Dean&Francis
ISSN 2959-6130

Does Stricter Environmental Regulation Curb Corporate Greenwashing? Evidence from China's 2014 Environmental Protection Law

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Abstract:

Amid growing public concern regarding climate change and environmental sustainability, corporate greenwashing, defined as the practice of misleadingly portraying firms as environmentally responsible, has emerged as a pivotal challenge in environmental governance. Understanding how regulatory interventions shape such behavior is crucial to fostering authentic corporate environmental responsibility. This paper investigates the impact of the 2014 revision of China's Environmental Protection Law on listed firms' greenwashing practices. Utilizing panel data from A-share listed companies spanning 2008 to 2024, this study employs a difference-in-differences (DID) approach to evaluate the law's effectiveness. A novel greenwashing index is constructed by integrating positive environmental information disclosure (PEID, from 8 environmental management disclosure items in annual reports), green investment (from "Construction in Progress" notes), and environmental violation penalties (from the CSMAR database). Empirical results demonstrate a significant reduction in greenwashing following the law's enactment, with the effect being particularly pronounced among state-owned enterprises. These findings underscore the effectiveness of stricter environmental regulation in mitigating symbolic corporate environmental claims and offer methodological and policy insights for future research and governance strategies.

Keywords: Greenwashing, 2014 Environmental Protection Law Amendment, green finance, environmental regulation, DID

1. Introduction

As extreme weather events increase and ecological degradation continues, public attention to climate change and environmental protection has intensified[1]. This heightened awareness pressures corporations to reduce environmentally harmful activities and demonstrate commitment to green transitions, such as through clean energy innovation. However, the financial costs associated with renewable energy investments and managerial short-termism frequently discourage firms from undertaking such initiatives. To balance public scrutiny and profit maximization, some firms resort to greenwashing—making symbolic environmental claims without taking genuine action[2]. Existing studies have highlighted the role of environmental regulations in curbing greenwashing. For example, Shi and Xin found that the implementation of China's Environmental Protection Tax Law significantly reduced greenwashing by mitigating managerial short-termism and strengthening internal control systems[3]. Conversely, other scholars argue that stringent regulations may intensify firms' financial and reputational pressures, potentially leading to increased greenwashing behaviors. Cao, Chen, and Zhu found that the Green Credit Policy, rather than improving corporate environmental practices, unexpectedly exacerbated greenwashing among Chinese listed companies by restricting their access to bank credit[4]. Given the mixed findings in the literature, it is imperative to identify which specific policies effectively curb greenwashing and unpack the underlying mechanisms, thereby providing deeper insights into enhancing market integrity and public trust.

This paper focuses on the 2014 revision of China's Environmental Protection Law, widely regarded as the strictest in history, which marked a critical milestone in environmental governance. The new law introduced measures such as the "daily penalty" system for continuous violations and accountability mechanisms for local officials who tolerate pollution. Employing a difference-in-differences (DID) approach with panel data from A-share listed companies spanning 2008 to 2024, this paper assesses the law's impact on firms' symbolic and substantive environmental practices. The findings contribute to the literature by examining an underexplored policy context and clarifying whether high compliance costs and potential sanctions can genuinely deter greenwashing, thus offering actionable insights for optimizing environmental governance.

2. Literature review

Even though greenwashing is generally understood by scholars as the discrepancy between a firm's symbolic environmental communication and its actual environmentally friendly practices, there is still no consistent operational definition for its measurement. Some researchers employ natural language processing techniques to conduct textual analyses and calculate an environmental disclosure index that reflects the gap between disclosed information and actual actions reported in listed companies' annual reports [5][6]. However, the NLP-based method for analyzing greenwashing tendencies may encounter issues such as semantic ambiguity, insufficient behavioral validation, and the risk that models absorb biases from firms' disclosure styles. Another common approach calculates the greenwashing index as the ratio of symbolic to substantive environmental disclosure [2][3][7]. This method also tends to overemphasize the textual characteristics of disclosures, and the subjectivity inherent in the classification process may introduce researcher bias. A third line of research measures greenwashing by comparing a company's environmental communication with its actual actions. This method relies on audited data obtained from certified databases, which enhances the reliability and credibility of the results[4][8]. Existing approaches to measuring actual environmental actions typically focus on a single indicator, such as the amount of environmental investment, the monetary value of penalties, or the frequency of violation incidents.

