ENVIRONMENTAL REGULATORY CENTRALIZATION, ESG PERFORMANCE, AND CORPORATE TAX AVOIDANCE: EVIDENCE FROM POLLUTING INDUSTRIES IN CHINA

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Abstract: This study evaluates the impact of China's vertical environmental management reform on corporate tax avoidance. Using data on A-share listed firms in high-polluting industries from 2015 to 2023 and a staggered difference-in-differences approach, we find that the reform significantly increases tax avoidance. The effect is more pronounced among private firms and in regions with weaker environmental regulation. Firms with better ESG performance show weaker responses. The results highlight how changes in environmental enforcement shape corporate financial decisions and underscore the need to strengthen both regulatory independence and firm-level governance.

Keywords: Environmental Regulatory Centralization；Corporate Tax Avoidance；ESG Performance

1   Introduction

Improving the environmental regulatory system is a core component of advancing ecological civilization in China. In recent years, as the central government has placed increasing emphasis on environmental protection, efforts have been made to address long-standing problems such as local protectionism and weak enforcement in traditional environmental governance (Guo, 2023; Qian, Ding, & Ding, 2023) As a major institutional innovation, the vertical environmental management reform aims to enhance the authority and independence of environmental law enforcement by transferring key regulatory functions to provincial-level ecological departments and strengthening their unified leadership over local agencies. Launched as a pilot in selected provinces in 2016 and gradually expanded nationwide, the reform has played a critical role in modernizing China's environmental governance system. It has not only optimized the intergovernmental regulatory structure but also significantly changed the external environment and compliance pressure faced by high-polluting firms.

As key participants in environmental governance, firms' behavioral responses to environmental policy shifts have attracted growing academic interest. The reform, by enhancing enforcement and reducing local government interference, increases both compliance costs and operational risks for high-polluting firms (Ren, Li, Liu, & Tang, 2024; Shen & Jiang, 2021; Xu, 2022). Under such pressure, firms may adopt various financial strategies to mitigate the burden. Due to its flexibility and concealment, tax avoidance has become a common channel for firms to respond to tightened environmental regulation (Bird & Davis-Nozemack, 2018; Fu, Yuan, Xiao, Chen, & Yang, 2023). While existing studies have examined the effects of environmental policy on corporate green investment and innovation, there is limited empirical evidence on how the vertical reform affects firms' tax avoidance behavior.

This study investigates the impact of the vertical environmental management reform on corporate tax avoidance using a sample of A-share listed firms in high-polluting industries from 2015 to 2023. Exploiting variation in the timing of reform implementation across provinces, a staggered difference-in-differences model is employed. The results show that the reform significantly increases firms' tax avoidance, suggesting that stricter environmental regulation adds financial pressure and drives firms to shift costs through tax planning. Further analysis reveals a moderating role of ESG performance. Specifically, the reform's effect on tax avoidance is stronger among firms with poor ESG performance, while it is weaker or insignificant among those with better ESG records. This implies that strong ESG performance can help mitigate the pressure induced by regulatory shocks.

This paper makes several contributions. First, it adds to the literature on the economic consequences of environmental regulation by focusing on corporate tax behavior, offering a new perspective on the effects of the vertical reform (He, Jing, & Chen, 2023; Li, Wu, & Feng, 2024; Peng, Song, Tu, & Liu, 2021). Second, it highlights the moderating role of ESG performance, deepening our understanding of the link between environmental governance and corporate social responsibility (Amarna, López‑Pérez, Garde Sánchez, & Rodríguez Ariza, 2025; Elamer, Boulhaga, & Ibrahim, 2024; Yoon, Lee, & Cho, 2021). Third, the findings provide practical implications for the targeted design of environmental policies, supporting efforts to align environmental regulation with corporate financial behavior and achieve the dual goals of green development and tax compliance.

2   Background and research hypotheses
3   Policy background

For a long time, China's environmental regulatory system has faced institutional barriers such as fragmented responsibilities and unclear authority. Local environmental protection departments are often constrained by local governments and lack independence in fulfilling their duties. When economic development goals conflict with environmental protection, some local governments may tolerate or overlook environmental violations by high-polluting firms due to concerns about tax revenue, employment, and other factors. This has led to weak enforcement and serious bottlenecks in policy implementation at the local level. To address this "local protectionism driven by performance incentives," the central government began piloting a vertical environmental management reform in provinces like Hebei, Jiangsu, and Fujian starting in 2016, and accelerated its nationwide rollout from 2018.

