Economics & Business Management
ISSN Print: 3079-5214
ISSN Online: 3079-5222
https://doi.org/10.63313/EBM.9169

How Green Public Funds Empower Enterprises' New Quality Productivity — An Empirical Study Based on Path Analysis and Threshold Characteristics

Yilan Huang. Yuelan Ping and Maisha Liang*
China Jiliang University, Hangzhou, China
Email: 2300711107@cjlu.edu.cn

How to cite this paper: Huang, Y. L., Ping, Y. L., & Liang, M. S. (2026). How green public funds empower enterprises' new quality productivity — An empirical study based on path analysis and threshold characteristics. *Economics & Business Management*, 5(2), 1-19. ISSN Print: 3079-5214; ISSN Online: 3079-5222. https://doi.org/10.63313/EBM.9169
Published: 2026-04-03

Copyright © 2026 by author(s) and Erytis Publishing Limited.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/



Abstract

Against the backdrop of China's current efforts to deeply integrate green finance with high-quality development, green public funds, as an important market-oriented investment force, require in-depth research on their impact mechanism on corporate new-quality productivity. Based on data from A-share listed companies that received investments from green public funds between 2015 and 2024, this paper empirically investigates the influence of green public funds on corporate new-quality productivity. The study finds that introducing green public fund investments can significantly enhance corporate new-quality productivity, a conclusion that remains valid after robustness testing and endogeneity treatment. Heterogeneity analysis results indicate that green public funds have a more pronounced effect on promoting new-quality productivity in state-owned enterprises and non-heavy-pollution enterprises. Pathway analysis reveals that green public funds can improve corporate new-quality productivity by reducing carbon emission intensity, incentivizing green innovation, and alleviating financing constraints. Further research also demonstrates a dual threshold effect in the impact of green public funds on corporate new-quality productivity, with the promoting effect significantly strengthening when the fund's shareholding ratio exceeds a specific threshold value. This study provides evidence for green finance to boost new-quality productivity development and offers reference value for China to accelerate green transformation and build a modern industrial system.

Keywords

Enterprise New-Quality Productivity; Green Public Funds; Path Analysis; Dual Threshold Effect

1. Introduction

Currently, the global economy is transitioning toward green and sustainable development, with balancing economic growth and ecological conservation

becoming a consensus. Against this backdrop, General Secretary Xi Jinping proposed the crucial concept of "new-type productive forces," emphasizing that developing such forces is an inherent requirement and key focus for advancing high-quality development. The Third Plenary Session of the 20th CPC Central Committee stated that green development forms the foundation of high-quality growth, with new-type productive forces themselves constituting green productivity. As a vital force driving green development, green finance provides services including financing, project operations, and risk management for environmental protection, energy conservation, and clean energy sectors, effectively channeling social capital into green and low-carbon fields to promote economic transformation and sustainable development. China's green finance policy framework is rapidly maturing, with institutional safeguards ranging from the "Overall Plan for Ecological Civilization System Reform" (2015) to the "Green Finance Supported Projects Catalog" (2025). In recent years, green public funds have emerged as significant financial instruments. As of May 23, 2025, China's domestic market hosts 669 active ESG (Environment, Social, and Governance) public funds (typically including green-themed funds), totaling 824.232 billion yuan in assets under management. The continuous expansion of green public fund assets exerts profound influence on resource allocation optimization and industrial transformation promotion. A thorough exploration of the intrinsic connections and operational mechanisms between green public funds and enterprises' new-type productive forces not only helps reveal capital-driven innovation pathways, but also provides theoretical foundations and practical guidance for optimizing green financial policies and stimulating corporate innovation vitality. Therefore, Studying the impact of green public funds on enterprises' new-type productive forces holds significant practical implications for promoting high-quality economic development.

Previous studies have systematically explored issues related to new quality productivity from both macro and micro perspectives. At the macro level, research primarily focuses on defining the connotation and development pathways of new quality productivity, clarifying its strategic positioning, emphasizing the core driving role of scientific and technological innovation (Hu Hongbin, 2023)[6], analyzing the formation conditions and cultivation strategies for new quality productivity, and proposing coordinated strategies integrating technology, factors, and institutional frameworks (Sheng Chaoxun, 2024)[16]. At the micro level, existing studies predominantly examine influencing factors and operational mechanisms of new quality productivity. For instance, ESG practices not only enhance new quality productivity by improving corporate stakeholder relationships (Song Jia et al., 2024)[18] but also effectively drive low-carbon economic transformation through green technological innovation (Sun Xiaoting et al.[20], 2024; Dai, 2025; Khalil et al., 2023). Digital technological innovation, for example, significantly promotes new quality productivity development through multiple mechanisms, including

enhanced digital integration, activation of redundant resources, and improved production efficiency (Qiu Jing et al., 2025)[15]. In terms of institutional policies, measures such as optimizing science and technology management systems, strengthening digital talent cultivation (Chen Xiuying et al., 2024)[3], relaxing market access restrictions (Sun Shiqiang, 2024)[19], and refining fiscal incentives (Zhao Guoqing, 2024)[29] play crucial roles in fostering enterprise new quality productivity. Although green development has garnered widespread attention, the relationship between green finance—as a key driver of green transition—and new quality productivity remains an area requiring further in-depth exploration.

In academic research on the impact of green finance on new quality productivity, most studies focus on areas such as green bonds and green credit. For instance, corporate issuance of green bonds can enhance new quality productivity through green technological innovation and alleviating financing constraints (He Pingjun and Wang Zhenyi, 2025[5]; Zhao Lili, 2025[30]), while green credit policies facilitate resource-based enterprises in developing new quality productivity by leveraging environmental regulation and resource allocation coordination (Li Cunfang, 2024)[11]. Beyond these positive findings, some studies have yielded negative or inconclusive results. The implementation of green credit policies may suppress corporate innovation quality to varying degrees (Zhang Yinsai, 2023; Wang Xin [22], 2024; Yu Xulan, 2023 [26]). Berikhanovna et al. (2023)[32] further discovered that green credit policies significantly promote technological innovation in large enterprises but show limited effectiveness for small and medium-sized enterprises. Overall, existing research predominantly concentrates on traditional policy instruments like green credit and green bonds, while insufficient attention remains given to the role of market-oriented capital such as green public funds.

