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New Quality Productive Forces and Corporate Greenwashing in Manufacturing Firms

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Abstract. With the deepening of global commitment to sustainable development, the green transformation of enterprises is receiving increasing attention. In this context, new-quality productive forces (NQPF) provide a new perspective. By using the entropy method to measure NQPF, this study explores how NQPF affects greenwashing behavior in the manufacturing industry. It is found that NQPF significantly reduced greenwashing. Mechanism analysis shows that NQPF alleviates financing constraints and promotes disruptive technological innovation, thus guiding enterprises to shift from strategic environmental disclosure to substantive environmental governance. This effect is more pronounced in a more stringent regulatory environment and in highly competitive industries. This study proposes new empirical findings on the micro-level impact of NQPF on environmental governance. The report provides practical policy guidance for preventing corporate greenwashing, promoting high-quality green development of manufacturing, and meeting China's sustainable development goals.

Keywords: New-quality productive forces, corporate greenwashing, green transition

1. Introduction

As climate change intensifies, resource constraints tighten, and ecological systems become more fragile, transforming growth models and accelerating the green transition have become key strategic priorities. Firms, as micro-level actors in this transition, are regarded as fundamental units for implementing ESG principles and advancing sustainable development. Under China's "dual-carbon" goals, corporate green transition has been promoted through large-scale green subsidies, preferential credit, and industrial policies. Under these policy incentives, the share of A-share–listed firms disclosing ESG reports increased from less than 25% in 2018 to 45% in 2024 [1]. However, because ESG disclosure standards remain fragmented and oversight remains incomplete, strategic behavior may be incentivized among some firms. In 2024, the negative media coverage of greenwashing for A-share-listed companies increased by over 30%, which included traditional heavy energy sectors and new industries like renewable energy and technology [2]. Selective ESG reporting focuses on highlighting positive impacts while ignoring negative aspects; this is often observed in so-called "high-commitment" yet ineffective initiatives aimed at reducing emissions and constitutes what is termed as ESG greenwashing. Companies leverage ESG reports to pursue subsidies or investors, thus damaging their own reputations as well as the green economy, whereas external regulation and

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internal governance encompassing media supervision and executives' backgrounds may restrain greenwashing [3-5]. In recent years, it has also been found through research that digital technologies seem to decrease information asymmetry somewhat, thus limiting such behaviors [6].

However, focusing narrowly on technological tools is probably not going to get the root reasons for the green transition. If we want to deal with greenwashing from where it comes from, then our analysis needs to go back to what productivity theory is based on. "Digital transformation" usually means taking on information technologies, but NQPF goes further: it's a greater level of digitization and also about combining highly skilled workers, environmentally friendly work materials, and new ways of working better. NQPF stands for high-tech, efficient and quality-driven processes, symbolizing a qualitative leap in productivity levels. Earlier research suggests that when considering economic impacts, NQPF notably enhances production efficiency and bolsters corporate resilience, thus acting as a crucial catalyst for high-quality growth [7,8]. NQPF fosters green innovation and enhances ESG performance [9,10], though few studies have used such a basic "capability endowment" viewpoint to see if NQPF could influence how companies make their strategies. With just digital tools, can NQPF prevent corporations from engaging in greenwashing at its core by providing resources and boosting capabilities? This question is examined in this study.

2. Literature review

Greenwashing is the act by which companies create a misleading impression of their environmental responsibility through selective disclosure of environmental information. This conduct harms financial outcomes, harms reputations, and endangers green supply chains [11]. Current literature investigates governance mechanisms from external and internal viewpoints. From outside, regulatory pressure like environmental rules and media watchfulness reduces greenwashing by making it costlier to ignore [12,13]. From within, aspects like executives' environmental experience, board governance and internal control quality have been found to be effective at preventing greenwashing.