The core of this reform is the recentralization of the powers of monitoring, inspection, and enforcement. It replaces the previous system where local environmental departments were managed by the corresponding local government, with a unified leadership by provincial-level ecological environment authorities (Ma, 2017) By streamlining the management relationship between higher and lower-level environmental agencies, the reform aims to establish a clear and efficient regulatory system that enhances the independence, authority, and consistency of environmental law enforcement. Additionally, the reform includes adjustments in personnel management, financial support, and mechanisms to strengthen cross-regional and cross-departmental coordination in enforcement. Based on the timing of reform documents released across provinces, the vertical environmental management reform has progressed gradually through a top-down, step-by-step approach (see Table 1). This phased implementation provides a practical basis for conducting multi-period policy evaluations.

Table 1. Reform Timeline

Year	Provinces
2017	Hebei, Jiangsu, Fujian, Chongqing, Shandong
2018	Jiangxi, Tianjin, Guangxi, Ningxia, Shanghai, Hubei, Shaanxi, Guizhou, Qinghai
2019	Inner Mongolia, Heilongjiang, Gansu, Shanxi, Liaoning, Anhui, Henan, Yunnan, Beijing, Guangdong, Hunan, Jilin, Zhejiang, Sichuan, Tibet, Xinjiang

4　Research hypothesis

For high-polluting firms, the vertical environmental management reform significantly strengthens external environmental compliance pressure, enhances enforcement rigidity, and raises the cost of violations. Facing stricter environmental regulations, firms may adopt more covert or evasive financial strategies to maintain operating profits and ease the pressure. Tax avoidance, as a highly feasible and concealed financial behavior, may become an important response for firms under increasing environmental pressure. On one hand, tax avoidance directly reduces firms' tax burdens, providing financial space to cope with environmental compliance costs. On the other hand, tax avoidance often faces relatively less regulatory scrutiny, making it more attractive when weighing costs and benefits. Previous studies suggest that policy shocks may trigger firms to adopt "substitute avoidance" strategies in other areas (Hanlon & Heitzman, 2010) Therefore, this study proposes the following hypothesis:

Hypothesis 1: The vertical environmental management reform significantly increases tax avoidance among high-polluting firms.

However, firms' responses to policy pressure are heterogeneous, especially due to differences in governance quality and social responsibility performance. ESG (Environmental, Social, and Governance) performance is widely recognized as an important indicator of corporate responsibility awareness and sustainability (Karwowski & Raulinajtys‑Grzybek, 2021) Good ESG performance not only reflects active environmental compliance but also stronger risk management capabilities and reputation concerns. Related research finds that firms with high ESG scores tend to follow regulatory rules and avoid illegal behaviors for short-term gains (Jiang, Hu, & Jiang, 2024; Yuan, Zhang, Guo, & Jiang, 2025). Therefore, although the vertical environmental reform may overall increase firms' tax avoidance tendencies, firms with better ESG performance are more likely to adopt compliant strategies, showing relatively lower levels of tax avoidance or even no significant change. Based on this, the study further proposes:

Hypothesis 2: ESG performance moderates the relationship between vertical environmental management reform and tax avoidance, such that the positive effect of the reform on tax avoidance weakens as ESG performance improves.

5　Research Design

6　Data

This study focuses on A-share listed firms in high-polluting industries in Shanghai and Shenzhen from 2015 to 2023. The classification of polluting industries is based on the 2008 *Industry Classification Guidelines for Environmental Inspection of Listed Companies*, issued by China's Ministry of Environmental Protection. The sample construction follows several screening steps: (1) firms located in the four centrally administered municipalities are excluded; (2) ST, *ST, and PT firms are removed; (3) firms with negative return on assets are excluded; (4) observations with an effective tax rate below 0 or above 1 are dropped; (5) firms with less than two years of listing history are excluded; and (6) observations with missing values for key variables are removed. After applying these filters, the final sample consists of 10290 firm-year observations. Firm-level financial and ESG-related

data are obtained from the CSMAR and Wind databases. Macroeconomic indicators are collected from the *China City Statistical Yearbook* and various provincial statistical yearbooks.