Research on green public funds primarily focuses on economic benefits, innovation incentives, and environmental performance. Notably, these funds not only motivate enterprises to implement more green initiatives and enhance green governance outcomes (Jiang Guangsheng et al., 2021)[9], but also effectively boost corporate green innovation capabilities by alleviating financing constraints and reducing information asymmetry (Chie et al., 2023; Jin Yu et al., 2022[10]). Furthermore, green public funds exert regulatory oversight and incentive-driven effects to curb corporate greenwashing practices (Zhou Min et al., 2024)[31]. These findings suggest that green public funds may influence corporate new-quality productivity through unique mechanisms, representing a critical gap in existing research frameworks that requires urgent integration.

While existing studies have separately demonstrated the impact of green bonds and green credit on new-type productivity, as well as the role of green public funds in corporate green behavior, there is a lack of empirical research directly linking green public funds to corporate new-type productivity. Moreover, these studies have not elucidated the transmission pathways or heterogeneous characteristics between the

two. Based on data from A-share listed companies that received green public fund investments between 2015 and 2024, this paper aims to explore effective pathways for accelerating new-type productivity development from the perspective of financial support.

Specifically, the marginal contributions of this study lie in three key aspects: First, it expands the research perspective on influencing factors of new-quality productivity by focusing on the emerging field of green public funds. Due to their relatively short development history and indirect mechanisms of impact on new-quality productivity, existing research in this area remains insufficient. Second, it analyzes the micro-level mechanisms through which green public funds enhance corporate new-quality productivity, demonstrating their effects via carbon emission reduction, improvement of green technology innovation capabilities, and alleviation of financing constraints. Third, it reveals the nonlinear characteristics and threshold effects of green public funds' influence on corporate new-quality productivity, deepening understanding of their operational boundaries. This study aims to establish that green public funds exhibit an "optimal threshold range" in promoting new-quality productivity, thereby exploring their underlying mechanisms and heterogeneous manifestations to provide scientific basis for precision-oriented green financial support policies.

2. Hypothesis In Theory

New-type productive forces, catalyzed by technological breakthroughs and innovative allocation of production factors, possess ecological efficacy in driving green production and low-carbon development. Currently, China has systematically established three pillars: green and low-carbon transition strategies, innovation-driven technological advancement, and financial empowerment systems. Green mutual funds, as market entities combining green finance attributes with institutional investor roles, primarily invest in energy conservation, environmental protection, and clean energy sectors. These funds can alleviate corporate financing constraints (Zhang W, 2024) [34] and leverage their professional investment management capabilities along with active shareholder engagement to guide enterprises in concentrating resources on green technology R&D and production efficiency enhancement (Jiang Guangsheng et al., 2021 [9]; Cai Guilong, 2023) [1]. The green innovation practices embedded within these funds directly propel technological innovation and factor restructuring, serving as strategic cornerstones for overcoming ecological-economic transition bottlenecks and cultivating sustainable competitive advantages—aligning with the core requirements of new-type productive forces. However, this catalytic effect may not follow a linear pattern. When fund holdings exceed specific thresholds, compliance costs for environmental governance may divert resources from core technological innovation, resulting in diminishing marginal support effects and nonlinear characteristics (Qi

Jia, 2024)[14]. Based on this analysis, this study proposes the following hypothesis:

H1: Green public funds exhibit an "optimal threshold range" in their role of promoting new-type productivity in enterprises.

The essence of new-type productivity lies in green productivity. Reducing corporate carbon emission intensity serves as the core manifestation of enterprises' commitment to green development. Green public funds can promote new-type productivity by driving corporate decarbonization efforts. With green attributes as their investment focus, these funds allocate capital to support targeted low-carbon projects (such as clean energy substitution and carbon capture technology applications) (Jiang Guangsheng et al., 2021), providing financial support for corporate carbon reduction. As professional institutional investors, they also supervise enterprises through enhanced ESG disclosure and governance participation (Zhou Min et al., 2024)[31], compelling companies to establish carbon emission control systems and reduce high-carbon production practices. During the process of lowering carbon emission intensity, enterprises tend to shift production factors toward low-carbon and efficient sectors, aligning with the "innovative allocation of production factors" characteristic of new-type productivity. Moreover, technological R&D and process innovations required for decarbonization can facilitate clean and intelligent upgrades in production workflows, breaking traditional high-carbon production patterns—key to cultivating new-type productivity. Additionally, the green advantages generated through decarbonization enable enterprises to secure policy support and market recognition (Song Jia et al., 2024)[18], paving the way for new-type productivity development. Therefore, Hypothesis 2 is proposed.

H2: Green public funds can enhance corporate new-quality productivity by reducing corporate carbon emission intensity.

Technological innovation serves as the core requirement for developing new-quality productive forces, where both the "quantity" and "quality" of technological innovation are crucial to their formation (Hu Jianbo, 2024)[7]. Corporate new-quality productive forces represent the micro-level manifestation of such forces at the enterprise level, emphasizing how companies enhance production efficiency and competitiveness through technological innovation (Zhang Yunping, 2024)[28]. However, due to the long-term nature and high risks associated with innovation activities, they often require substantial capital investment with slow returns, leading to insufficient support from traditional financial markets (Wu Weixing, 2024)[24]. By issuing green public funds, enterprises can obtain stable medium-to-long-term funding, which helps mitigate financial risks caused by lengthy R&D cycles and delayed capital recovery. Additionally, increased project transparency during green fund issuance processes reduces information asymmetry, boosts investor confidence, lowers corporate financing costs, and provides more robust financial support for green innovation projects, thereby further advancing

corporate new-quality productive forces. Based on these findings, Hypothesis 3 is proposed.

