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| RESEARCH ARTICLE

The Impact of New Quality Productive Forces on Corporate Environmental Performance: A Dual Perspective Based on Green Innovation and Environmental Information Disclosure

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| ABSTRACT
In the era of coordinated advancement of the "dual carbon" goals and high-quality development, how to transform new quality productive forces into tangible environmental governance outcomes has become a core issue in enterprises' green transformation. This study takes Chinese A-share listed companies from 2015 to 2024 as the research sample and systematically examines the impact of new quality productive forces on corporate environmental performance, as well as its underlying mechanisms and heterogeneous characteristics. To address potential endogeneity issues, the instrumental variable approach and propensity score matching method are employed. The baseline regression results show that an increase in the level of new quality productive forces significantly improves corporate environmental performance. The conclusion remains robust after a series of robustness checks, including replacing the explanatory variable, changing the regression model, excluding samples from municipalities, and adjusting the clustering level. Mechanism tests reveal that new quality productive forces exert their effects primarily through two pathways: first, by stimulating enterprises' green technological innovation vitality and promoting the output of green invention patents, thereby providing technological support for environmental improvement; second, by enhancing the quality of environmental information disclosure, which increases the transparency and supervisability of corporate environmental behavior and forms a combined internal and external supervisory force that compels continuous improvement. Heterogeneity analysis indicates that the positive environmental effect of new quality productive forces is more pronounced in enterprises with high profitability, in high-tech industries, and in heavily polluting industries, while the effect is relatively weaker in enterprises with low profitability, in non-high-tech industries, and in lightly polluting industries. This study not only theoretically expands the cognitive boundaries of the environmental effects of new quality productive forces and reveals the dual transmission mechanisms of green innovation and environmental information disclosure, but also provides practical references for enterprises to cultivate new quality productive forces in a differentiated manner according to their own resource endowments, thereby promoting green transformation.

| KEYWORDS

New quality productive forces; corporate environmental performance; level of green innovation; environmental information disclosure quality

| ARTICLE INFORMATION

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I. Introduction

As an innovation-driven new form of productive forces, new quality productive forces are injecting green momentum into economic and social development, demonstrating broad prospects in promoting industrial upgrading and efficient resource utilization. In September 2023, General Secretary Xi Jinping first proposed the concept of "new quality productive forces," emphasizing the integration of scientific and technological innovation resources to lead the development of strategic emerging industries and future industries, and to accelerate the formation of new quality productive forces. With scientific and technological innovation as its engine, new quality productive forces can promote the clean transformation of production processes through the upgrading of production factors. While improving production efficiency, they reduce resource consumption and pollution emissions, thereby providing technological possibilities for improving ecological and environmental quality. Facing the "15th Five-Year Plan" period, the central government has clearly proposed accelerating the comprehensive green transformation of economic and social development, coordinately promoting carbon reduction, pollution reduction, green expansion, and growth, and building a green, low-carbon, and circular development economic system. The relevant white paper issued by the Ministry of Ecology and Environment also points out that corporate green transformation is shifting from policy advocacy to institutional norms. New quality productive forces are widely regarded as the core driving force for green development, and their deep integration with green transformation has become a key pathway for implementing national strategies and enhancing corporate environmental performance.

Although the strategic significance of new quality productive forces has been fully affirmed at the policy level, at the micro-level of enterprises, effectively transforming them into tangible environmental governance outcomes still faces practical challenges. On the one hand, enterprises often lack systematic solutions to effectively link technological breakthroughs with green process transformations, resulting in conversion barriers between input and performance. On the other hand, the environmental information disclosure system remains imperfect; some enterprises, due to cost considerations or regulatory avoidance, exhibit insufficient willingness to proactively disclose environmental information, thereby weakening the constraining power of external supervision. Clarifying the internal mechanisms by which new quality productive forces drive improvements in environmental performance from both theoretical and empirical perspectives, and identifying their boundary conditions, has become an important issue that urgently needs to be addressed.

In recent years, the academic community has conducted extensive research on new quality productive forces. In terms of connotative characteristics, scholars have elucidated its essential attributes of being "high-tech, high-efficiency, and high-quality," arguing that its development path is intrinsically consistent with the direction of green transformation (Pu Qingping and Xiang Wang, 2024; Shi Minjun et al., 2024) [1][2]. In terms of measurement methods, some studies have constructed evaluation indicator systems using methods such as the entropy method and total factor productivity (Song Jia et al., 2024; Zhang Xiue et al., 2025) [3][4]. However, existing literature has mostly focused on macro-level theoretical discussions and evaluations of regional development levels. Qualitative analysis still dominates in connotative measurement, with relatively few unified quantitative indicators, and micro-level empirical studies at the enterprise level remain relatively scarce. In particular, there is a lack of direct empirical tests on the impact of new quality productive forces on corporate environmental performance, in-depth analyses of its underlying mechanisms are relatively rare, and the heterogeneous characteristics of this effect under different contexts have not yet received sufficient attention. Therefore, systematically examining the impact of new quality productive forces on environmental performance, its transmission pathways, and its heterogeneous boundaries at the enterprise level holds significant theoretical value.

Based on the theoretical analysis, this paper first incorporates new quality productive forces into the analytical framework of corporate environmental performance and derives two transmission pathways: green innovation and the quality of environmental information disclosure. The marginal contributions of this study are reflected in three aspects. First, it extends the research perspective to the micro-level of enterprises, focusing on environmental performance—a core indicator of green transformation—thereby enriching the empirical literature on new quality productive forces in the field of corporate green performance. Second, to address the internal mechanisms through which new quality productive forces drive improvements in environmental performance, this study constructs a dual mediation model in which green innovation and environmental information disclosure quality operate in parallel. It reveals multiple transmission mechanisms from these two dimensions and expands the theoretical framework of mechanism research. Third, it adopts a multi-pronged endogeneity treatment strategy that combines industry-mean instrumental variables, lagged variables, and propensity score matching. It also systematically examines heterogeneity from three dimensions—profitability, industrial technological characteristics, and environmental regulatory pressure—thereby refining the boundary conditions of the environmental effects of new quality productive forces and providing empirical evidence for differentiated policy design.

