The Impact of Environmental Protection Tax on High-Quality Enterprise Development: Evidence from China

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Abstract. This study investigates the impact of China's Environmental Protection Tax (EPT), implemented in 2018 as a quasi-natural experiment replacing the pollution discharge fee, on high-quality enterprise development. Utilizing a difference-in-differences (DID) model with panel data from listed companies on the Shanghai and Shenzhen stock exchanges (2015-2023), the research focuses on heavily polluting firms as the treatment group. The findings reveal that the EPT significantly promotes enterprise high-quality development, proxied by total factor productivity (TFP_LP), despite potential short-term cost increases. This positive effect operates primarily through a synergistic triple mechanism: enhanced green innovation, improved ESG (Environmental, Social, and Governance) performance, and the suppression of managerial short-termism. Heterogeneity analysis indicates that the positive impact is more pronounced for large enterprises and state-owned enterprises (SOEs), while small and medium-sized enterprises (SMEs) and non-SOEs face greater transformation challenges due to resource constraints and market pressures. The results support the Porter Hypothesis, demonstrating that environmental regulation can stimulate innovation and efficiency gains. The study concludes with policy recommendations for differentiated tax design, strengthened ESG incentives, optimized corporate governance, and coordinated policy support systems to foster enterprise transformation towards high-quality development.

Keywords: Environmental Protection Tax; High-Quality Enterprise Development; Green Innovation; ESG Performance; Managerial Short-Termism.

1 Introduction

Since the initiation of the reform and opening-up policy, China's economy has sustained long-term high-speed growth. However, the extensive development model has also imposed severe environmental pressures. Ecological issues have become a critical constraint on development. The 19th National Congress proposed that China's economy should shift towards high-quality development, and the 20th National Congress further emphasized that high-quality development is the foremost task of socialist

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modernization. Enterprises, as the core units of economic activities, play a significant role in the processes of production, distribution, and circulation.Therefore, whether enterprises can achieve green transformation under the context of environmental regulations is crucial for the overall quality of economic development.

The Environmental Protection Tax Law, officially implemented in 2018, replaced the pollutant discharge fees and became China's first independent environmental tax, covering four types of pollutants: air, water, solid waste, and noise. This policy not only represents a institutional innovation for green development but also provides a quasi-natural experiment for studying the effects of environmental regulations on enterprises' micro-level behaviors. This paper selects listed companies in heavily polluting industries as the research sample and employs the difference-in-differences method to deeply analyze the overall effect of the environmental protection tax on high-quality enterprise development, its heterogeneous impacts, and the transmission mechanisms. The study aims to provide more detailed evidence at the enterprise level on the existing research, offering references for the optimization of related policies.

2 Policy Background and Literature Review

2.1 Policy Background

Since the 16th National Congress proposed the concept of "productive development, affluent living, and sound ecology," the idea of ecological civilization has gradually been elevated to a national strategy. The 18th National Congress incorporated ecological civilization into the "Five-in-One" integrated layout, and the Fifth Plenary Session of the 18th Central Committee introduced the concept of green development. The 19th National Congress in 2017 explicitly outlined reforms in the ecological civilization system, and the "dual carbon" targets in 2020 further reinforced the requirements for green transformation.

As illustrated in Figure 1, taxation serves as a crucial instrument in national governance, playing a pivotal role in promoting green development. The implementation of the Environmental Protection Tax Law not only addressed issues of insufficient enforcement rigidity and frequent local interference under the pollutant discharge fee system but also enhanced corporate compliance and environmental responsibility through institutionalized design, achieving the rule of law in tax systems. China's environmental tax regime has evolved through three main stages: exploration, development, and refinement. Beginning with resource taxes and land occupation taxes, progressing to vehicle purchase taxes and income tax incentives, and eventually forming a systematic framework based on the Environmental Protection Tax Law, a multi-tax collaborative pattern has gradually emerged.