H3: Green public funds can enhance corporate new-quality productivity by fostering green technological innovation in enterprises.

Capital serves as a vital resource for driving efficient corporate operations, market expansion, and innovation, yet financing constraints remain a key factor limiting high-quality enterprise development. These constraints can reduce corporate R&D investment incentives and scale (Chen Junying, 2023)[2], impair production innovation efficiency (Zhang Luyao, 2023)[27], and hinder the development of new-type productive forces. Green public funds possess fundamental characteristics of green financial instruments, with alleviating financing constraints being a core function of green finance. The Clean Reform Model developed by Peng Bin and Peng Fei (2017)[13] demonstrates that increasing green institutional investors can lower corporate capital costs, ease external financing constraints, and promote sustainable development. As an emerging financing tool, green public funds provide enterprises with direct financing channels, reducing reliance on bank loans while offering stable funding for long-term, capital-intensive green projects. Their environmental attributes not only attract investors with green preferences and enhance market appeal but also lower corporate financing costs through "green premiums," stimulating R&D investment willingness and fostering new-type productive forces. Based on these findings, Hypothesis 4 is proposed.

H4: Green public funds can enhance enterprises' new-type productivity by easing financing constraints.

3. Research Design

3.1. Model building

To validate the aforementioned theoretical derivations and hypotheses, this study establishes the following model:

$$NPro_{it} = \alpha_0 + \alpha_1 Greenshare + \alpha_2 Controls + \mu_i + \tau_t + \varepsilon_{it} \quad \text{Equation (1)}$$

The core explanatory variable Greenshare in Equation (1) represents the shareholding ratio of listed companies, while the explained variable $NPro_{it}$ measures the level of new-quality productivity (%). Controls represents control variable, while μ_i represents the individual fixed effect at the enterprise level. τ_t represents the time-fixed effect. In the regression model, the coefficient of concern is α_1, which represents the impact of green public funds on the new quality productivity of enterprises, while is the random error term.

$$CI_{it} = \beta_0 + \beta_1 Greenshare + \beta_2 Controls + \mu_i + \tau_t + \varepsilon_{it} \quad \text{Equation (2)}$$

$$Patent_{it} = \gamma_0 + \gamma_1 Greenshare + \gamma_2 Controls + \mu_i + \tau_t + \varepsilon_{it} \quad \text{Equation (3)}$$

$$FC_{it} = \delta_0 + \delta_1 Greenshare + \delta_2 Controls + \mu_i + \tau_t + \varepsilon_{it} \quad \text{Equation (4)}$$

Equations (2), (3), and (4) jointly constitute the model set for path analysis, aiming to analyze the specific channels through which Greenshare affects NPro. Among them, CI_{it}、$Patent_{it}$ and FC_{it} represent carbon emission intensity, green technology innovation, and financing constraints, respectively. The coefficient β_1 measures the effect of green investment through the path of reducing carbon emissions per unit of output. The coefficient γ_1 measures the effect of green investment through the path of stimulating enterprise technological innovation.

The coefficient δ1 measures the effect of green investment through the path of alleviating the financing pressure on enterprises.

$$NPro_{it} = \theta_0 + \theta_1 Greenshare \times I(Greenshare < \omega_1) + \theta_2 Greenshare \times I(\omega_1 \leqslant Greenshare < \omega_2) + \theta_3 Greenshare \times I(Greenshare \geqslant \omega_2) + \theta_4 Controls + \mu_i + \tau_t + \varepsilon_{it} \quad (5)$$

To explore the non-linear impact of green public offering funds on enterprises' new quality productivity, a panel threshold model as shown in Equation (5) is constructed.

Here, I(·) represents the indicator function, ω_1、$\omega_2$are the threshold values to be estimated, θ_i is the impact coefficient of different Greenshare on NPro.

3.2. Variable selection

3.2.1. Explained variable

New-type productivity refers to the productivity demonstrated by enterprises through innovation activities, encompassing two key dimensions: labor force and production tools. This study adopts the research methodology and indicator system proposed by Song Jia et al. (2024)[18] to measure corporate new-type productivity. Specifically, based on the two-factor productivity theory, we employ the entropy method to allocate weights and perform comprehensive calculations for various indicators, thereby deriving a comprehensive metric that reflects an enterprise's innovation capabilities and production efficiency.

Table 1. Framework for Constructing New Quality Productivity Indicators for Enterprises

Primary indicator	Subfactor	Metric	Quantitative index
labour force	active labor	Research and development personnel salary ratio	R&D expenses-salaries and compensation / operating revenue
		Research and development personnel ratio	Number of R&D personnel/total employees
		Proportion of highly educated individuals	Number of employees with bachelor's degree or above / total employees
	Materialized object (subject of labour)	Fixed assets proportion	Fixed assets/total assets
		Manufacturing cost ratio	(Cash outflow from operating activities subtotal + Fixed asset depreciation + Intangible asset amortization + Impairment provision-Cash paid for goods and services received-Payments to employees and employee salaries) / (Cash outflow from operating activities subtotal + Fixed asset depreciation + Intangible asset amortization + Impairment provision)
Primary indicator	Subfactor	metric	quantitative index
tool of production	Hard Technology	Research and development depreciation and amortization ratio	R&D expenses-Depreciation and amortization / Operating revenue
		R&D lease expense ratio	R&D expenses-lease expenses/operating revenue
		R&D direct investment ratio	R&D expenses-direct investment/operating revenue
		intangible assets ratio	intangible assets/total assets