II. Theoretical Analysis and Research Hypotheses

2.1. New Quality Productive Forces and Environmental Performance

New quality productive forces represent an advanced form of productive forces with scientific and technological innovation as the core driving force. Through qualitative leaps in the three major factors of labor, means of labor, and objects of labor, as well as their optimized combination (Pu Qingping and Xiang Wang, 2024) [1], they achieve systematic improvements in production efficiency and quality. Their characteristics of being "high-tech, high-efficiency, and high-quality" determine their intrinsic theoretical alignment with green development. New quality productive forces are themselves green productive forces (Shi Minjun et al., 2024) [2]. This assertion essentially reveals the relationship between new quality productive forces and environmental performance. At the theoretical level, the promoting effect of new quality productive forces on environmental performance can be explained from both internal and external dimensions.

From the internal dimension, new quality productive forces jointly drive the improvement of environmental performance through technological innovation, resource allocation optimization, and production efficiency enhancement. On the one hand, with their green and innovative characteristics, new quality productive forces facilitate the transformation of enterprises' production methods toward cleaner and low-carbon practices. The root cause lies in the technological breakthrough capabilities they embody (Chen Jinyu and Yuan Qing, 2026) [5]. This indicates that by leveraging new quality productive forces to promote green process innovation and the application of clean technologies, enterprises can achieve pollutant reduction and resource consumption optimization at the source of production. On the other hand, from the perspective of resource-based theory, the development of new quality productive forces encourages enterprises to optimize resource allocation by directing it toward green production (Wang Gang et al., 2025) [6]. That is, when enterprises use new quality productive forces to transition from extensive operations to intensive development, the resource and environmental costs per unit of output are significantly reduced. At the same time, new quality productive forces effectively address the ecological constraints faced by traditional productive forces and significantly reduce resource consumption and environmental impact per unit of output (Qian Youqi, 2025) [7]. The intrinsic linkage between such efficiency gains and environmental improvements constitutes a key component of the internal driving force.

From the external dimension, new quality productive forces form external drivers for improving environmental performance by strengthening institutional compliance and stakeholder collaboration. On the one hand, environmental regulatory pressure prompts enterprises to convert new quality productive forces into environmental actions. From the perspective of institutional theory, environmental regulation provides an institutional framework for the environmental application of new quality productive forces (Xu Ronglian, 2025) [8]. Facing increasingly stringent environmental supervision, new quality productive forces become an important technical support for enterprises to achieve compliance. At the same time, environmental regulation uses new quality productive forces as a carrier to stimulate the innovation compensation effect of enterprises, transforming regulatory pressure into a substantive driving force for green technological progress (Shao et al., 2024) [9]. On the other hand, improvements in stakeholder relationships provide external support for new quality productive forces to deliver environmental benefits. With the improvement of market mechanisms and information transmission channels, the coupling and coordination between new quality productive forces and environmental performance deepen (Wang Teng, 2025) [10], indicating that a favorable external information environment can amplify the contribution of new quality productive forces to green development.

In summary, new quality productive forces not only drive the improvement of environmental performance internally through technological innovation and resource allocation optimization, but also generate external pressure and support through institutional compliance and stakeholder relationships, forming a coordinated internal-external promotion mechanism. Based on the above theoretical analysis, the following research hypothesis is proposed:

Hypothesis 1: New quality productive forces have a significant positive effect on environmental performance.

A. ***2.2. Mechanisms of the Impact of New Quality Productive Forces on Environmental Performance***

B. *The coordinated development of enterprises' technological capabilities and governance capabilities constitutes an inherent requirement for promoting continuous industry progress. The accumulation of technological capabilities determines whether enterprises can achieve the transition from factor-driven to innovation-driven growth, while the improvement of governance capabilities concerns whether enterprises can establish effective internal and external supervision mechanisms to ensure that production and operation activities align with the requirements of social sustainable development. Technological innovation and institutional innovation together constitute the core driving force of sustainable development (Rennings, 2000) [11], enabling enterprises to effectively fulfill their environmental responsibilities while pursuing economic benefits. Based on this logic, this paper selects two pathways—green innovation level and environmental information disclosure quality—to examine the mechanisms through which new quality productive forces affect environmental performance.*

(1) Green Innovation Level

Green innovation serves as the core link connecting technological input and environmental output. Its level directly determines whether enterprises can convert innovation advantages into actual environmental improvement outcomes. On the one hand, the development of new quality productive forces provides an important driving force for green innovation. New quality productive forces not only help increase the quantity of green innovation output but also enhance the technological content of innovation achievements (Li Zibiao et al., 2025) [12]. The underlying reason is that the digital and intelligent elements embedded in new quality productive forces optimize the allocation of research and development resources and reduce the uncertainty and trial-and-error costs of green technology research and development. At the micro-mechanism level, big data analysis capabilities, management commitment, and human resource practices significantly improve the efficiency of converting green innovation into organizational performance (El-Kassar and Singh, 2019) [13], which also aligns with the data element advantages inherent in new quality productive forces. On the other hand, green innovation can directly promote the improvement of environmental performance. Wang Bo and Kang Qi (2023) [14] point out that green product innovation, green process innovation, and green management innovation are important pathways for enterprises to enhance environmental performance. This indicates that when enterprises apply new quality productive forces to promote green technology research and development, they can achieve cleaner transformation of production processes, intensive utilization of energy consumption, and source control of pollution emissions, thereby fundamentally improving environmental performance.