New-Quality Productive Forces (NQPF) have the potential to reorganize firms' operations and decision-making by means of empowerment, innovation, and green influence. The current research explores its impact on the enterprise level from multiple perspectives, especially in terms of economic outcomes, which can significantly improve production efficiency, enhance enterprise resilience, improve resource allocation, and promote high-quality growth [7,8]. As for environmental impacts, they can reduce carbon emissions, improve carbon emission performance, promote green technology innovation, simplify green transformation, and improve ESG performance [9,10]. In summary, although previous studies have covered many of the effects of NQPF, research on how these forces affect corporate greenwashing behavior is still very limited.

This study explores whether and how new quality productivity affects corporate greenwashing, with particular attention to shifting the focus from "green empowerment" to "greenwashing governance" when considering NQPF. We have created a framework of mechanisms to enable these forces to work through two channels : resource release and capacity enhancement, both of which enhance resource allocation and the ability of companies to take meaningful environmental action, thereby reducing symbolic disclosure. Using the entropy method and integrating corporate financial data, we estimate the fixed effect model and perform heterogeneity analysis to provide guidance for more accurate policy interventions.

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3. Methods and data

3.1. Data sources

Our sample consists of Chinese A-share manufacturing companies during 2015–2024, forming an unbalanced panel dataset. The core data are obtained from CSMAR. Data on corporate greenwashing are sourced from Bloomberg, Huazheng, and Wind. Following data collection, the subsequent procedures are applied: (1) exclusion of ST and PT firms, and those with missing key variables; (2) since manufacturing is a major source of environmental pollution and thus holds stronger research relevance, the sample is further restricted to manufacturing firms; (3) winsorizing continuous variables at the 1% level to address outliers.

3.2. Model specification

To assess how NQPF affects corporate greenwashing, the following econometric specification is employed.

$$Gws_{it} = \alpha_0 + \alpha_1 Npro_{it} + \beta X_{it} + \mu_i + \tau_t + \varepsilon_{it} \tag{1}$$

The dependent variable, Gwsit, quantifies the greenwashing level of firm (i) during year (t). The key explanatory variable, Nproit, indicates the degree of development of NQPF for firm (i) in year (t), and Xit is a vector of control variables. μi and τt represent firm and year-specific effects respectively, while εit denotes the error term.

3.3. Variables

The dependent variable is the extent of corporate greenwashing (Gwsit). In order to achieve reputational benefits and attract investors, firms may overstate their environmental accomplishments without fulfilling their commitments. This creates an ESG "say–do" discrepancy. As per [14,15], we assess greenwashing by means of a firm's environmental disclosure score (ESGdis) and its actual environmental performance score (ESGper).

$$Gws_{it} = \left(\frac{ESG_{dis,it} - \overline{ESG_{dis}}}{\sigma_{dis}}\right) - \left(\frac{ESG_{per,it} - \overline{ESG_{per}}}{\sigma_{per}}\right) \tag{2}$$

In Equation (2), ESGdis stands for the amount of environmental information made public, which comes from the 'E' category in Wind ESG ratings. This measure reflects how much ESG data a company chooses to share on its own. On the other hand, ESGper denotes the real environmental impact of the firm. The data range and industry differences can result in measurement bias, so we scale both variables to minimize such bias. Gwsit equals the difference between standardized environmental disclosure (ESGdis) and actual environmental performance (ESGper). A larger Gwsit indicates a greater discrepancy between claims and facts, implying more serious greenwashing.

The core explanatory variable, which is firm-level New Quality Productive Forces (NQPF), is quantified via a composite index method. On the basis of the theoretical framework for NQPF, this index is built in three dimensions: "New Quality Labor", "New Type of Labor Object" and "New Material Means of Production", as Li et al. did in their 2024 research [8]. As far as particular indicators go, we take into account many different elements at once, such as human capital structure, asset accumulation traits and technological innovation/greening levels. And then we use the entropy

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method so as to assign weights to each indicator objectively, after which we do a weighted sum to get the overall score of firm-level NQPF.

To mitigate omitted-variable bias, we include firm-level controls (Size, log of total assets; ListAge, log of years listed), financial controls (Lev, leverage; ROA, profitability; Tobin's Q, investment efficiency), and we also control for the capital intensity (CAP), shareholding ratio of the top ten shareholders (Top10) and whether the CEO also serves as board chair (Dual). Descriptive statistics for the main variables are provided in Table 1.