	Soft technology	turnover of total capital	Operating revenue/Average total assets
		inverse of equity multiplier	Owners' equity/total assets

Appendix 1-2: Indicator Construction System for New Quality Productivity of Enterprises

3.2.2. Explanatory variable

This study employs the shareholding ratio of green funds as the core explanatory variable. Following the methodology proposed by Wei Ping & Shu Hao (2018)[23] and Ma et al. (2023), the specific processing procedure is as follows: Step 1 – Identifying green public funds. Extract all funds whose names, investment objectives, and investment scope contain keywords such as "green," "ecology," "new energy," "clean energy," "low-carbon," "energy conservation," "environmental protection," "carbon neutrality," "emission reduction," and "natural resources." Step 2 – Obtaining investment data for green public funds. Retrieve holding data from the end-of-period statements in annual reports of public funds through the CSMAR database. Match green public funds with fund shareholding data to obtain detailed stock investment records during the sample period. Step 3 – Matching to determine listed companies' green fund shareholding ratios. Align stock investment details of green public funds with the listed company database compiled by the CSMAR database, as illustrated in Equation (6).

$$Greenshare_i = \frac{\sum_j \text{Greenfund}j\text{Holding The number of stocks}_{ij} \text{ of listed companies}i}{\text{Number of tradable A-shares}_i} \quad \text{Equation (6)}$$

3.2.3. Controlled variable

Drawing on the research frameworks of Yu Jian (2025)[25], Wang Huaiming (2025)[21], and others, this study selects corporate-level control variables including company market value (logarithm of Value), book-to-market ratio (MtB), debt-to-asset ratio (Debt), fixed asset ratio (PPE), current ratio (CR), and asset intensity (Intensity).

3.3. Data sources

This study selects A-share listed companies that received investments from green public funds between 2015 and 2024 as the research sample. The data primarily originates from the China Stock Market & Accounting Research Database (CSMAR), with sample processing conducted according to the following principles: excluding companies with abnormal trading activities, those with asset-liability ratios below 0 or above 1, financial sector enterprises, and companies with missing relevant data.

3.4. Descriptive statistics

The descriptive statistics of key variables are presented in Table 2. The explanatory variable NPro exhibits significant differences between its minimum and maximum values, with the mean substantially lower than the maximum. This indicates substantial disparities in new quality productivity levels across enterprises, coupled with an overall low performance level, suggesting considerable room for

improvement in China's corporate new quality productivity. Additionally, the explanatory variable Greenshare demonstrates marked variations in its minimum and maximum values, reflecting the broad coverage of the selected sample population, which further reinforces the research conclusions.

Table 2. Descriptive statistics

variable	unit	sample number	mean	standard deviation	least value	crest value
NPro	%	30529	0.704	1.017	0.018	15.090
Greenshare	%	30529	5.933	9.200	0.004×10-5	98.224
Value	-	30529	23.089	1.110	20.403	28.811
MtB	-	30529	0.568	0.272	0.011	1.636
Debt	-	30529	0.408	0.198	0.010	2.290
PPE	%	30529	21.057	15.336	0.006	95.418
CR	-	30529	2.572	2.861	0.093	60.417
Intensity	-	30529	2.430	1.767	0.408	11.122

4. Empirical Results Analysis

4.1. Regression To Baseline

Table 3 presents the regression results on the impact of green public funds on enterprises' new-type productivity. Column (1) shows that without control variables and two-way fixed effects, the regression coefficient of Greenshare was 0.003, statistically significant at the 1% level. After incorporating control variables, the coefficient increased to 0.002 while remaining largely unchanged, still maintaining significance at the 1% level. Although the coefficient showed a slight decline, this change primarily resulted from additional control variables and fixed effects that partially absorbed the impact. The overall findings demonstrate that green public funds significantly enhance enterprises' new-type productivity levels, providing empirical support for the core hypothesis of this study and validating Hypothesis H1.

Table 3. Benchmark Regression Results

Variables and statistical parameters	（1）	（2）
	NPro	NPro
Greenshare	0.003*** （0.001）	0.002*** （0.001）
Value		0.067*** （0.017）
MtB		0.177*** （0.037）

Appendix Table 3-2. Benchmark Regression Results

Variables and statistical parameters	(1)	(2)
	NPro	NPro
Debt		-0.224*** (0.058)
PPE		0.003*** （0.001）
CR		0.015*** (0.005)
Intensity		0.002*** (0.000)

Constant term	0.691*** (0.005)	-0.970** (0.398)
Sample number	31,109	31,109
R2	0.714	0.716
Individuality	YES	YES
Time	YES	YES

Note: The values within parentheses represent standard errors adjusted for industry-level clustering: *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. The same applies to the following table.

4.2. Robustness Test

To ensure the robustness of the regression results in this study, we employed the following methods for robustness testing, as shown in Table 4.

Table 4. Robustness Analysis

Variables and statistical parameters	(1)	(2)	(3)
	TFP	NPro	NPro
Greenshare	0.001***		0.002***
	(0.000)		(0.001)
Greenvalue		0.040***	
		(0.003)	
Constant term	-4.577***	7.800***	-1.527***
	(0.188)	(0.457)	(0.478)
Controlled variable	control	control	control
Fixed effect	YES	YES	YES
Sample number	25,756	30,206	20,957
R2	0.943	0.506	0.708

4.2.1. Replace the dependent variable

This study conducts regression analysis by substituting NPro with Total Factor Productivity (TFP), a classic academic metric for measuring production efficiency, to revise the model accordingly. The results are presented in Table 4(3). The Greenshare coefficient reaches 0.001 and remains statistically significant at the 1% level, consistent with the original benchmark regression findings. This demonstrates that the conclusion regarding green mutual funds' effective enhancement of corporate performance exhibits robustness.