7   Measurements

    7.1.1   Dependent variable

    The dependent variable is corporate tax avoidance. Following Desai and Dharmapala (2006), we use the abnormal book-tax difference (DDBTD) to measure tax avoidance. The regression model is specified as follows:

$$BTD_{i,t} = \beta_1 TACC_{i,t} + \mu_i + \varepsilon_{i,t} \tag{1}$$

where $BTD_{i,t}$ refers to the book-tax difference of firm i in year t; $TACC_{i,t}$ represents the total accruals for firm i in year t; μ_i denotes the average residual value for firm i over the sample period; and $\varepsilon_{i,t}$ indicates the deviation of the residual from μ_i in year t. Therefore, $DDBTD_{i,t}$ ($\mu_i + \varepsilon_{i,t}$) reflects the unexplained component of $BTD_{i,t}$, which can be interpreted as a proxy for tax avoidance.

7.1.2 Explanatory variables

    Firms are assigned a value of 1 starting from the year after their province implemented the vertical management reform of environmental protection; otherwise, the value is 0.

7.1.3 Control variables

    To account for other factors influencing corporate tax avoidance, we follow the approach of (Qi, Liu, Hu, & Yang, 2024; Yu et al., 2021) by controlling for firm-level financial characteristics and city-level variables. To mitigate the impact of extreme values, key continuous variables are winsorized at the 1st and 99th percentiles. Key variable statistics appear in Table 2.

8   Model

    Our empirical analysis exploits environmental vertical management reform as an exogenous policy shock. The identification strategy employs a difference-in-differences framework specified as follows:

$$DDBTD_{ipt} = \beta_0 + \beta * DID_{pt} + \gamma X_{ipt} + \mu_i + \theta_t + \delta_j + \varepsilon_{iptj} \tag{2}$$

Where $DDBTD_{i,p,t}$ measures the level of tax avoidance for firm i in province p and year t; DID_{pt} captures the implementation of the environmental vertical management reform. X is a vector of firm-level and city-level control variables. The model includes firm fixed effects (μ_i)、 industry fixed effects (δ_j) and year fixed effects (θ_t). All regressions are estimated with industry-year level clustered robust standard errors. $\varepsilon_{i,t}$ is the error term. To support a causal interpretation of β, we test the parallel trends assumption. We conduct an event study to compare the pre-treatment trends in tax avoidance between treated and control firms. The event study model is specified as follows:

$$DDBTD_{ipt} = \beta_0 + \sum_{n=-4,n\neq-1}^{3} \beta_n (DID)_{pt}^n + \gamma X_{ipt} + \mu_i + \theta_t + \delta_j + \varepsilon_{iptj} \tag{3}$$

We use the year prior to the policy rollout ($n = -1$) as the baseline period for comparison. Following (Beck, Levine, & Levkov, 2010; Ohrn, 2018), we normalize the event-study coefficients β_n based on the mean of pre-treatment estimates. All other variable definitions remain consistent with Equation (2).

Table 2. Descriptive Statistics.

Variable	N	Mean	SD	Min	Max
DDBTD	10,290	0.010	0.026	-0.084	0.094
roa	10,290	0.061	0.043	0.002	0.207
ci	10,290	2.066	1.231	0.396	10.607

ky	10,290	0.460	0.436	0.005	3.310
lev	10,290	0.377	0.175	0.051	0.845
top1	10,290	0.337	0.141	0.086	0.758
indir	10,290	0.387	0.075	0.250	0.600
size	10,290	8.501	1.212	6.137	12.702
soe	10,290	0.240	0.427	0	1
age	10,290	20.047	5.719	6	36
tobinq	10,290	2.042	1.204	0.828	7.644
lnpergdp	10,290	11.651	0.720	9.883	13.036
lnpopden	10,290	6.600	0.675	4.388	8.058
chanye2	10,290	0.415	0.078	0.149	0.623
urbanrate	10,290	0.755	0.137	0.396	1.007
chanye1	10,290	0.047	0.046	0	0.216
hb_exp	10,290	0.029	0.014	0.007	0.084