Given that both green investment and environmental penalties capture different facets of a firm's actual environmental performance, with the former reflecting proactive engagement and the latter indicating adverse outcomes, relying solely on either indicator yields an incomplete understanding. To address this limitation, this paper constructs a greenwashing index that integrates both the positive and negative aspects of corporate environmental behavior. This approach addresses a key research gap by providing a more balanced and comprehensive assessment of the discrepancy between symbolic disclosure and actual environmental performance. Furthermore, recent findings suggest that local governments' environmental targets may inadvertently promote rather than restrain corporate greenwashing, primarily by reducing firms' substantive environmental performance and the quality of their environmental information disclosure [8]. This context makes the analysis of the 2014 Environmental Protection Law Amendment particularly meaningful.

3. Method

3.1 Dependent variable

As discussed in the literature review, this study constructs

ISSN 2959-6130

a greenwashing index (GW) to capture the discrepancy between a firm's environmental communication and its actual environmental actions. Building on previous research, the GW index is redefined as follows:

$$GW_{it} = \frac{PEID_{it}}{\ln(GreenInvestment_{it}+1)+c} + PENAL_{it} \quad (1)$$

Firms' level of environmental communication with stakeholders is gauged using Positive Environmental Information Disclosure (PEID), first proposed by Cao, Chen, and Zhu [4]. In this study, PEID is derived from eight disclosure items listed in the Summary Table of Environmental Management Disclosures of publicly listed companies, which is collected by the China Stock Market and Accounting Research (CSMAR) database. For each item, a firm is assigned a value of 1 if relevant information is disclosed and 0 if not. The PEID score, therefore, ranges from 0 to 8, with higher values indicating greater levels of positive environmental disclosure. The specific items and their definitions are summarized in Table1 below.

Table 1: PEID item description

Items	Project Name	Explanation
1	Environmental Concept	Disclosure of the company's environmental philosophy, environmental policies, organizational structure for environmental management, circular economy development model, and green development strategies.
2	Environmental Goal	Disclosure of the company's achievement of past environmental goals and its future environmental objectives
3	Environment Management System Schema	Disclosure of the establishment of environmental management systems, regulations, procedures, and the assignment of environmental responsibilities.
4	Environmental Training and Education	Disclosure of the company's participation in environmental education and training programs.
5	Environmental Special Act	Disclosure of the company's involvement in environmental campaigns and public welfare activities related to environmental protection.
6	Environment Event Emergency Mechanism	Disclosure of the establishment of emergency response mechanisms for major environmental incidents, including adopted measures and pollutant treatment outcomes.
7	Environmental Honor Reward	Disclosure of environmental awards or honors received by the company.
8	Three Simultaneity	Disclosure of the company's implementation of the "Three Simultaneities" system (simultaneous design, construction, and operation of pollution control facilities along with the main project).

For each company's environmental investment payment, the measurement follows the approach of Zhao and Wang [10]. Environmental investments refer to expenditures associated with environmental governance and green production, such as desulfurization and denitrification, wastewater treatment, waste gas and solid waste disposal, and clean production practices. They are identified from the "Construction in Progress" notes. These payments are aggregated to calculate each to obtain each firm's total annual green investment, which is then standardized by dividing by the firm's total assets at the end of the year.

Green expenditures, on the other hand, include operating expenses related to environmental protection, such as landscaping fees, environmental impact assessment fees, and resource compensation fees, which are extracted from the "Administrative Expenses" statement. These values are standardized by dividing by the firm's operating revenue.