Table 1. Descriptive statistics

Variable	N	Mean	S.D.	Min	Max
Gws	3714	-0.0131	1.1893	-3.8529	6.2971
Npro	3714	0.4093	1.0297	-1.5619	3.3012
Size	3714	23.3611	1.1149	20.3582	26.4523
Age	3714	3.0545	0.2754	1.6094	4.0073
Lev	3714	0.4388	0.1757	0.0487	0.9077
ROA	3714	0.0557	0.0594	-0.5562	0.2223
tobins_q	3714	2.1707	1.5577	0.7946	13.5269
CAP	3714	1.8557	1.1235	0.3788	14.6599
Top10	3714	0.5812	0.1498	0.2083	0.9097
Dual	3714	0.2596	0.4385	0.0000	1.0000

4. Empirical analysis

4.1. Baseline regression

The baseline relationship between new quality productivity and greenwashing among manufacturing firms is reported in Table 2. Column (1) shows that after taking into account firm and year fixed effects, NQPF has a significant negative coefficient of -0.261 at the 1% level, which suggests there is less corporate greenwashing. Column (2) adds control variables; the coefficient stays negative and statistically significant. This means that when advanced productivity factors get better, corporate greenwashing gets reduced.

Table 2. The results of main regression

Variables	(1)	(2)
	Gws	Gws
Npro	-0.261***	-0.249***
	(0.039)	(0.038)
Control variables	Yes	Yes
Area fixed	Yes	Yes
Time fixed	Yes	Yes
N	3615	3615
R2	0.4864	0.4906

Notes: Standard errors in parentheses p<0.1,p<0.05,p<0.01. This note applies to the following tables.

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4.2. Robustness checks

To confirm if the baseline results are consistent, more robustness tests were executed. After excluding firms located in centrally administered municipalities, the estimated coefficient for NQPF was still significantly negative, which means that observations from special administrative areas didn't influence our findings. When firm-level clustered standard errors were substituted for industry-level clustered standard errors, the coefficient of this new productivity model was still significantly negative, showing that the results aren't affected by within-industry serial correlation. To evaluate sensitivity to index creation, a PCA-derived measure was formed by taking the first seven principal components (which account for 80.49% of total explained variance); substituting the original index with this alternative measure produced a coefficient that was negative and significant at the 1% level. To reduce worries about omitted-variable bias and reverse causality, we take managers' overseas study experience as an instrument, and the two-stage estimates confirm that our findings are strong. First-stage results show a very large positive coefficient, and the Kleibergen–Paap F-statistic is over 10, which shows that this instrument is quite strong. The second stage estimate remains negative and significant, meaning our main results are still valid even if there was some endogeneity.

Table 3. Robustness tests

Variables	(1)	(2)	(3)	(4)	(5)
	Alternative sample range	Alternative Clustering Method	Alternative Specification of Key Explanatory Variable	Npro	2SLS
Npro	-0.231***	-0.249***	-1.260***		-0.368***
	(0.041)	(0.034)	(0.098)		(0.083)
IV				0.623***	
Control variables	Yes	Yes	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes	Yes
K-P F Value					316
N	2995	3615	3615	3615	3615
R2	0.4747	0.4906	0.5434	0.8005	0.0271

4.3. Heterogeneity analysis

4.3.1. Environmental regulatory stringency

Environmental regulatory pressure varies from region to region. We evaluate the strictness of regulation by dividing industrial pollution control investment by industrial added value [16]. Columns 1-2 of Table 4 show that the coefficient of NQPF is more negative in regions with stricter regulation. Under stricter regimes, non-compliance entails higher costs, so companies with higher NQPF values are more likely to take significant environmental action than mere symbolic disclosure. If the regulatory supervision is more relaxed, the cost of greenwashing will be reduced, making it more attractive.

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4.3.2. Industry competition

Industry competition is quantified by means of the Herfindahl–Hirschman Index (HHI), and we divide our sample into two groups, namely high-competition and low-competition ones, based on the mean value from the sample. Table 4 (columns 3-4) shows that NQPF cuts down greenwashing in both categories, especially so in highly competitive industries. The firms are under greater pressure to show they're "green," and those with higher NQPF can use their real performance as backing for this claim, thus reducing symbolic reporting even more.