9 Empirical Results

10 Baseline Regression

Table 3 reports the baseline regression results. Column (1), based on the full sample, shows that the coefficient on the interaction term is positive and statistically significant at the 1% level, suggesting that the vertical environmental management reform has incentivized corporate tax avoidance. To further examine the role of firms' ESG performance in this relationship, we split the sample based on firms' ESG scores prior to the reform. Columns (2) and (3) show that the reform significantly increases tax avoidance among firms with poor ESG performance, while the effect is not statistically significant for firms with better ESG profiles. This finding implies that stronger ESG practices may serve as a buffer against the adverse behavioral response induced by the reform. In other words, firms with higher ESG standards may be less likely to increase tax avoidance in response to heightened environmental regulation.

Table 3. Baseline results

Dependent variable	DDBTD		
	Full sample	High ESG firms	Low ESG firms
	(1)	(2)	(3)
DID	0.003***	0.004**	0.002
	(0.001)	(0.002)	(0.002)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Obs	10290	6256	4034
R-squared	0.590	0.594	0.592

Note: Robust standard errors shown in the paratheses are clustered at the industry-year level. significance level: *** $p < 0.01$, **$p < 0.05$, * $p < 0.1$.

11 Parallel Trend Test

Figure 1 presents the event study estimates. Before the reform, the coefficients on the interaction terms are close to zero with no clear trend, supporting the parallel trends assumption. After the reform, the coefficients rise significantly, indicating that the vertical environmental management reform led to increased tax avoidance. Further analysis by ESG performance shows that the increase is more pronounced among firms with poor ESG ratings, with the effect emerging in the first year and

strengthening over time. In contrast, firms with stronger ESG profiles show no significant change in tax avoidance behavior. These findings suggest that better ESG practices may mitigate the behavioral response induced by the reform.
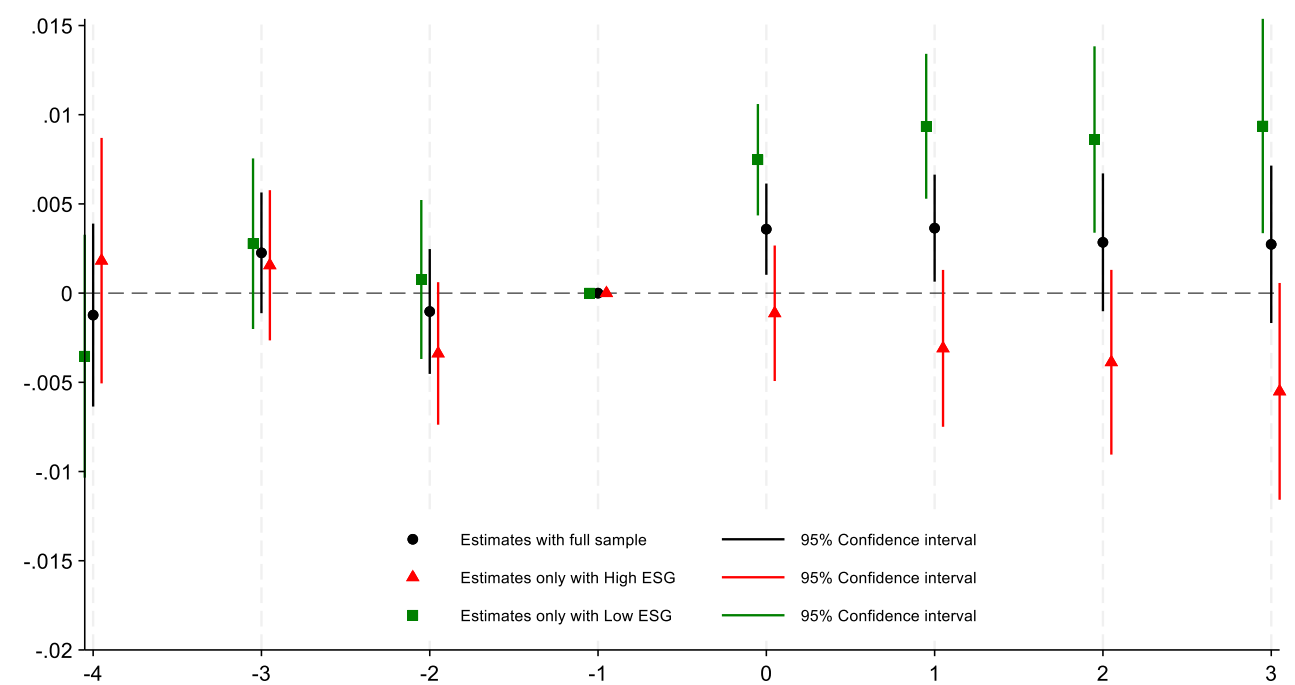

Figure1 Parallel trend. The horizontal axis indicates years relative to the DID event, and the vertical axis shows the estimated coefficients. The baseline period is set as the year immediately prior to the policy implementation.