(2) Environmental Information Disclosure Quality

Enterprises place their environmental behavior under external supervision through environmental information disclosure. This transparency mechanism not only constrains enterprises' short-term profit-seeking behavior but also provides continuous momentum for long-term environmental improvement. From the perspective of how new quality productive forces promote environmental information disclosure, although the digital development of enterprises reduces their willingness to passively disclose environmental management information in the short term, it significantly promotes investment in research and development innovation and drives enterprises' environmental governance philosophy to actively shift toward internal innovation (Kou Dongxue et al., 2024) [15]. Specifically, technologies derived from new quality productive forces—such as big data analysis, artificial intelligence algorithms, and blockchain evidence storage—can effectively improve the timeliness, accuracy, and verifiability of environmental information disclosure, shifting report formats from static annual documents to dynamic real-time updates. From the perspective of the impact of environmental information disclosure on environmental performance, high-quality environmental information disclosure is closely related to factors such as public participation and industrial development. The "demonstration–catch-up" effect revealed by Xin et al. (2024) [16] indicates that environmental information disclosure can form supervisory synergy through inter-regional interactions. In addition, environmental information disclosure plays a positive moderating role between environmental auditing and corporate environmental performance (Ding Shenghong and Hu Jun, 2022) [17], suggesting that high-quality environmental information disclosure can enhance the effectiveness of external supervision and encourage enterprises to internalize environmental responsibility into management practices. Therefore, new quality productive forces provide effective institutional safeguards for improving corporate environmental performance by enhancing the quality of environmental information disclosure.

In summary, new quality productive forces can not only achieve the green reconstruction of production processes by driving green innovation but also strengthen external supervision and internal management by improving the quality of environmental information disclosure. The two pathways complement each other and jointly promote the enhancement of corporate environmental performance. Based on the above analysis, this paper proposes the following research hypothesis:

Hypothesis 2: New quality productive forces promote environmental performance by improving the level of green innovation and the quality of environmental information disclosure.

III. Sample Selection and Variable Definition

3.1. Sample, Data, and Processing

This paper selects Chinese A-share listed companies on the Shanghai and Shenzhen Stock Exchanges from 2015 to 2024 as the initial research sample to examine the impact of corporate new quality productive forces on environmental performance. The starting year of the sample is set at 2015, primarily based on two considerations. First, the Fifth Plenary Session of the 18th CPC Central Committee in 2015 first proposed the new development concept of "innovation, coordination, green, openness, and sharing," which provided important policy guidance for enterprises' green development. Second, as an emerging research topic, new quality productive forces have become more available and complete in relevant data after 2015.

The initial sample is screened and processed as follows: financial industry listed companies are excluded; ST, *ST, and PT samples are excluded; and samples with severe missing data on relevant variables are excluded. To mitigate the potential interference of extreme values on the regression results, all continuous variables are winsorized at the 1% and 99% percentiles. The data used in this study are obtained from the CSMAR database, the China National Intellectual Property Administration, corporate annual reports, and other sources.

3.2. Variable Selection and Measurement

Dependent Variable: Environmental Performance (EP). Drawing on the research approach of Qu Yuxiao (2023) [18], this paper employs the comprehensive scoring method to quantify corporate environmental performance. Specifically, based on the environmental research sub-database in the CSMAR database, multiple indicators that reflect enterprises' inputs and outcomes in environmental management are selected to construct an environmental performance evaluation system. This system covers nine dimensions: whether the enterprise possesses an environmental protection philosophy, whether it has set environmental protection objectives, whether it has established an environmental protection management system, whether it organizes environmental education and training, whether it implements special environmental protection actions, whether it has established an environmental emergency response mechanism, whether it implements the "three simultaneous" system, whether it has received environmental protection honors or awards, and whether it has obtained ISO14001 environmental management system certification. For each indicator, a value of 1 is assigned if the enterprise meets the condition, otherwise 0. The scores of the nine indicators are then summed to obtain the comprehensive score of corporate environmental performance. A higher score indicates more active performance in environmental management and a correspondingly higher level of environmental performance.

Explanatory Variable: New Quality Productive Forces (PL). New quality productive forces represent an advanced qualitative state formed by the systematic leap of the three elements of productive forces driven by scientific and technological innovation, embodying the organic unity of improved laborer quality, iterative upgrading of means of labor, and expansion of the boundaries of objects of labor (Pu Qingping and Xiang Wang, 2024) [1]. Under this theoretical framework, new quality productive forces not only encompass the optimized combination of traditional production factors but also emphasize the deep integration of green technology and digital technology into the production process, thereby constituting the internal foundation for promoting improvements in environmental performance. Based on the above understanding, this paper constructs the indicator system primarily by referring to the approach of Li Xinru et al. (2024) [19], which draws on the theoretical frameworks of Song Jia et al. (2024) [3] and Zhang Xiue et al. (2025) [4]. Adjustments are made to specific evaluation indicators based on data availability, and the entropy method is ultimately used for objective weighting to obtain the comprehensive score of corporate new quality productive forces. The specific composition of the indicator system and the weights are shown in Table 1.

Table 1 Indicators of Corporate New Quality Productive Forces

Dimension	Sub-dimension	Indicator Name	Measurement Method	Weight(%)	Weight(%)
New Quality Laborers	Employee Quality	R&D Personnel Ratio	Number of R&D personnel / Total number of employees	6.89	Positive
		Proportion of Highly Educated Employees	Number of employees with postgraduate degree or above / Total number of employees	9.78	Positive
	Management Perspective	Overseas Background of Management	1 if executives have overseas background, otherwise 0	7.38	Positive
		Executives' Green Awareness	Ln (Frequency of green development keywords in annual report + 1)	5.21	Positive
New Quality Means of Labor	Technical Equipment	Fixed Assets Ratio	Fixed assets / Total assets	3.26	Positive
		Intangible Assets Ratio	Intangible assets / Total assets	5.69	Positive
	Digital Empowerment	Digital Transformation	Ln (Frequency of digitalization keywords in annual report + 1)	5.51	Positive
	Innovation Output	Innovation Level	Ln (Total number of patent applications + 1)	6.45	Positive
New Quality Objects of Labor	Green Transformation	Green Technology Level	Ln (Number of green patent applications + 1)	18.91	Positive
		Green Patent Ratio	Number of green patent applications / Total number of patent applications	22.77	Positive
		E Score	Environmental Dimension Score in Huazheng ESG Rating	8.16	Positive
	Future Development	Capital Accumulation	(Growth in owners' equity in the current year / Owners' equity at	0.01	Positive