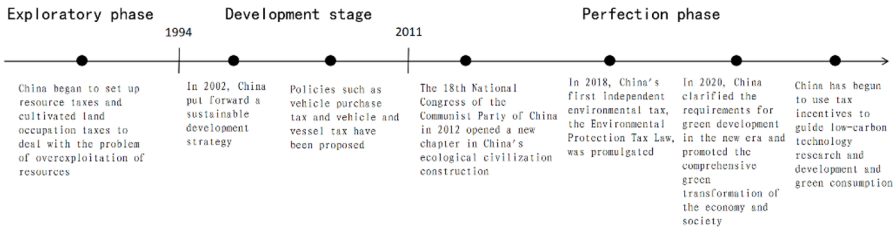

Fig. 1. Stages of China's Environmental Protection Tax System Construction

Related research shows that implementing an environmental protection fee-to-tax reform helps solve problems in the pollution fee system, such as insufficient enforcement rigidity and local government intervention; helps raise taxpayers' environmental awareness and compliance, strengthening corporate responsibility for pollution reduction; helps construct a green tax system that promotes economic restructuring and transformation of development modes[23][25][28]; and helps standardize government distribution order, optimize fiscal revenue structure, and strengthen budget constraints, thereby fostering green development and the formation of new-quality productivity[26][27][29]. Therefore, this paper focuses on using a difference-in-differences model, treating the 2018 Environmental Protection Tax Law as a quasi-natural experiment, to explore the impact of environmental protection tax on enterprise development quality and its mechanisms, and proposes relevant policy recommendations for China's tax modernization and high-quality enterprise development.

2.2 Current State of Academic Research

The academic discourse on the role of environmental protection taxes primarily revolves around three aspects:

Positive Effects: Some studies posit that appropriate environmental regulations can stimulate enterprises to enhance their innovation capabilities, leveraging the "Porter Effect" to drive technological advancements and efficiency improvements, thereby achieving a balance between economic growth and environmental improvement[1][2][3].

Negative Effects: Another perspective emphasizes that environmental taxes increase production costs, squeezing profit margins and potentially suppressing productivity and investment enthusiasm in the short term[4][5].Moreover, studies on the green innovation efficiency of industrial enterprises indicate that green tax policies may exert a dual impact on innovation, with their incentive or crowding-out effects depending on the specific tax burden and policy design[24]

Heterogeneous Effects: Existing research has identified significant variations in policy responses across different industries, regions, and types of enterprises. For instance, the green tax effect is more pronounced in central regions, with heavy pollution industries experiencing more concentrated impacts[6][7][8].

In summary, most extant literature is based on macro-level panel data analysis, lacking micro-level studies on the transmission mechanisms at the enterprise level, particularly systematic examinations of the net effects of policies and mediating roles.

This paper addresses this gap by utilizing panel data from heavy pollution enterprises listed on the Shanghai and Shenzhen stock exchanges between 2015 and 2023. According to the Guidelines for the Industry Classification of Listed Companies revised by the China Securities Regulatory Commission in 2012 and the Classification Management Directory for Environmental Protection Verification of Listed Companies issued by the Ministry of Ecology and Environment, the following industries are defined as heavy pollution industries: B06, B07, B08, B09, C15, C17, C18, C19, C22, C25, C26, C27, C28, C29, C31, with enterprises in these high-pollution sectors classified as heavy pollution enterprises. This study aims to explore the direct effects, heterogeneity, and mechanisms of environmental protection taxes on the high-quality development of enterprises by following the logical chain of "policy shock—enterprise response—quality improvement.".

3 Theoretical Mechanism and Research Hypotheses

3.1 Direct Impact of Environmental Protection Tax on Enterprise Development Quality

The environmental protection tax, by internalizing environmental costs, compels enterprises to assume responsibility for emissions [9]. In the short term, this may increase costs and pressure on profitability, but in the long term, it incentivizes enterprises to reduce pollutant emissions through process improvements and green technology research and development, thereby enhancing operational efficiency. Simultaneously, the fulfillment of environmental responsibilities and the creation of green brands can also help enterprises establish a reputation advantage in market competition [10].

Based on the above analysis, this paper proposes

Hypothesis 1: The environmental protection tax, on the whole, can promote high-quality development of enterprises.

3.2 Mechanisms of Environmental Protection Tax on Enterprise Development Quality

1. Green Innovation Drive: Tax pressures compel enterprises to increase investments in clean production and green technologies, thereby generating an "innovation compensation effect"[5][11].

2. ESG Optimization: Policy pressures drive comprehensive improvements in enterprises' environmental, social, and governance dimensions, enhancing information disclosure and social responsibility, and elevating market recognition and financing capabilities[12].

3. Governance Upgrade: The environmental protection tax increases compliance costs, prompting management to strengthen long-term planning and reduce short-term behaviors [13][14][15].

As illustrated in Figure 2, these three mechanisms collectively enhance productivity [16], reduce compliance risks [17], and establish a virtuous cycle of "green technological breakthroughs—ESG improvement—reduced financing costs" [18]. However, the ef-

fects exhibit heterogeneity, necessitating differentiated policies based on industry pollution density [19], enterprise life cycle [20], and environmental accounting and digital monitoring tools[21].

