green innovation of firm i in industry c, province p, at year t; $GF_{p,t}$ is the green finance index of province p. $\mu_p, \mu_c, \mu_i, \mu_t$ represent province, industry, firm, and year fixed effects, respectively.

Mediation Effect Model

To verify the transmission mechanisms of financing constraints and technology spillovers (Hypothesis 2 & 3), we employ the standard three-step mediation procedure9:

Step 1: Test total effect (Equation 1).
Step 2: Test the effect of GF on mediators ($M_{i,c,p,t}$, representing FC or TS):

$$M_{i,c,p,t} = \gamma_0 + \gamma_1 GF_{p,t} + \sum \gamma_j Controls + FEs + \text{ò}$$

Step 3: Test the effect of both GF and mediators on innovation:

$$GT_{i,c,p,t} = \theta_0 + \theta_1 GF_{p,t} + \theta_2 M_{i,c,p,t} + \sum \theta_j Controls + FEs + \text{ò}$$

Spatial Durbin Model (SDM) To examine spatial spillover effects (Hypothesis 5), we construct the Spatial Durbin Model. Given that is firm-level data while is a regional variable, we focus on the spatial lag of the independent variable $(W \times GF)$:

$$GT_{i,c,p,t} = \beta_1 GF_{p,t} + \theta WGF_{p,t} + \sum \beta_j Controls + FEs + \text{ò}_{i,c,p,t}$$

Where W is the spatial weight matrix. We employ three matrices for robustness: the Geographic Adjacency Matrix, Inverse Distance Matrix, and Economic-Geographic Matrix. The coefficient θ captures the spillover effect of neighboring green finance development on local corporate innovation.

4. Research Design

4.1. Model Specification

Table 2. Descriptive Statistic

Variable	Obs	Mean	Std.dev.	Min	Max
GT	38570	0.3235	0.7318	0.0000	6.8680
GF	38570	0.1886	0.0651	0.0854	0.3899
faratio	38570	0.2037	0.1591	0.0016	0.6911
tobin	38570	2.0244	1.3421	0.8496	8.9094
mbratio	38570	0.6281	0.2497	0.1122	1.1770
daratio	38570	0.4299	0.2170	0.0525	0.9447
roa	38570	0.0362	0.0657	-0.2780	0.2149
lnage	38570	2.0325	0.9509	0.0000	3.3673
topten	38570	0.5888	0.1552	0.2292	0.9183
pgdp	38570	11.2223	0.4759	10.0498	12.1226
trade	38570	16.8917	1.3647	13.2533	18.6672

Note: Data sources include CNRDS, CSMAR, and Wind databases (2010-2022).

Table 2 presents the descriptive statistics. The mean of Green Innovation (GT) is 0.3235 with a standard deviation of 0.7318, showing significant variation. The Green Finance Index (GF) averages 0.1886.

4.2. Baseline Regression Analysis

Table 3 reports the multi-dimensional fixed effects regression results. The coefficient of GF in Column (3) is 0.6138, significant at the 1% level ($p<0.01$). This confirms that green finance significantly empowers corporate green technology innovation, supporting Hypothesis 1.

Table 3. Baseline Regression Results

Variables	(1) GT	(2) GT	(3) GT
GF	0.60	0.58	0.61
(Standard Error)	(0.08)	(0.08)	(0.08)
(p-value)	.000	.000	.000
Controls	No	Yes	Yes
Province FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	38,266	38,266	38,266
R2	0.72	0.72	0.72

4.3. Mechanism Analysis

Table 4 examines the mediating roles of Financing Constraints (FC) and Technology Spillovers (TS).

Hypothesis 2 (FC): Column (1) shows GF reduces FC (-0.1269). Column (2) confirms FC negatively impacts innovation (-0.0807).

Hypothesis 3 (TS): Column (3) shows GF promotes TS (1.0302). Column (4) confirms TS boosts innovation (0.0536).

Table 4. Mechanism Tests (Financing Constraints & Tech Spillovers)

	Financing Constraint Channel		Tech Spillover Channel	
Variables	(1) FC	(2) GT	(3) TS	(4) GT
GF	-0.13	0.51	1.03	0.46
(Standard Error)	(0.03)	(0.09)	(0.25)	(0.09)
(p-value)	.000	.000	.000	.000
FC		-0.08		

(Standard Error)		(0.02)		
(p-value)		.000		
TS				0.05
(Standard Error)				(0.00)
(p-value)				.000
Controls & FEs	Yes	Yes	Yes	Yes
N	32,708	32,708	32,708	32,708
R2	0.86	0.73	0.68	0.74

Note: Standard errors are in parentheses. p-values are reported below standard errors. FC denotes Financing Constraints (SA Index); TS denotes Technology Spillovers (Patent Citations).