Dimension	Sub-dimension	Indicator Name	Measurement Method	Weight(%)	Weight(%)
		Rate	the beginning of the year) × 100%		

It should be noted that the above indicator system, while drawing on existing studies, reflects the unique considerations of this study in terms of both indicator composition and weight distribution.

First, in the laborers dimension, this paper not only focuses on hard qualities such as R&D personnel and highly educated talents, but also uses the overseas background of management and executives' green awareness to depict the strategic vision and value orientation of the management team. An overseas background helps enterprises introduce international cutting-edge technologies and governance experience, while executives' green awareness reflects the degree of importance that enterprises attach to sustainable development at the strategic level. Both are important soft strengths in the formation of new quality productive forces.

Second, in the means of labor dimension, a progressive chain is constructed from "technical equipment" to "digital empowerment" and then to "innovation output." The ratios of fixed assets and intangible assets reflect the technological hardware foundation of enterprises; the digital transformation indicator captures the degree of intelligent penetration in enterprises' production and management; and the innovation level measures the transformation efficiency of technological achievements through patent output. This chain can more comprehensively demonstrate the modernization level of enterprises' production technology systems.

Third, in the objects of labor dimension, the core position of green development is emphasized. From the weight distribution in Table 1, the combined weight of green technology level and green patent ratio exceeds 40%, and the E score also accounts for a relatively high proportion. This fully reflects the profound connotation of quality and greenness within the "high-tech, high-efficiency, and high-quality" characteristics of new quality productive forces. The impact of enterprises on the ecological environment during the production process and their mastery of green technologies have become key yardsticks for measuring the advancement of their productive forces. In contrast, the weight of the capital accumulation rate is extremely low, indicating that the traditional development model relying solely on capital expansion is no longer suitable for the requirements of new quality productive forces.

Mechanism Variables:

(1) Green Innovation (LnGreen_Inv). This paper measures the level of corporate green innovation by the number of green invention patent applications. The reason is that invention patents have higher innovation content and technological value compared with other patent types, and thus better reflect substantive breakthroughs made by enterprises in the field of green technology. Following the approach of Xu Jia and Cui Jingbo (2020) [20], green patents of listed companies are identified and screened according to the International Patent Classification Green List issued by the World Intellectual Property Organization. Considering that patent applications are more timely than patent grants, this paper takes the natural logarithm of the number of green invention patent applications in the current year plus one to obtain the green innovation indicator (LnGreen_Inv), which is used to measure the level of corporate green technological innovation output.

(2) Environmental Information Disclosure Quality (Eidq). Referring to the study by Wu Zhongxin and Wei Jiajia (2022) [21], this paper adopts the content analysis method to construct an environmental information disclosure quality evaluation system. Based on the detailed items of environmental information disclosure in the CSMAR database, indicators are selected from five dimensions: environmental management, regulatory certification, performance outcomes, environmental liabilities, and environmental governance. Scores are assigned according to the degree of disclosure: 0 points for non-disclosure, 1 point for qualitative disclosure, and 2 points for quantitative disclosure. The sum of all item scores is then divided by the theoretical maximum score to obtain the environmental information disclosure quality index (Eidq). This index ranges from 0 to 1, with higher values indicating higher quality of corporate environmental information disclosure.

Control Variables: Enterprise size (Size), current ratio (Liquid), inventory ratio (Inv), ownership concentration (Top1), firm age (Age), total asset growth rate (AssetGrowth), capital intensity (CAP), and management shareholding ratio (Mshare) are selected.

The definitions of all variables are presented in Table 2.

Table 2 Variable Definitions

Variable Type	Variable Name	Symbol	Measurement Method
Dependent Variable	Environmental Performance	EP	Comprehensive score of 9 environmental protection items
Explanatory Variable	New Quality Productive Forces	PL	Calculated using the entropy weighting method
Mechanism Variables	Green Innovation Level	LnGreen_Inv	Ln (Number of green invention patent applications + 1)
	Environmental Information Disclosure Quality	Eidq	Sum of scores of 25 environmental information disclosure indicators
Control Variables	Enterprise Size	Size	Ln (Total assets)
	Current Ratio	Liquid	Current assets / Current liabilities
	Inventory Ratio	Inv	Net inventory / Total assets
	Ownership Concentration	Top1	Shareholding proportion of the largest shareholder / Total shares
	Firm Age	Age	Number of years since the firm was listed
	Total Asset Growth Rate	AssetGrowth	(Total assets in the current year / Total assets in the previous year) − 1
	Capital Intensity	CAP	Total assets / Operating revenue
	Management Shareholding Ratio	Mshare	Number of shares held by management / Total shares

3.3. Model Construction

To test Hypothesis 1, the following model is constructed:

$$EP_{i,t} = \beta_0 + \beta_1 PL_{i,t} + controls_{i,t} + stkcd_i + year_t + \varepsilon_{i,t}$$

To test Hypothesis 2, referring to the approach of Jiang Ting (2022) [22], the following model is constructed:

$$M_{i,t} = \beta_0 + \beta_1 PL_{i,t} + controls_{i,t} + stkcd_i + year_t + \varepsilon_{i,t}$$

where $PL_{i,t}$ denotes the new quality productive forces of firm i in year t , $EP_{i,t}$ denotes the environmental performance of firm i in year t , M_1 represents the level of green innovation, M_2 represents the quality of environmental information disclosure, $controls_{i,t}$ denotes the control variables, $stkcd_i$ represents firm fixed effects, $year_t$ represents time fixed effects, and $\varepsilon_{i,t}$ is the random disturbance term.