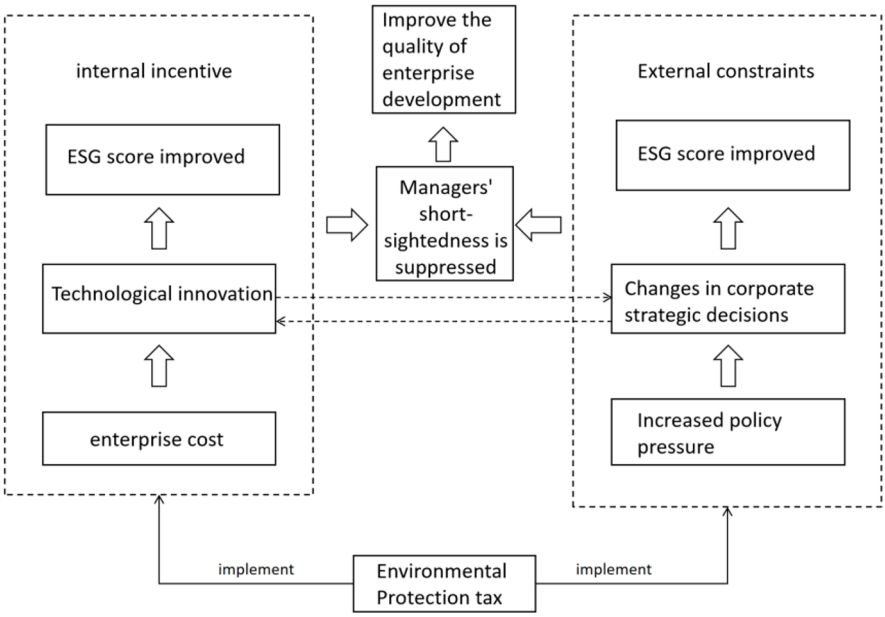

Fig. 2. Synergistic Triad Mechanism.

Based on the aforementioned mechanism analysis, this paper further proposes.

Hypothesis 2: Green innovation, ESG, and governance improvement serve as mediating and transmitting factors in the relationship between environmental taxes and corporate development quality.

4 Research Design

4.1 Sample Selection and Data Sources

This paper selects companies listed on the Shanghai and Shenzhen stock exchanges from 2015 to 2023 as the initial sample, excluding ST and *ST companies, financial industry companies, and listed companies with missing data. Continuous variable data were winsorized at the 1% level at both tails, resulting in a final sample of 4,683 observations. The research data comes from the CSMAR database, Huazheng ESG ratings, Cnrds green innovation data, and CSMAR managerial short-termism data. Managerial short-termism is measured following the research in "China Industrial Economics", using the ratio of current short-term investment to initial total enterprise investment.

4.2 Variable Definitions

Dependent Variable.

Enterprise high-quality development (TFP_LP). Following Wu Changqi et al.[22], total factor productivity is used as a proxy variable for enterprise high-quality development. Currently, there are roughly three methods for measuring enterprise total factor productivity: the OP method, LP method, and OLS method. Considering that directly estimating enterprise total factor productivity using the production function may produce bias due to endogeneity problems, this paper adopts the LP method proposed by Levinsohn and Petrin (2003) to calculate enterprise total factor productivity as an indicator of enterprise high-quality development level. The OP and OLS methods will be used to measure total factor productivity in the robustness tests discussed later.

Core Explanatory Variable.

Environmental protection tax (did). The environmental protection tax is the interaction term between the policy time dummy variable (Time) and the grouping dummy variable (Treat). Time indicates whether the policy is in effect in a given year. Since the environmental protection tax replaced the pollution discharge fee in 2018, Time takes a value of 1 for 2018 and thereafter, and 0 otherwise. Treat is the environmental protection tax treatment variable, taking a value of 1 for heavily polluting enterprises in the experimental group sample and 0 for non-heavily polluting enterprises in the control group sample.

Control Variables.

This paper controls for factors that may affect enterprise total factor productivity from three dimensions: enterprise financial indicators, governance structure characteristics, and enterprise attribute characteristics. Financial indicators, following Song Min et al. (2021), include enterprise size (Size), asset-liability ratio (Lev), profitability (ROA), cash ratio (Cashflow), fixed asset ratio (FIXED), growth capability (Growth), whether the enterprise is suffering losses (Loss), and institutional investor shareholding ratio (INST). Governance structure characteristic variables, referring to Huang Bo et al. (2022), include board size (Board) and the shareholding ratio of the largest shareholder (Top1). Enterprise attribute characteristic variables include enterprise nature (SOE) and enterprise age (FirmAge).

4.3 Model Design

To verify Hypothesis 1 (the impact of environmental protection tax on enterprise high-quality development), this paper constructs a multi-period difference-in-differences model (1):

$$TFP\_LP_{it}=\alpha+\beta_1(Treat_i\times Post_t)+\gamma X_{it}+\mu_i+\lambda_t+\epsilon_{it} \quad (1)$$

To examine the mediating roles of enterprise green innovation, enterprise ESG scores, and managerial short-termism in the relationship between environmental protection tax and enterprise high-quality development, this paper introduces these factors into model (1) and constructs the following models.