4.4. Moderating Effect of Marketization

Table 5 shows that the interaction term GF × Market is significantly positive (0.0868). This indicates that a higher degree of marketization amplifies the empowering effect of green finance, supporting Hypothesis 4.

Table 5. Moderating Effect of Marketization

Variables	**(1) GT**
GF	0.57
(Standard Error)	(0.10)
(p-value)	.000
Market	-0.01
(Standard Error)	(0.01)
(p-value)	.104
GF × Market	0.09
(Standard Error)	(0.03)
(p-value)	.007

Controls & FEs	Yes
N	32,708
R2	0.73

Note: Interaction terms are centered.

4.5. Spatial Spillover Effects

Table 6 reports results from the Spatial Durbin Model (SDM). Under the Economic-Geographic Matrix (W_3), the spatial lag coefficient ($W \times GF$) is significantly negative (-1.0274). This supports Hypothesis 5, revealing a "siphoning effect" where strong GF development in one region may suppress innovation in economically connected neighbors.

Table 6. Moderating Effect of Marketization

Variables	(1) W1: Adjacency	(2) W2: Distance	(3) W3: Econ-Geo
GF (Direct)	0.63	0.58	0.48
(Standard Error)	(0.08)	(0.09)	(0.09)
(p-value)	.000	.000	.000
W × GF (Spillover)	0.29	-0.51	-1.03
(Standard Error)	(0.19)	(0.65)	(0.21)
(p-value)	.128	.427	.000
Controls & FEs	Yes	Yes	Yes
N	38,266	38,266	38,266
R2	0.72	0.72	0.72

Note: W_3 accounts for both geographical distance and economic disparity.

4.6. Robustness Checks and Endogeneity Tests

To ensure the reliability of our baseline findings, we conducted a series of robustness checks and endogeneity tests.

Robustness Checks

We performed four types of robustness tests:

Alternative Independent Variable: We replaced the entropy-weighted Green Finance Index with an index constructed using Principal Component Analysis (PCA).

Alternative Dependent Variable: We used the number of green patent applications instead of authorizations to measure innovation output.

Adjusting Sample Period: We narrowed the sample to 2012–2019 to exclude potential policy shocks and the impact of COVID-19.

Excluding Special Samples: We excluded municipalities directly under the central government (Beijing, Shanghai, Tianjin, Chongqing) to mitigate bias from their unique administrative status.

The results of all these tests showed significantly positive coefficients for green finance, consistent with the baseline regression, confirming the robustness of our conclusions.

Endogeneity Tests (IV Approach)

To address potential endogeneity issues arising from reverse causality (e.g., regions with higher innovation might attract more green finance), we employed the Instrumental Variable (IV) approach using the Two-Stage Least Squares (2SLS) method. We selected two instruments:

IV_1: The average Green Finance index of three provinces with similar GDP levels.

IV_2: The one-period lagged Green Finance index $(L.GF)$.

Table 7 presents the 2SLS regression results. Column (1) reports the first-stage results, showing that both instruments are significantly positively correlated with Green Finance ($p<0.01$). The Anderson LM statistic rejects the null hypothesis of under-identification, and the Cragg-Donald Wald F statistic exceeds the critical value (19.93), indicating no weak instrument problem. The Sargan test ($p=0.1642$) suggests the instruments are valid and exogenous. Column (2) reports the second-stage results, where the coefficient of Green Finance remains significantly positive (0.7534, $p<0.01$). This indicates that after correcting for potential endogeneity, green finance still significantly promotes green technology innovation.

Table 7. Moderating Effect of Marketization

Variables	**(1) First Stage (GF)**	**(2) Second Stage (GT)**
IV1 (GDP-based Avg GF)	0.03	
(Standard Error)	(0.01)	
(p-value)	.000	
IV2 (Lagged GF)	0.74	
(Standard Error)	(0.00)	
(p-value)	.000	

Table 7 (Continued)

Variables	(1) First Stage (GF)	(2) Second Stage (GT)
GF (Instrumented)		0.75
(Standard Error)		(0.13)
(p-value)		.000
Controls & FEs	Yes	Yes
Anderson LM Statistic	16759.60	

(p-value)	[.000]	
Cragg-Donald Wald F	14370.53	
Sargan Statistic (p-value)		.164
N	30,451	34,444

4.7. Heterogeneity Analysis

Table 8 analyzes regional and ownership heterogeneity. The impact of GF is significant in the Eastern/Central regions but not in the West. State-Owned Enterprises (SOEs) exhibit a stronger response (0.8393) than Non-SOEs (0.3227).