IV. Empirical Analysis

4.1. Descriptive Statistics

The descriptive statistics of the main variables are presented in Table 3. The mean value of EP is 2.249, the median is 2.000, the standard deviation is 2.252, and the minimum and maximum values are 0.000 and 8.000, respectively. These figures indicate significant differences in environmental management levels among the sample enterprises. The mean value of PL is 13.630, the median is 12.860, the standard deviation is 7.487, and the span between the minimum and maximum values is relatively large, reflecting that enterprises are still at different stages in cultivating new quality productive forces. The control variables also exhibit reasonable ranges of variation, providing a solid data foundation for subsequent regression analysis.

Table 3 Descriptive Statistics

Variable	N	Min	Max	Mean	p50	SD
PL	29750	1.831	38.010	13.630	12.860	7.487
EP	29750	0.000	8.000	2.249	2.000	2.252

Variable	N	Min	Max	Mean	p50	SD
Size	29750	20.070	26.100	22.350	22.160	1.275
Liquid	29750	0.340	14.180	2.442	1.714	2.248
Inv	29750	0.000	0.642	0.130	0.104	0.116
Top1	29750	0.084	0.729	0.327	0.303	0.145
Age	29750	0.693	3.367	2.209	2.303	0.794
AssetGrowth	29750	-0.292	1.659	0.134	0.074	0.269
CAP	29750	0.412	13.020	2.575	1.994	2.047
Mshare	29750	0.000	0.675	0.140	0.019	0.190

4.2. Baseline Regression

Table 4 reports the baseline regression results of the impact of corporate new quality productive forces on environmental performance. Column (1) includes only the core explanatory variable while controlling for firm and year fixed effects. The estimated coefficient of PL is 0.021, which is significantly positive at the 1% level. In Column (2), after further including control variables, the coefficient of PL remains 0.016 and is still significant at the 1% level. This indicates that the improvement in the level of new quality productive forces has a robust positive effect on corporate environmental performance. Regarding the control variables, enterprise size, the shareholding proportion of the largest shareholder, and the management shareholding ratio are significantly positively correlated with environmental performance, while firm age, asset growth rate, and capital intensity show negative associations. These results are generally consistent with existing research findings. In terms of model goodness-of-fit, the adjusted R^2 increases from 0.673 to 0.681, indicating that the explanatory power of the model is further enhanced after including the control variables. Overall, the baseline regression results support the core conclusion that new quality productive forces can effectively improve corporate environmental performance.

Table 4 Baseline Regression Results

	(1)	(2)
VARIABLES	EP	EP
PL	0.021***	0.016***
	(8.233)	(6.662)
Size		0.607***
		(14.791)
Liquid		0.030***
		(3.082)
Inv		0.581***
		(2.655)
Top1		0.544**
		(2.105)
Age		-0.255***
		(-3.608)
AssetGrowth		-0.119***

		(-3.271)
CAP		-0.038***
		(-3.890)
Mshare		0.544***
		(3.035)
Constant	1.961***	-11.265***
	(57.363)	(-12.580)
Year	Yes	Yes
Stkcd	Yes	Yes
Observations	29,398	29,398
R^2	0.721	0.728
Adj. R^2	0.673	0.681

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. The same applies to the tables below.

4.3. Endogeneity Tests

To mitigate potential estimation bias caused by endogeneity issues such as reverse causality and omitted variables, this paper employs the instrumental variable (IV) method and the propensity score matching (PSM) method for endogeneity tests.

First, the instrumental variable method. On the one hand, considering the possible dynamic correlation between new quality productive forces and environmental performance, and following the approach of Zhang Chuan and Wang Yueyun (2025) [23], this study uses the one-period lagged new quality productive forces (LPL) as an instrumental variable for two-stage least squares (2SLS) regression. This variable satisfies the relevance requirement, as the lagged PL is highly correlated with the current-period PL. At the same time, as historical information, the lagged term is unlikely to be reversely affected by the current environmental performance, thus exhibiting good exogeneity. The regression results in Column (1) of Table 5 show that the one-period lagged PL has a significantly positive impact on the current PL. In Column (2), the effect of PL on EP remains significantly positive at the 1% level, consistent with the baseline regression results. This indicates that the core conclusion still holds after accounting for endogeneity.

On the other hand, drawing on the research idea of Wang Lei and Jia Leyi (2025) [24], the mean value of new quality productive forces of other firms in the same industry and same year can be used as an instrumental variable to further alleviate the interference of individual heterogeneity and industry-wide common shocks on the estimation. Firms in the same industry share similarities in technological paths and policy environments, making their new quality productive forces highly correlated with those of the target firm. Meanwhile, the development level of new quality productive forces of other firms is unlikely to directly affect the environmental performance of the target firm. Therefore, this instrumental variable satisfies both relevance and exogeneity requirements. Columns (3) and (4) present the test results. In the first stage, the estimated coefficient of the instrumental variable is 0.867, which is highly significant. In the second stage, the regression coefficient remains significantly positive at the 1% level, further verifying the robustness of the research conclusions.

Second, the propensity score matching method. To control for potential endogeneity arising from sample selection bias, this paper follows the approach of Cao Siyu and Wang Qinggang (2026) [25] and further employs the propensity score matching method for testing. Specifically, using control variables as matching covariates, the nearest-neighbor matching method is adopted to match a control group for the treatment group (i.e., firms with higher new quality productive forces). The results in Column (5) show that the regression coefficient of new quality productive forces is positive and significant at the 1% level, with a pseudo R^2 of 0.662. Thus, after alleviating sample selection bias, the core conclusion remains robust.