The annual environmental investment payment of listed corporates is then calculated as the sum of standardized green investment and green expenditures. To handle zero values in the data, a constant c = 1 is added in the formula to ensure valid logarithmic transformations. A comparison of descriptive statistics for ln(Investment + 1) before and after the adjustment confirms that the means and standard deviations are identical to three decimal places, verifying the robustness of this adjustment. For the penalty variable (PENAL), the data collection method follows that of Jiang, Ning, and Lin [8].

3.2 Control variable

Referring to the existing literature, several firm-level characteristics are controlled to rule out their potential confounding effects[3][4]. These control variables are included to account for firm-level heterogeneity that might otherwise confound the estimated impact of the 2014

Environmental Protection Law Amendment on corporate greenwashing behaviors(Table 2).

(1) Firm size(Size): measured by taking the logarithmic number of the total assets of the incorporated enterprise.

(2) Firm age(FirmAge): measured by the natural logarithm of (the current year minus the firm's establishment year plus 1)

(3) Firm level(Lev): measured by the total liabilities at year-end divided by the total assets at year-end.

(4) Firm growth rate(Growth): measured by (operating revenue in the current year divided by operating revenue in the previous year) minus 1.

(5) Return on equity(ROE): measured by Net profit divided by average balance of shareholders' equity.

(6) Cashflow(Cashflow): measured by Net cash flow from operating activities divided by total assets.

Table 2. Control variable descriptive data

	(1)	(2)
VARIABLES	N	mean
Size	42,314.000	22.258
Lev	42,314.000	0.425
ROE	42,314.000	0.061
Cashflow	42,314.000	0.049
Growth	42,314.000	0.150
FirmAge	42,314.000	2.943
GW	42,306.000	0.907

3.3 Data sources

This study utilizes panel data of Chinese A-share listed companies from 2008 to 2024 to construct the research sample. Data on firms' *Environmental Management Disclosure* tables—employed to compute PEID—were obtained from the China Stock Market and Accounting Research (CSMAR) database[12], along with basic financial information used to compute control variables and perform heterogeneity analyses. To ensure data quality, the following sample screening criteria were implemented: (1) financial and real estate firms were excluded; (2) companies marked as ST or *ST were excluded; (3) firms with abnormal financial statistics or missing data were removed; and (4) all continuous variables were winsorized at the 1% and 99% levels. Descriptive statistics for the core variables are reported in Table 2 (see Appendix).

4. Econometric model and empirical analysis

4.1 Methods

Drawing on the methodological framework of Shi and Xin, this study constructs the following econometric model:

$$GWit = \alpha 0 + \alpha 1 Treati \times Postt + \sum n \gamma n Controlnit + \theta i + \lambda t + \varepsilon it \quad (2)$$

GWit is the dependent variable in this study, representing the degree of greenwashing of firm_i in year_t.

The core explanatory variable in this study is $Treat_i \times Post_t$. Here, $Treat_i$ is a group-specific dummy variable. Considering that the penalty provisions of the new amendment have a stronger regulatory effect on polluting enterprises, this study follows the approach of Pan et al. to classify firms in heavily polluting industries as the treatment group and those in non-heavily polluting industries as the control group[11]. The classification is based on the Guidelines for the Industry Classification of Listed Companies revised by the China Securities Regulatory Commission in 2012. Industries with the following codes are identified as heavily polluting enterprises: B06, B07, B08, B09, C17, C19, C22, C25, C26, C28, C29, C30, C31, C32, and D44. $Post_t$ is a time dummy variable. Since the new amendment was implemented starting in 2015, $Post_t$ takes the value of 1 for years 2015 and beyond (post-implementation) and 0 for pre-2015 years.