Table 8. Heterogeneity Analysis

	Panel A: By Region			**Panel B: By Ownership**	
Variables	(1) East	(2) Central	(3) West	(4) Non-SOE	(5) SOE
GF	0.73	0.84	0.02	0.32	0.84
(Standard Error)	(0.12)	(0.21)	(0.16)	(0.12)	(0.13)
(p-value)	.000	.000	.917	.007	.000
Controls & FEs	Yes	Yes	Yes	Yes	Yes
N	26,852	6,007	4,732	23,899	13,899
R^2	0.73	0.72	0.68	0.70	0.76

Note: Regional classification follows the National Bureau of Statistics of China.

5. Conclusion and Policy Implications

5.1. 5.1 Research Conclusions

Based on the empirical analysis of Chinese listed companies from 2010 to 2022, this study systematically investigates the impact of green finance on green technology innovation. The five core findings are summarized as follows:

Significant Promoting Effect

Green finance exerts a robust and significant positive impact on corporate green technology innovation. By optimizing resource allocation, green finance effectively channels funds into the green sector, serving as a fundamental driver for corporate technological progress.

Dual Mediation Mechanisms

The study clarifies the "black box" of transmission channels, identifying that green finance promotes innovation through two distinct paths: alleviating financing constraints and fostering technology

spillovers. It not only provides a financial "blood transfusion" by reducing funding costs but also enhances the "hematopoietic" function by accelerating the diffusion of technical knowledge.

Positive Moderation of Marketization

The institutional environment plays a critical role. The marketization level significantly and positively moderates the relationship between green finance and innovation. In regions with higher marketization, the efficiency of financial intermediaries is enhanced, thereby amplifying the promoting effect of green finance and strengthening the mediating channels.

Negative Spatial Spillover (Siphoning Effect)

Contrary to the common assumption of positive radiation, this study identifies a significant negative spatial spillover effect among economically connected regions. This suggests a "siphoning effect" where rapid green finance development in advantaged regions attracts capital and talent from neighboring areas, potentially suppressing their innovation vitality.

Multidimensional Heterogeneity

The impact of green finance is not uniform across different firms and regions. Regarding ownership structure, the promoting effect is more pronounced for State-Owned Enterprises (SOEs) compared to non-SOEs, likely due to SOEs' advantages in accessing policy resources and assuming social responsibilities. Regionally, the effect is significant in Eastern and Central China, whereas it is insignificant in the Western region, indicating that the efficacy of green finance relies on a certain level of economic foundation and innovation ecosystems.

5.2. Policy Implications

Drawing from the empirical evidence, we propose three targeted policy recommendations:

Improve the Multi-layered Green Finance System

To consolidate the financial foundation for innovation, policymakers should further diversify the green financial product system. Beyond traditional green credits and bonds, the development of green equity, venture capital, and insurance should be accelerated to match the high-risk, long-cycle characteristics of green R&D. Furthermore, a unified standard system and mandatory environmental information disclosure mechanism must be established. This will reduce information asymmetry and transaction costs, enabling financial institutions to accurately identify and support high-potential green projects.

Implement Differentiated and Precise Support Policies

Policies should move away from a "one-size-fits-all" approach and adapt to heterogeneity. First, given the stronger empowering effect on SOEs, additional support mechanisms—such as credit guarantees and specialized valuation models—should be designed for non-SOEs and SMEs to ensure fair access to green capital and stimulate their market vitality. Second, considering the regional disparity, specific financial policies should be tailored for the Western region. Instead of simply replicating the models of the East, policymakers should focus on building basic innovation infrastructure and talent cultivation in these under-developed areas to enhance their capacity to absorb green finance.

Strengthen Regional Coordination to Mitigate Siphoning Effects

To address the negative spatial externalities, a cross-regional coordination mechanism is essential. Local governments should avoid malicious competition for financial resources and instead establish regional green development funds and information-sharing platforms. Policies should guide the rational flow of green factors to prevent excessive concentration in a few centers. For under-developed regions (e.g., Western China), differentiated financial policies and infrastructure support are needed to cultivate local innovation ecosystems and achieve balanced regional development.

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