Table 5 Endogeneity Test Results

	(1)	(2)	(3)	(4)	(5)
	first	second	first	second	PSM Method
VARIABLES	PL	EP	PL	EP	EP
PL		0.046***		0.019***	0.016***
		(20.261)		(4.530)	(7.190)
LPL	0.763***				
	(183.344)				
IV			0.867***		
			(67.574)		
Size	0.503***	0.629***	1.802***	0.667***	0.593***
	(17.683)	(51.581)	(49.922)	(51.997)	(19.302)
Liquid	0.005	0.043***	0.046**	0.032***	0.035***
	(0.325)	(6.573)	(2.408)	(5.866)	(4.018)
Inv	-1.554***	-0.487***	-2.177***	-0.678***	0.475**
	(-6.061)	(-4.536)	(-6.466)	(-6.889)	(2.473)
Top1	-1.340***	0.956***	-3.495***	0.723***	0.526***
	(-6.316)	(10.751)	(-12.636)	(8.737)	(2.609)
Age	-0.708***	0.020	-1.529***	-0.092***	-0.316***
	(-12.691)	(0.857)	(-24.112)	(-4.529)	(-5.815)
AssetGrowth	0.064	0.021	-0.831***	-0.102**	-0.091**
	(0.535)	(0.416)	(-5.591)	(-2.385)	(-2.458)
CAP	-0.053***	-0.161***	-0.126***	-0.151***	-0.047***
	(-3.572)	(-25.808)	(-6.509)	(-26.859)	(-5.162)
Mshare	0.213	-0.616***	-0.430*	-0.586***	0.529***
	(1.086)	(-7.533)	(-1.753)	(-8.327)	(3.510)
Constant	-9.087***	-9.855***	-32.996***	-13.153***	-10.832***
	(-14.368)	(-36.988)	(-40.737)	(-54.942)	(-16.185)
Year	Yes	Yes	Yes	Yes	Yes
Stkcd	Yes	Yes	Yes	Yes	Yes
Observations	24,646	24,646	29,702	29,702	23,852
R^2	0.624	0.299	0.227	0.294	0.721
Adj. R^2	0.624	0.298	0.226	0.294	0.662

4.4. Robustness Tests

First, replacing the explanatory variable. To address the potential influence of the measurement method of the core explanatory variable on the estimation results, following the approach of Guo Huiting et al. (2024) [26], this study uses total factor productivity processed by the FE method as an alternative variable for regression testing. The results are shown in Column (1) of Table 6. The estimated coefficient of the new variable on environmental performance is positive and largely consistent with the baseline regression results, indicating that the model still has good explanatory power.

Second, changing the regression model. Considering that environmental performance exhibits the distributional characteristics of a count variable, and drawing on the study by Yu Jinping et al. (2024) [27], a Poisson regression is adopted for re-estimation to examine whether the baseline results depend on a specific model specification. Column (2) of Table 6 shows that the results remain significant, with a pseudo R^2 of 0.350. It should be noted that the pseudo R^2 in Poisson regression is calculated based on the log-likelihood function and measures the improvement in model fit relative to the null model. A relatively low value is normal for nonlinear count models and does not indicate poor model fit or unreliable core conclusions.

Third, excluding provincial-level municipalities. Since Beijing, Shanghai, Tianjin, and Chongqing exhibit systematic differences from other provinces in terms of economic development level, environmental regulation intensity, and policy support, which may interfere with the estimation results, the samples from these four municipalities are excluded for re-regression, following the approach of Shen Huayan et al. (2025) [28]. Column (3) shows that the estimated coefficient of new quality productive forces on environmental performance remains significantly positive at the 1% level, and the core conclusion does not change.

Fourth, changing the clustering method. The robust standard errors are changed from clustering at the firm level to clustering at the province level. The regression results are presented in Column (4) of Table 6. To control for potential intra-group correlation at the province level, and following the study by Gu Cheng et al. (2025) [29], the clustering level of robust standard errors is adjusted from the firm level to the province level, and the baseline model is re-estimated. The results in Column (4) remain significant at the 1% level and are largely consistent with the baseline regression. This indicates that the core conclusion remains robust even under stricter clustering standards.

Table 6 Robustness Test Results

	(1)	(2)	(3)	(4)
	Replacing the independent variables	Changing the regression model	Excluding provincial-level municipalities	Changing the clustering method
VARIABLES	EP	EP	EP	EP
PL		0.011***	0.016***	0.016***
		(5.891)	(5.733)	(7.755)
TFP_FE	0.105*			
	(1.695)			
Size	0.525***	0.098***	0.629***	0.604***
	(8.021)	(8.881)	(13.854)	(20.556)
Liquid	0.029***	-0.003	0.034***	0.031***
	(2.935)	(-1.338)	(3.037)	(4.288)
Inv	0.574***	-0.083	0.907***	0.590***
	(2.708)	(-1.349)	(3.662)	(3.479)
Top1	0.546**	-0.032	0.547*	0.554***
	(2.180)	(-0.430)	(1.869)	(2.912)
Age	-0.217***	0.002	-0.291***	-0.253***
	(-3.059)	(0.118)	(-3.584)	(-4.908)
AssetGrowth	-0.121***	-0.053***	-0.125***	-0.121***

	(-3.458)	(-5.715)	(-3.005)	(-3.695)
CAP	-0.013	-0.001	-0.038***	-0.039***
	(-0.867)	(-0.506)	(-3.487)	(-5.363)
Mshare	0.562***	0.076*	0.515***	0.537***
	(3.190)	(1.646)	(2.624)	(3.999)
Constant	-10.579***	0.518**	-11.674***	-11.217***
	(-10.795)	(2.152)	(-11.803)	(-17.484)
Year	Yes	Yes	Yes	Yes
Stkcd	Yes	Yes	Yes	Yes
Observations	29,745	29,398	23,693	29,398
R^2	0.729		0.724	0.729
Adj. R^2 / Pseudo R^2	0.681	0.350	0.675	0.681

V. Heterogeneity Analysis and Mechanism Study

5.1. Heterogeneity Analysis

The empirical results above indicate that new quality productive forces exert a significant positive effect on environmental performance. However, firms differ substantially in resource endowments, operational characteristics, and industry environments, which may lead to heterogeneous environmental improvement effects of new quality productive forces. To comprehensively reveal the boundary conditions of this effect, heterogeneity analysis is conducted from three perspectives—corporate profitability, industrial technological characteristics, and environmental regulation pressure—to examine the differentiated impacts of new quality productive forces under different contexts.