Controlnit denotes the control variables; θi represents firm fixed effects; λt represents year fixed effects; and εit is the random error term. The main focus of the study is on the coefficient α1, which captures the net effect of the 2014 Environmental Protection Law Amendment on corporate greenwashing behavior.

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4.2 Baseline regression results

Table 3. Baseline regression results

	(1)	(2)
VARIABLES	fixed effects only	fixed effects only
Post_Treat	-0.114**	-0.099*
	(0.057)	(0.057)
Size		0.145***
		(0.028)
Lev		-0.209**
		(0.094)
Growth		-0.050***
		(0.014)
FirmAge		0.340
		(0.216)
ROE		0.046
		(0.066)
Cashflow		0.277**
		(0.117)
Constant	0.922***	-3.232***
	(0.009)	(0.835)
Observations	42,034	42,034
R-squared	0.544	0.546
Control	NO	NO
Year Fixed	Yes	Yes
Firm Fixed	Yes	Yes
Observations	42,034	42,034
R-squared	0.544	0.546
Control	NO	NO
Year Fixed	Yes	Yes
Firm Fixed	Yes	Yes
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 3 presents the baseline regression results of the proposed econometric model. Column (1) presents results incorporating only year and firm fixed effects, excluding control variables. Column (2) adds control variables related to the firms' basic financial characteristics. In both models, the coefficient of Post_Treat remains statistically significant and negative, confirming that the 2014 Environmental Protection Law Amendment effectively curbed corporate greenwashing behavior. Specifically, the estimated coefficients of –0.114 and –0.099 suggest that, following the policy implementation, the greenwashing index of listed firms decreased by approximately 11% to 10% on average. This magnitude indicates a moderate but economically significant reduction, suggesting the Amendment exerted a notable deterrent effect on symbolic environmental claims. The slightly smaller coefficient after introducing control variables indicates that part of the policy effect is transmitted through firms' financial attributes. Nevertheless, the overall influence remains robust and significant. These findings highlight the policy's effectiveness in promoting more authentic environmental practices among Chinese firms.

4.3 Robustness tests

To verify the robustness of the baseline findings, a parallel trend test was performed alongside the core regression. The core identifying assumption of the DID approach is that the treatment and control groups follow parallel trends in greenwashing before the policy intervention. The resulting graph demonstrates no statistically significant pre-policy differences in greenwashing trends between the two groups before the policy was introduced. As depicted in Figure 1, the policy exhibits a lagged effect, becoming statistically significant approximately five years after implementation.