4.2.2. Replace explanatory variables

Column (2) of Table 4 presents the regression results after substituting Greenshare with the natural logarithm of total holdings (Greenvalue) for green public funds. The analysis reveals that the Greenvalue coefficient remains significantly positive at the 1% significance level, confirming that the conclusion—that green public funds enhance corporate new-quality productivity—holds true even with modified measurement methods. This demonstrates the robustness of the regression findings.

4.2.3. Remove special samples

To examine whether the benchmark regression results are driven by specific events, this study analyzes estimation outcomes after excluding samples from the COVID-19 pandemic and lockdown periods. Column (4) of Table 4 presents regression results after removing observations from pandemic-affected years (2020-2022).

Observations indicate that the Greenshare coefficient remains significantly positive at the 1% significance level, with its sign and magnitude showing no substantial changes compared to the original benchmark regression results. This demonstrates that even after excluding the COVID-19 pandemic period, the positive impact of green public funds on corporate new-quality productivity persists robustly.

4.3. Endogenous treatment

After completing the aforementioned robustness tests, the core conclusion of this study that green public funds exhibit significant positive effects on corporate new-quality productivity—has been validated through multidimensional analysis which demonstrates strong robustness. However, robust correlations do not equate to definitive causality, and the research findings remain susceptible to endogeneity issues. Specifically, green public funds tend to actively invest in companies with high new-quality productivity levels and preferentially allocate capital to firms with even higher productivity metrics. This reverse causality may lead to biased regression coefficient estimates of fund ownership ratios.

This study employs the instrumental variable method to address endogeneity issues. Drawing on prior research findings (Jiang Guangsheng et al., 2021)[9], we select the one-period lagged sector-specific total green public fund holdings as the instrumental variable (IV). The rationale behind this construction approach lies in ensuring the instrumental variable's correlation with explanatory variables while remaining independent of the error term, thereby eliminating reverse causality over time and avoiding current-period missing variables. This ensures reliable estimation of the causal effect of "green public funds influencing new quality productivity," rather than false associations caused by endogeneity bias. Notably, current-period new quality productivity cannot inversely influence prior-period fund holding decisions, effectively breaking the reverse causality path. Regression results from two-stage least squares estimation (as shown in Table 6) demonstrate robust conclusions, with the instrumental variable passing both identification tests and weak instrument tests, confirming the validity of our selected instrument variable.

Table 5. 2SLS regression results

Variables and statistical parameters	(1)	(2)
	stage Ⅰ	stage Ⅱ
	Greenshare	NPro
IV	0.052***	
	(0.010)	
Greenshare		0.048***
		(0.014)
Controlled variable	control	
Fixed effect	YES	
Cragg-Donald F	61.820	
Kleiburg-Paap F	27.795	
Sample number	24952	

5. Expansion Analysis

5.1. Heterogeneity analysis

After effectively mitigating endogenous interference through instrumental variable methods and further confirming the causal relationship between green public funds' stock holdings and enterprises' new-quality productivity, this study investigates whether the impact of green public funds on corporate new-quality productivity exhibits structural differentiation based on firm characteristics. The analysis is conducted across three dimensions: ownership structure, pollution intensity, and geographical distribution, with a focus on regression coefficient differences in Greenvalue metrics. Results are comprehensively interpreted by integrating control variable outcomes and model robustness, as presented in Table 6.

Table 6. Heterogeneity Analysis

Variables and statistical parameters	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	State-owned enterprise	Non-state-owned enterprises	Heavy polluting enterprises	Non-heavy polluting enterprises	The East Area	The Middle Area	The West Area
Greenshare	0.003**	0.002***	0.002	0.002***	0.002***	0.002	0.003**
	(2.469)	(2.777)	(1.584)	(3.280)	(3.256)	(1.271)	(2.107)
Constant term	1.317***	1.264***	0.925**	1.448***	-1.301***	-0.305	-0.787
	(2.723)	(-3.645)	(2.070)	(-4.227)	(-3.654)	(-0.434)	(-1.282)
Controlled Variable	control	control	control	control	control	control	control
Individuality	YES	YES	YES	YES	YES	YES	YES
Time	YES	YES	YES	YES	YES	YES	YES
Sample Number	9686	21368	8729	22380	21738	4612	3703
R2	0.720	0.730	0.751	0.710	0.718	0.728	0.725
Adjusted R2	0.679	0.679	0.712	0.660	0.669	0.685	0.681

The ownership structure of enterprises directly influences their resource acquisition capabilities, governance frameworks, and policy responsiveness mechanisms, potentially leading to divergent outcomes in green public funds' effectiveness. As shown in Column (1) and Column (2) of Table 6, green public funds exhibit significant positive impacts on both types of enterprises' new quality productivity, with state-owned enterprises demonstrating stronger effects. State-owned enterprises, leveraging proactive policy responsiveness and robust environmental foundations, can directly allocate funds to green technological innovation. In contrast, non-state-owned enterprises may divert capital to address short-term operational pressures, thereby weakening innovation incentives. Consequently, state-owned enterprises' enhanced policy responsiveness and environmental foundations enable faster implementation of green public funds and drive sustainable green transformation.

This study categorizes listed companies into heavy-pollution enterprises and non-heavy-pollution enterprises based on the "Industry Classification Guidelines for Listed Companies" and the "Environmental Verification Industry Classification Management Catalogue for Listed Companies." The results in Column (3) and Column (4) demonstrate that green public funds exhibit only significant positive impacts on non-heavy-pollution enterprises, while showing no significant effect on heavy-pollution enterprises. Heavy-pollution enterprises face high compliance costs, with funds primarily allocated to compliance rectification measures. In contrast,

non-heavy-pollution enterprises possess stronger green foundations, enabling direct funding for green technology R&D and digital transformation initiatives.