From the perspective of corporate profitability, profitability directly affects a firm's ability to allocate resources for environmental governance. Firms with stronger profitability typically possess more abundant financial reserves and can more readily convert the technological advantages embedded in new quality productive forces into actual environmental investments. To test this difference, return on equity (ROE) is adopted as a proxy for corporate profitability. The full sample is divided into high-profitability and low-profitability groups based on the median ROE during the sample period. As shown in Columns (1) and (2) of Table 7, in the high-profitability group, the estimated coefficient of PL is 0.020 and significant at the 1% level. In the low-profitability group, the estimated coefficient of PL is 0.009, also significant at the 1% level, but smaller in magnitude than that in the high-profitability group. The Fisher combination test results show that the coefficient difference between the two groups is significant at the 1% level. This indicates that the promotional effect of new quality productive forces on environmental performance is more pronounced in firms with stronger profitability.

From the perspective of industrial technological characteristics, significant differences exist across industries in technological foundations and innovation endowments, which may influence the absorption and transformation efficiency of new quality productive forces. High-tech industries, as technology-intensive sectors, generally exhibit stronger R&D capabilities and innovation awareness, leading to greater capacity to absorb and transform new quality productive forces. Following the classification method of Yao Kai and Wang Yajuan (2020) [30] and based on the CSRC industry classification standards, the pharmaceutical manufacturing industry, computer communication and other electronic equipment manufacturing industry, instrument and meter manufacturing industry, chemical raw materials and chemical products manufacturing industry, chemical fiber manufacturing industry, and railway, ship, aerospace, and other transportation equipment manufacturing industry are identified as high-tech industries. In Columns (3) and (4), PL is significant at the 1% level in both high-tech and non-high-tech industries, but the coefficient is relatively smaller in the latter. The inter-group difference between these two groups is significant at the 10% level. This suggests that the environmental effect of new quality productive forces is more significant in high-tech industries, likely due to their strong technological absorption capacity and innovation transformation mechanisms.

From the perspective of environmental regulation pressure, the external pressure from environmental supervision intensity may influence firms' motivation to apply new quality productive forces to environmental governance. Heavy-pollution industries, as the key targets of environmental regulation, face greater urgency in improving environmental performance and are more inclined to convert new quality productive forces into practical environmental governance actions. Therefore, following the classification criteria for heavy-pollution industries proposed by Guo Ye et al. (2019) [31], the 14 categories of industries listed in the Catalogue of Classified Management for Environmental Verification of Listed Companies issued by the Ministry of Environmental Protection are identified as heavy-pollution industries. Specifically, firms whose industry codes fall within B06 to B12, C13, C15, C17, C19, C22, C25 to C32, D44, and D45 are classified into the heavy-pollution group.In Columns (5) and (6), the coefficients of PL are significantly positive in both the heavy-pollution group and the low-pollution group. However, the coefficient in the low-pollution group is substantially smaller, and the difference between the two groups is significant at the 5% level. This indicates that the environmental improvement effect of new quality productive forces is more pronounced in heavy-pollution industries. The possible reason is that heavy-pollution firms face greater pressure for environmental compliance and are therefore more inclined to apply new quality productive forces to environmental governance, thereby achieving green transformation.

Table 7 Heterogeneity Analysis Results

	(1)	(2)	(3)	(4)	(5)	(6)
	High ROE	Low ROE	High-tech	Non high-tech	Heavy pollution	Light pollution
VARIABLES	EP	EP	EP	EP	EP	EP
PL	0.020***	0.009***	0.022***	0.014***	0.023***	0.012***
	(5.274)	(2.582)	(4.539)	(4.831)	(5.161)	(4.329)
Size	0.587***	0.429***	0.743***	0.565***	0.623***	0.610***
	(8.624)	(7.624)	(8.074)	(12.222)	(7.491)	(12.096)
Liquid	0.038**	0.026**	0.030*	0.032***	0.056***	0.015
	(2.511)	(2.098)	(1.741)	(2.726)	(3.195)	(1.241)
Inv	0.344	0.425	0.319	0.531**	0.876	0.419*
	(0.894)	(1.550)	(0.506)	(2.283)	(1.543)	(1.734)
Top1	0.177	0.404	0.579	0.618**	0.238	0.732**
	(0.444)	(1.154)	(0.913)	(2.197)	(0.471)	(2.458)
Age	-0.278***	-0.341***	-0.312**	-0.231***	-0.129	-0.299***
	(-2.776)	(-3.082)	(-2.239)	(-2.791)	(-0.952)	(-3.562)
AssetGrowth	-0.163***	-0.096*	-0.224***	-0.085**	-0.106	-0.161***
	(-2.893)	(-1.898)	(-2.935)	(-2.080)	(-1.482)	(-3.819)
CAP	-0.031	-0.036***	-0.059**	-0.032***	-0.023	-0.043***
	(-1.160)	(-3.095)	(-2.078)	(-3.103)	(-0.982)	(-3.962)
Mshare	0.631**	0.463**	0.487	0.558***	0.610*	0.457**
	(2.103)	(2.014)	(1.280)	(2.844)	(1.660)	(2.208)
Constant	-10.592***	-7.066***	-13.674***	-10.572***	-11.296***	-11.519***
	(-7.074)	(-5.656)	(-6.750)	(-10.529)	(-6.159)	(-10.547)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Stkcd	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,106	14,176	7,938	21,327	9,241	20,054