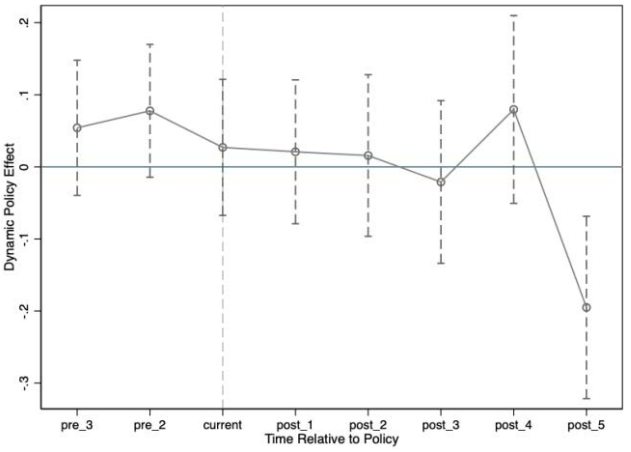

Figure 1: Parallel trend test

4.4 Heterogeneity analysis

Table 4. Heterogeneity Analysis - Property Rights

	(1)	(2)
VARIABLES	SOE=0	SOE=1
Post_Treat	-0.079	-0.147*
	(0.072)	(0.089)
Constant	-4.324***	-2.556
	(1.036)	(1.587)
Observations	26,159	15,814
R-squared	0.566	0.544
Control	Yes	Yes
Year Fixed	Yes	Yes
Firm Fixed	Yes	Yes
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Given that state-owned enterprises (SOEs) in China are subject to stricter supervisory oversight, and their executive management teams tend to be more responsive to central government policies, this study first investigates how ownership structure differences moderate the policy's impact on firms' greenwashing behaviors. The variable SOE denotes ownership type, taking the value of 1 if a firm is state-owned and 0 otherwise. To explore heterogeneity, the sample is split into two subsamples by ownership type, with separate DID regressions estimated for each group. As reported in Table 4, when SOE = 1, the coefficient of the Post_Treat variable is -0.147*, indicating a significant negative effect compared with the coefficient when SOE = 0. This result suggests that state-owned enterprises (SOEs) experienced a markedly stronger deterrent effect from the 2014 Environmental Protection Law Amendment than non-state-owned firms. The finding reflects the elevated regulatory scrutiny and stronger policy responsiveness of SOEs, which likely motivated them to adopt more genuine and substantive environmentally friendly practices.

Table 5. Heterogeneity Analysis - Regional Differences

	(1)	(2)
VARIABLES	East = 1	East = 0
Post_Treat	-0.092*	-0.089

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	(0.084)	(0.077)
Constant	-3.646***	-1.436
	(1.023)	(1.361)
Observations	29,646	12,374
R-squared	0.571	0.468
Control	Yes	Yes
Year Fixed	Yes	Yes
Firm Fixed	Yes	Yes
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

The second heterogeneity analysis examines regional differences. Based on disparities in economic development and the adoption of environmental policies, this study follows the conventional classification of Chinese provinces into two categories: eastern and non-eastern regions, with the latter including both central and western regions [7]. We hypothesize that, given the eastern regions' higher economic development level and their role as pilot zones for environmental policy innovations (such as the implementation of early carbon trading mechanisms and stricter pollution control standards), firms located in these regions are more likely to comply with the 2014 Environmental Law Amendment and consequently reduce their greenwashing behaviors. As shown in Table 5, the coefficient of the Post_Treat variable is statistically significant and negative for eastern firms, corroborating our hypothesis. The results indicate that the amendment exerts a more salient inhibitory effect on corporate greenwashing in the eastern regions. However, the findings also suggest that in less developed central and western areas, economic development remains a higher priority. Therefore, while strengthening environmental regulation is necessary, complementary policies—including targeted subsidies and incentive mechanisms—are indispensable to incentivize and guide environmental investments in regions with weaker economic foundations.

5. Conclusion

Through a DID analysis, the results suggest that the 2014 amendment exerts a moderate yet statistically significant inhibitory effect on greenwashing, underscoring the value of stringent environmental governance and regulatory enforcement. Furthermore, the heterogeneity analysis reveals that state-owned enterprises are more responsive to the policy, primarily attributable to stricter governmental oversight and greater sensitivity to central policy directives. In addition, regional heterogeneity is evident: the inhibitory effect of the policy is more pronounced in the economically advanced eastern provinces, characterized by stronger institutional capacity and higher public environmental awareness. These findings suggest that while stringent environmental regulations can effectively discourage symbolic environmental behaviors, their efficacy varies by ownership structure. Policymakers should thus adopt differentiated regulatory strategies that accommodate firm ownership and operational capacity, while also enhancing enforcement mechanisms for non-state enterprises to ensure balanced and sustainable policy outcomes. Notwithstanding its contributions, this study has several limitations. The analysis primarily documents the policy's aggregate and heterogeneous effects but fails to empirically test the underlying mechanisms—specifically, whether the Amendment reduces greenwashing by reshaping local officials' incentives (shifting their focus from GDP-centric performance appraisal to environmental governance) and reinforcing environmental considerations in bureaucratic evaluation frameworks. Future research could explore this channel by incorporating local political indicators or officials' promotion incentives into the empirical framework, thereby providing a deeper understanding of how institutional reforms translate into corporate behavioral changes.

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