From a regional perspective, the impact of green public funds exhibits regional differentiation. Results from Columns (5)-(7) in Table 6 demonstrate significant positive effects in both eastern and western regions, while the central region's impact failed to pass statistical significance tests. This reflects disparities in regional development levels, industrial structures, and policy environments. The well-developed financial markets in eastern regions and national strategic support in western regions create favorable conditions for green funds to function effectively, whereas transformation pressures in traditional manufacturing industries in central regions may dilute the marginal utility of green capital. These findings indicate that green fund effectiveness is moderated by regional contexts, necessitating differentiated policies tailored to local realities.

5.2. Path Analysis

5.2.1. Carbon financial instrument

The core of new-type productive forces lies in green and low-carbon development, with corporate carbon reduction serving as the key to implementing sustainable practices. Drawing on the research by Geng Xiaoyuan [4] and Wang Shaomin (2025), carbon emission trading policies—as market-based environmental regulatory tools—can effectively curb carbon emissions, facilitate green transformation, and support new-type productive forces. This study employs carbon emission intensity (CI) as an intermediary variable to measure the transmission effect of carbon financial instruments between green public funds and corporate new-type productive forces. Regression results from Table 7(1) demonstrate that green public funds exert a significant negative impact on carbon emission intensity, indicating their role in reducing carbon emissions, lowering green production costs, and improving resource efficiency. These findings validate the path effect of carbon financial instruments and support Hypothesis H2.

Table 7. Path Analysis: Green Technology Innovation, Financing Constraints, and Carbon Financial Instruments

Variables and statistical parameters	(1)	(2)	(3)
	CI	Patent	FC
Greenshare	-0.0003*	0.0017*	-0.0002**
	(0.0002)	(0.0010)	(0.0001)
Constant term	0.6199***	-0.8379	4.4439***
	(0.0917)	(0.5788)	(0.0420)
Controlled Variable	control	control	control
Fixed Effect	YES	YES	YES
Sample Number	16159	9692	30465
R2	0.9423	0.6987	0.9196
Adjusted R2	0.9307	0.6136	0.9062

5.2.2. Green Technology Innovation

Green technological innovation serves as the core driving force for enterprises to transcend traditional production models and cultivate new-quality productivity.

Drawing on the research of Shi Huajun [17] and Chen Qiangli (2025), green innovation capability exhibits a significant positive correlation with corporate new-quality productivity levels, demonstrating a positive driving effect on enhancing new-quality productivity through green technological innovation. As new-quality productivity essentially represents green productivity, green technological innovation directly empowers corporate digital transformation and low-carbon production by improving energy efficiency in computing equipment. Regarding proxy variables for green innovation, considering that green patent authorization requires approval processes (typically with a 1-3 year time lag) and thus cannot accurately reflect current R&D investment and innovation outcomes (Liu et al., 2022), this study constructs the indicator "natural logarithm of green patent applications plus 1" (Patent) to better align with actual innovation activities. Referencing Jiang Ting's (2022)[8] mediation effect testing methodology, we validate this pathway through direct regression analysis of core explanatory variables and mediating variables. Regression results in Column (2) of Table 7 show that green public funds exert a significant positive impact on green patent applications, indicating their effective incentive mechanism for corporate green technological innovation. This confirms that green technological innovation serves as a transmission mechanism between green public funds and new-quality productivity, validating Hypothesis H3.

5.2.3. Financing constraint

Financing constraints serve as a critical bottleneck limiting corporate productive investments and hindering the cultivation of new-quality productivity. Drawing on Li Yanli et al. (2025)[12], green finance can effectively alleviate financing constraints by reducing corporate debt financing costs, thereby promoting the enhancement of new-quality productivity. This study employs the FC index proposed by Fee et al. (2009)[33] to measure financing constraint intensity. A higher index value indicates stronger financing constraints, while a lower value suggests weaker constraints. Regression results from Table 7(3) show that the Greenshare coefficient measures -0.0002 with statistical significance at the 5% level, demonstrating its effectiveness in reducing corporate financing constraints. This effect may stem from the "certification effect" of green equity ownership, which expands financing channels and reduces costs through compliance signals, thereby providing financial support for technological R&D and capacity upgrades. In summary, green public funds mitigate corporate financing constraints, offering financial safeguards for activities such as technological innovation and capacity modernization, thereby validating Hypothesis H4.

5.3. Threshold effect test

The benchmark regression results indicate that green public funds' stock holdings

positively contribute to new quality productivity. However, excessively high ownership ratios may exert negative effects, necessitating threshold effect tests to delineate the boundaries of their nonlinear impact.

Table 8. Existence of Threshold and Confidence Interval Testing

Threshold variable	Threshold count	F price	P price	10% Critical value level	5% Critical value level	1% Critical value level
Green Public Fund	A threshold	63.390	0.043	54.543	60.861	74.299
	Second threshold	56.580	0.013	39.877	44.022	57.941

Table 9. Threshold Value Estimation Results

Threshold variable	threshold	threshold value	95% confidence interval
Green Public Fund	First threshold	5.028	（4.689,5.236）
	Second threshold	27.306	（23.256,31.613）

Table 10. Threshold Regression Results

Variables and statistical parameters	(1)
Greenshare	0.063***
（Mid<5.028）	(0.007)
Greenshare	0.013***
（5.028≤Mid<27.306）	(0.002)
Greenshare	0.001
（Mid≥27.306）	（0.001）
Constant term	8.638
	（0.870）
Controlled variable	control
Sample number	16650