Fisher's Permutation test	0.008***		0.066*		0.035**	
R^2	0.752	0.753	0.725	0.730	0.723	0.709
Adj. R^2	0.682	0.690	0.672	0.683	0.675	0.656

5.2. Mechanism Analysis

Column (1) of Table 8 reports the impact of new quality productive forces on the level of green innovation. The results show that the estimated coefficient of PL is 0.010 and significant at the 1% level, indicating that an improvement in the level of new quality productive forces can significantly promote firms' output of green invention patents. In other words, the development of new quality productive forces helps stimulate firms' R&D vitality in the field of green technology. When firms leverage new quality productive forces to drive green technological innovation, they can convert technological breakthroughs into practical environmental governance capabilities, thereby providing technical support for the improvement of environmental performance. Column (2) of Table 8 examines the impact of new quality productive forces on the quality of environmental information disclosure. The estimated coefficient of PL is 0.005 and significant at the 1% level, suggesting that new quality productive forces can significantly enhance the quality of corporate environmental information disclosure. The digital and intelligent elements embedded in new quality productive forces help firms build more efficient and transparent information collection and processing systems. This enables firms to disclose environmental management information more comprehensively, strengthens the supervisability of their environmental behavior, and ultimately promotes the improvement of environmental performance. In summary, Hypothesis 2 is strongly supported.

Table 8 Mechanism Analysis Results

VARIABLES	(1) LnGreen_Inv	(2) Eidq
PL	0.010***	0.005***
	(9.041)	(5.535)
Size	0.340***	0.174***
	(15.734)	(9.821)
Liquid	0.004	0.002
	(0.947)	(0.436)
Inv	-0.044	0.116
	(-0.469)	(1.314)
Top1	0.009	0.083
	(0.069)	(0.783)
Age	-0.202***	0.050*
	(-7.123)	(1.871)
AssetGrowth	-0.059***	-0.049***
	(-3.681)	(-3.242)
CAP	-0.015***	-0.010**
	(-3.627)	(-2.437)
Mshare	0.181**	0.070
	(2.503)	(0.944)
Constant	-6.560***	-2.216***
	(-14.029)	(-5.766)
Controls	Yes	Yes

Year	Yes	Yes
Stkcd	Yes	Yes
Observations	29,035	29,035
R^2	0.780	0.771
Adj. R^2	0.730	0.730

VI. Conclusions and Implications

This paper takes Chinese A-share listed companies from 2015 to 2024 as the research sample and systematically examines the impact of new quality productive forces on corporate environmental performance and its underlying mechanisms. The study finds that an improvement in firms' new quality productive forces can significantly enhance environmental performance. This conclusion remains robust after addressing potential endogeneity issues and undergoing multiple robustness tests. Regarding the mechanisms, new quality productive forces promote the improvement of environmental performance by stimulating firms' green technological innovation vitality and enhancing the quality of environmental information disclosure. The heterogeneity analysis shows that the positive effect of new quality productive forces on environmental improvement is significantly stronger in the high-profitability group, high-tech industries, and heavy-pollution industries than in the low-profitability group, non-high-tech industries, and low-pollution industries, respectively. Based on the above findings, the following implications and policy recommendations are proposed:

First, enterprises should actively cultivate new quality productive forces and transform technological innovation advantages into practical outcomes in environmental governance. Firms should incorporate the development of new quality productive forces into their long-term development strategies and systematically plan the pace and key areas of investment in green technology R&D, intelligent transformation, and upgrading of environmental protection facilities. Specifically, enterprises can establish special funds for green technological innovation, build industry-university-research collaborative R&D platforms, and introduce digital energy efficiency management systems. These measures help convert technological breakthroughs into cleaner production processes and more intensive utilization of energy consumption, thereby reducing environmental loads while improving production efficiency. Internally, firms should establish cross-departmental coordination mechanisms for green innovation to deeply integrate the cultivation of new quality productive forces with daily production and operations, achieving synergistic enhancement of both economic and environmental benefits.

Second, firms should open up dual channels of green innovation and information disclosure to strengthen the institutional and technological foundations for environmental improvement. It is recommended that enterprises increase R&D investment, focus on the output of green invention patents, and direct R&D resources toward key technologies for emission reduction and pollution control. This can be achieved by establishing green technology incubation mechanisms, improving incentive systems for R&D personnel, and participating in the formulation of industry technical standards, thereby enhancing the transformation efficiency of innovation outcomes. At the same time, firms should leverage digital technologies to build a full-process environmental information collection system that integrates environmental management data with production and operation data. This enables real-time monitoring and dynamic disclosure of emission indicators, energy consumption, and the operational status of environmental protection equipment, thereby enhancing the transparency and supervisability of environmental behavior. Such efforts place corporate environmental performance under effective internal and external supervision and create a virtuous mechanism that compels continuous improvement in environmental management.

Third, when formulating development strategies, enterprises should fully recognize their own differences and identify the appropriate focus points for leveraging new quality productive forces. Leading enterprises should proactively assume the role of technological pioneers and provide replicable transformation experiences for peers in the same industry. Firms with weaker foundations should focus on their resource endowments, make up for shortcomings through technology introduction and collaborative R&D, and gradually improve their capacity to transform new quality productive forces. Meanwhile, the government should optimize differentiated support policies, providing targeted guidance and assistance to enterprises with different resource endowments, enabling them to enhance environmental performance through new quality productive forces. Only through the mutual coordination between proactive corporate actions and precise national policies can the differences among enterprises be transformed into a collective force driving green transformation, thereby achieving the inclusive release of the environmental effects of new quality productive forces.

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