Table 4. Heterogeneity analysis

Variables	(1)	(2)	(3)	(4)
	Low-Regulation Regions	High-Regulation Regions	Low-Competition Industries	High-Competition Industries
Npro	-0.183***	-0.257***	-0.173**	-0.273***
	(0.052)	(0.060)	(0.086)	(0.043)
Control variables	Yes	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes
N	1776	1621	609	2998
R2	0.5541	0.5606	0.5262	0.4882

4.4. Mechanism analysis

4.4.1. Financing constraints

New quality productivity is related to efficiency improvements and enhanced operational performance. And such enhancements could alleviate financing constraints by bolstering external financing circumstances, which we analyze through the SA index as a proxy for firms' financing constraints. In Column (1) of Table 5, the coefficient on NQPF is 0.003 and significant at the 1% level, implying that advanced productivity factors greatly raise the SA index, showing that financing constraints are eased. If financing constraints are eased, then firms gain more access to financial resources. They would be less likely to depend on greenwashing for resource acquisition or to exaggerate their achievements, and they would be better positioned to pursue meaningful green transformations.

4.4.2. Disruptive technological innovation

New productivity models have a core characteristic, which is transformative technological progress. Disruptive technological innovation is an immediate expression of this kind of progress. In line with Sun Ye et al. (2025) [17], we count the number of disruptive-technology patents held by a company in year (t) as its measure of disruptive innovation for that year. As shown in the second column of Table 5, the NQPF coefficient is significantly positive at the 1 % level (0.210), indicating that advanced productivity factors have greatly promoted the technological innovation of enterprises.

Innovation is heterogeneous. Invention patents usually represent major technological advances, while utility model patents often have more strategic significance. In order to assess the quality of

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innovation, we distinguish between invention patents and utility model patents. The estimation of invention patents in Column (3) is 0.196, which is significant at the 1 % level, while the corresponding utility model patents in Column (4) are 0.009, which is not statistically significant. This separation shows that the new productivity model enhances the real innovation ability of enterprises, not just the ability of strategic and quantity-driven innovation. Enterprises with strong innovation ability seldom resort to a greenwashing strategy. They have the conditions to compete effectively by achieving tangible improvements in environmental performance.

Table 5. Mediation effect test

Variables	Financing constraints	Disruptive Technological Innovation		
	(1)	(2)	(3)	(4)
	SA index	Invention & Utility Model Patents	Invention Patents	Utility Model Patents
Npro	0.003***	0.210***	0.196***	0.009
	(0.001)	(0.030)	(0.030)	(0.029)
Control variables	Yes	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes	Yes
N	3615	3214	3214	3214
R2	0.9862	0.5813	0.5600	0.4455

5. Research conclusion

Against the backdrop of intensifying global environmental challenges, green transformation has become an unavoidable choice for firms seeking sustainable development. In practice, however, greenwashing—often characterized by "high commitment but low implementation"—has seriously hindered the healthy development of the green economy. By focusing on new quality productive forces, this study introduces a fresh theoretical approach and practical solutions to tackle greenwashing.

Using a panel of Chinese A-share manufacturing firms (2015–2024), we investigate how new productivity models influence corporate greenwashing, as well as the underlying mechanisms and heterogeneous effects. The following summarizes the main outcomes of the study. After controlling for firm characteristics and fixed effects, it is found that advanced productivity factors significantly reduce corporate greenwashing. Further examination of the mechanisms shows that this governance effect mainly works through two channels: resource release and capability improvement. Financing constraints seem to be somewhat alleviated, while new productivity models may foster disruptive technological innovation. This shift reallocates resources toward meaningful environmental activities and minimizes opportunistic conduct. The impact is greater when environmental regulations are stricter and in fiercely competitive industries. Overall, NQPF boosts firm performance and encourages more responsible environmental behavior. Green development seems to be getting stronger, but the speed varies among firms and regions.

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