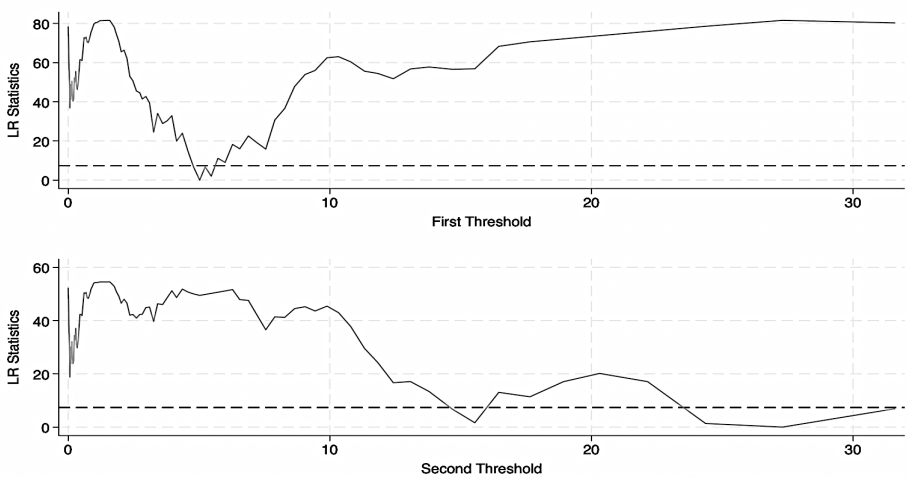

Figure 1. Estimation results of Greenshare dual-threshold model

The threshold effect test results shown in Figure 1 indicate that the impact of green public funds on new quality productivity follows a non-linear relationship with significant "dual-threshold" structural shifts, exhibiting diminishing marginal effects as shareholding ratios increase. Table 8 demonstrates that the dual-threshold model

outperforms the single-threshold model in fit quality, better capturing the relationship between variables. Tables 9 and 10 reveal the first threshold at 5.028% and the second at 27.306%. Within the shareholding range below 5.028%, the coefficient reaches 0.063, indicating peak productivity enhancement effects. Between 5.208% and 27.306%, the coefficient drops to 0.013, reflecting weakened support. Beyond 27.306%, the coefficient plunges to 0.001, showing no significant impact beyond a critical threshold—highlighting that higher shareholding doesn't automatically translate to better outcomes. Below 5.028%, green funds demonstrate distinct scarcity characteristics, enabling companies to concentrate investments in core green innovation sectors for optimal results. However, above 27.306%, potential capital redundancy may occur through inefficient green project investments, leading to diminishing marginal effects in corporate green innovation promotion.

Based on these findings, the government should strategically leverage the threshold effect of green public funds' equity holdings to precisely define their investment range. Maintaining the agency index of green public funds within the "middle range (5.028%-27.306%)" may better facilitate the enhancement of new-type productivity, optimize resource allocation efficiency, and drive the transition from scale expansion to quality improvement. When allocating green public funds, it is essential to concurrently reduce investments in high-market-capitalization and highly leveraged enterprises, prioritizing support for companies with sufficient fixed assets and strong liquidity to amplify the fund's catalytic effect on new-type productivity.

6. Conclusion and suggestion

Against the backdrop of the "dual carbon" goals and the vigorous development of new-quality productivity, this paper examines the impact, mechanism, and threshold characteristics of green public funds' holdings on corporate new-quality productivity based on data from China A-share listed companies from 2015 to 2024. The results show: First, green public funds can significantly enhance corporate new-quality productivity levels. After controlling for variables, fixed effects, and endogeneity issues, this conclusion remains robust. Second, green public funds influence corporate new-quality productivity through pathways such as green technological innovation, alleviating financing constraints, and carbon financial instruments. Heterogeneity tests indicate significant structural differences in the promoting effects of green public funds, which are more pronounced in state-owned enterprises and non-heavy-pollution enterprises. Third, the effect of green funds exhibits a nonlinear threshold effect, with optimal promotion effects occurring within the "middle range" of shareholding ratios from 5.028% to 27.306%. Beyond 27.306%, marginal effects may diminish, suggesting that "precision irrigation" is more effective than "flood irrigation."

Based on the aforementioned research findings, this paper proposes the following policy recommendations: First, incentivize state-owned enterprises and non-heavy polluting enterprises to establish green funds through tax incentives, subsidies, and reward policies. Second, refine the certification standards and information disclosure mechanisms for green funds to enhance investment precision and market credibility. Third, implement differentiated support measures to optimize market access for non-state-owned enterprises while providing transformational financial instruments for heavy polluting enterprises. Fourth, promote collaboration between green funds and technology incubators/industrial parks to establish specialized innovation funds, fostering synergy between green finance and technological advancement. Fifth, guide enterprises in establishing carbon accounting systems and carbon management frameworks to solidify institutional foundations for developing new productive forces.

References

[1] Cai Guilong, Zhang Yanan. The ESG Investment Commitment Effect of Funds: A Quasi-Natural Experiment from Public Funds Signing PRI [J]. Economic Research, 2023,58(12):22-40.

[2] Chen Junying, Chen Jingsi. The impact of financing constraints on corporate R&D collaboration decisions and investment scale [J]. Science and Technology Management Research, 2023,43(18):155-161.

[3] Chen Xiuying, Liu Sheng, Shen Hong. Empowering the enhancement of new-quality productivity through digital transformation [J]. Xinjiang Social Sciences, 2024, (02):41-45.

[4] Geng Xiaoyuan, Wang Shaomin. Carbon Emission Trading Policy and the Development of New Quality Productivity in Enterprises [J]. Friends of Accounting, 2025, (15):11-19.

[5] He Pingjun & Wang Zhenyi. Impact of Green Bonds on New Quality Productivity of Enterprises [J]. Modern Finance, 2025, (04):40-48.

[6] Hu Hongbin. Theoretical Logic and Practical Approaches to General Secretary Xi Jinping's Important Discourse on New Quality Productivity [J]. Economist, 2023, (12):16-25.

[7] Hu Jianbo, Ye Shu, Zhang Kuan yuan. Green finance policies and corporate ESG performance: A quasi-natural experiment based on green finance innovation and reform pilot zones [J]. Financial Forum, 2024,29(07):59-69.