12   Robustness Test

Columns (1) and (2) of Table 4 present regression results using alternative measures of tax avoidance. Following (Geng, Liu, Li, & Chen, 2021), we adopt the difference between the statutory and effective tax rates, as well as the book-tax difference (BTD), as proxies for tax avoidance. Column (3) addresses potential firm relocation by excluding firms that changed their registered or operational locations during the sample period. Column (4) restricts the sample to post-2017 observations to mitigate the potential confounding effects of the Golden Tax Phase III system (Li, Wang, & Wu, 2020; Liu & Xiao, 2022) Column (5) includes a dummy variable to control for the impact of the Central Environmental Inspection. The results remain robust across all specifications.

Table 4. Robustness Test Results

	RATE	BTD	DDBTD	DDBTD	DDBTD
	(1)	(2)	(3)	(4)	(5)
DID	0.008**	0.002**	0.003***	0.003***	0.003***
	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)

Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	10290	10290	10235	8610	10290
R-squared	0.514	0.655	0.590	0.625	0.591

Note: Robust standard errors shown in the paratheses are clustered at the industry-year level. significance level: *** $p < 0.01$, **$p < 0.05$, * $p < 0.1$.

13   Heterogeneity Analysis

We further conduct subgroup analyses based on firm ownership. As shown in Columns (1) and (2) of Table 5, the reform has a more pronounced positive effect on tax avoidance among privately owned firms. This suggests that, compared with state-owned enterprises, private firms are more likely to engage in tax avoidance following the reform, possibly due to weaker policy protection and stronger profit-maximization incentives (Bradshaw, Liao, & Ma, 2019; Tang, 2020). We also examine heterogeneity across regions with different levels of environmental regulation. Columns (3) and (4) show that the reform's effect on tax avoidance is more significant in regions with weaker regulatory enforcement. A possible explanation is that, in areas with limited enforcement capacity, firms perceive less regulatory pressure in practice. As a result, they are more inclined to use tax avoidance as a response to increased compliance costs, exacerbating the gap in regulatory effectiveness.

Table 5. Heterogeneity Analysis

	Dependent variable: DDBTD			
	SOEs	Non-SOEs	Stringent enforcement	Weak enforcement
	(1)	(2)	(3)	(4)
DID	0.003	0.003**	0.002	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Obs	2443	7806	3729	6551
R-squared	0.615	0.593	0.606	0.586

Note: Robust standard errors shown in the paratheses are clustered at the industry-year level. significance level: *** $p < 0.01$, **$p < 0.05$, * $p < 0.1$.

14   Conlusions

This study finds that the vertical environmental management reform significantly increases tax avoidance among high-polluting firms. This suggests that as environmental regulations become stricter, firms may strengthen their tax planning to ease the growing costs of compliance. This effect is especially pronounced in firms with poor ESG performance, indicating that the level of corporate social responsibility plays an important buffering role under policy pressure. Further analysis shows that tax avoidance is more evident among privately owned firms and high-polluting firms located in regions with weaker environmental regulations. This highlights the key roles that ownership type and local environmental enforcement play in shaping firms' responses to policy shocks.

The findings have important policy implications. On one hand, the vertical environmental reform, as a crucial institutional measure to break local protectionism and improve regulatory efficiency,

affects not only environmental governance but also firms' financial behavior. On the other hand, firms respond differently to increased external regulation. Those with higher ESG standards are more likely to comply, while others may resort to tax avoidance to reduce pressure. This suggests that policymakers should not only strengthen environmental enforcement but also encourage firms to improve their governance capabilities and social responsibility, promoting green development and tax compliance in a coordinated manner.

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