[8] Jiang Ting. Mediating effects and moderating effects in causal inference empirical research [J]. China Industrial Economics, 2022, (05):100-120.

[9] Jiang Guangsheng, Lu Jianci, Li Weian. Do Green Investors Play a Role? — An Empirical Study on Corporate Participation in Green Governance [J]. Financial Research, 2021, (05):117-134.

[10] Jin Yu, Wen Wen, Zhao Tingyu. Research on the Impact of Green Fund Holdings on Corporate Green Innovation [J]. Luojia Management Review, 2022, (03):22-45.

[11] Li Cunfang, Zhuang Jiarong, Wang Wenhui, et al. Systemic effects of green credit policies on the formation of new-quality productivity in resource-based enterprises [J]. Resource Science, 2024,46(10):1930-1943.

[12] Li Yanli, Yang Chengxin, Li Lijun. Green Finance Empowering the Development of New Quality Productivity in Enterprises: A Discussion on the Pathways of Technological Innovation and Debt Financing Costs [J]. Financial Economics, 2025, (01):13-24+89.

[13] Peng Bin, Peng Fei. Green investment sensitivity analysis of corporate clean-up reform

[J]. Soft Science, 2017,31(06):55-58.

[14] Qi Jia. Research on the Impact Mechanism of ESG Performance on Corporate Value: Based on Corporate Innovation and Total Factor Productivity Perspectives [J]. Foreign Trade and Economics, 2024, (09):93-99.

[15] Qiu Jing, Fan Qinqin. Digital technology innovation promotes the cultivation and development of new-quality productivity: Empirical evidence from digital patents of listed companies [J/OL]. Journal of Guizhou University of Finance and Economics, 1-12 [2025-09-15].

[16] Sheng Chaoxun. Formation Conditions and Cultivation Pathways of New Quality Productivity [J]. Economic Horizons, 2024, (02):31-40.

[17] Shi Huajun, Chen Qiangli. How does green innovation influence new quality productivity? -Based on dual perspectives of financing constraints and digital transformation [J]. Science and Technology Entrepreneurship Monthly, 2025,38(08):30-37.

[18] Song Jia, Zhang Jinchang, Pan Yi. Research on the Impact of ESG Development on New Quality Productivity of Enterprises: Empirical Evidence from China A-share Listed Companies [J]. Contemporary Economic Management, 2024,46(06):1-11.

[19] Sun Shiqiang, Hou Yaowei. Research on the Impact of Fiscal and Tax Incentive Policies on New Quality Productivity of Enterprises [J]. Contemporary Economic Research, 2025, (01):114-128.

[20] Sun Xiaoting, Li Min. Green technology innovation, new quality productivity and high-quality development of low-carbon economy [J]. Statistics and Decision-making, 2024,40(14):29-34.

[21] Wang Huaiming, Yang Jiaqi. The Impact of Green Fund Investments on Corporate Green Transformation: Guidance and Supervision Effects from Public Funds Signing PRI [J]. Journal of Nanjing Audit University, 2025,22(02):87-99.

[22] Wang Xin, Wang Ying. Research on Green Credit Policies Promoting Green Innovation [J]. Management World, 2021,37(06):173-188+11.

[23] Wei Ping, Shu Hao. Does China's capital market recognize green investment? -An analysis based on green funds [J]. Financial Research, 2018,44(05):23-35.

[24] Wu Weixing, Chen Xiaoyi. Green Finance and New Quality Productivity: International Experience, Typical Cases, and Practical Approaches [J]. International Trade Issues, 2024, (11):26-35.

[25] Yu Jian, Yang Fanjia, Su Zhi. Can green public funds improve corporate environmental performance? — Based on empirical evidence from China listed companies [J]. International Financial Research, 2025, (05):73-85.

[26] Yu Xulan, Zhou Ying. Green Credit Policies and Green Transformation of High-Pollution Enterprises: A Perspective on Emission Reduction and Development [J]. Quantitative Economic Research, 2023,40(07):179-200.

[27] Zhang Luyao, Pang Chuan. The impact of financing constraints on total factor productivity of enterprises: Based on data from ChiNext listed companies [J]. Social Scientist, 2023, (07):69-75.

[28] Zhang Yunping, Wang Xiaokai, Chen Yan. The impact of smart city construction on fostering new quality productivity in enterprises: empirical evidence from China A-share listed companies [J]. Journal of Chongqing University (Social Sciences Edition), 2025,31(03):46-63.

[29] Zhao Guoqing, Li Juntin. Does enterprise digital transformation empower the development of new quality productivity in enterprises? — Based on micro-level evidence from China listed companies [J]. Industrial Economics Review, 2024, (04):23-34.

[30] Zhao Lili, Liu Zhenhao, Yang Xin. Research on the Impact of Green Bond Issuance on Enterprise New Quality Productivity [J/OL]. Systems Science and Mathematics, 1-18 [2025-09-15].

[31] Zhou Min, Zhou Zhiyuan, Liu Qi. Green funds and corporate greenwashing: clearing the

muddied waters or exacerbating the problem [J]. Accounting Monthly, 2024,45(14):75-83.

[32] Berikhanovna M C, Bauirzhanovna A B, Kudaibergenovna G N, et al. The Influence of Green Credit Policy on Green Innovation and Transformation and Upgradation as a Function of Corporate Diversification: The Case of Kazakhstan[J]. Economies, 2023, 11(8): 210.

[33] Fee E C, Hadlock J C, Pierce R J. Investment, Financing Constraints, and Internal Capital Markets: Evidence from the Advertising Expenditures of Multinational Firms[J]. The Review of Financial Studies, 2009, 22(6): 2361-2392.

[34] Zhang W, Ke J, Ding Y, et al. Greening through finance: Green finance policies and firms' green investment[J]. Energy Economics, 2024, 131: 107401.