First stage (impact of policy on mediators):

$$Mediator_{it}=\alpha+\beta_1 DID_{it}+\gamma X_{it}+\mu_i+\lambda_t+\epsilon_{it} \quad (2)$$

Second stage (impact of mediators on outcome):

$$TFP\_LP_{it}=\alpha+\beta_1 DID_{it}+\beta_2 Mediator_{it}+\beta_3(DID_{it}\times Mediator_{it})+\gamma X_{it}+\mu_i+\lambda_t+\epsilon_{it} \quad (3)$$

5 Empirical Results Analysis

This paper empirically validates the proposed "technology-strategy-governance" three-dimensional interactive transmission path within the theoretical framework. The empirical results demonstrate that the environmental protection tax policy not only directly drives a significant enhancement in firms' total factor productivity but also, through differentiated responses in green innovation investment and systematic optimization of ESG, confirms the dynamic transmission chain of "cost restructuring → innovation-driven → governance upgrading" and the role of governance structure optimization in curbing managerial short-termism.

5.1 Descriptive Statistics

Table 1 indicates that the mean Total Factor Productivity (TFP_LP) of the sampled enterprises stands at 0.380, with a standard deviation of 0.213, evidencing a notable disparity in efficiency. The mean ESG score is 73.64, predominantly clustered within the AA grade range, characterized by high concentration but low dispersion, suggesting a general establishment of a baseline level across the industry with a tendency towards strategy convergence. The mean Green Innovation Investment (Ginvent) is 0.341, exhibiting a bipolar distribution, where some firms exhibit high investment seeking breakthroughs, while others maintain zero investment. The mean Managerial Myopia (Myopia) is 0.144, indicating practices of reducing long-term investments. In terms of governance structure, the mean board size is 8.22, and the mean shareholding ratio of the largest shareholder is 0.33, reflecting that both the degree of equity concentration and decision-making efficiency potentially influence policy responsiveness.

Table 1. Descriptive statistics.

Variable	N	Mean	SD	Min	Max
TFP_ LP	4,659	0.3802719	0.2039414	0	0.826
ESG	4676	73.64114	4.937692	57.61	84.38
Ginvent	4676	0.3414453	0.7001135	0	3.258096
Growth	4676	0.3762385	13.92564	-0.9498	944.0996

Variable	N	Mean	SD	Min	Max
Loss	4676	0.1446662	0.3518018	0	1
Size	4676	22.37248	1.444893	17.6413	28.293
ROA	4676	0.0328526	0.0737706	-0.9752	0.4191
Lev	4676	0.4269486	0.2051794	0.0143	1.1498
Variable	N	Mean	SD	Min	Max
Board	4676	8.220004	1.652216	5	15
Top1	4676	0.330995	0.1527515	0.03	0.8999
SOE	4676	0.2809616	0.449517	0	1
FirmAge	4676	20.97811	6.282046	5	45
INST	4676	0.3150687	0.2336231	0	1.0284
FIXED	4676	0.1504726	0.1328724	0	0.7715
Myopia	4676	0.0502298	0.0949202	0	0.4935372
Cashflow	4676	0.0439668	0.0762149	-0.7443	0.6612

5.2 Correlation Analysis

The correlation coefficient between corporate ESG scores and TFPLP is positive (0.0685), indicating a certain positive correlation with TFPLP. The correlation coefficient between managerial myopia and TFPLP is negative (-0.0682), reflecting that managerial myopia may exhibit a certain negative correlation with TFPLP. The presence of these correlation coefficients provides preliminary support for Hypothesis 2. In Table 2, the maximum absolute value of the correlation coefficients between all pairs of the dependent variables, independent variables, and control variables is 0.5213, indicating that there is no severe multicollinearity issue among the variables.

Table 2. Correlation analysis.

	tfp_lp	gin	myopia	esg	size	lev	roa	cashflow	fixed	growth	inst	board	top1	soe
tfp_lp	1.0000													
gin	0.0078	1.0000												
myopia	-0.0682	-0.0094	1.0000											
esg	0.0684	0.1152	0.0745	1.0000										
size	0.2614	0.1022	-0.1457	0.3267	1.0000									
lev	0.0686	0.0930	-0.3156	-0.0357	0.5213	1.0000								
roa	0.0464	-0.0024	0.1364	0.21 60	0.0520	-0.3044	1.0000							
cashflow	0.0308	-0.0033	0.0548	0.0866	0.0350	-0.1471	0.3579	1.0000						
fixed	0.0946	-0.0090	-0.1494	-0.0522	0.0812	-0.0143	-0.0222	0.2034	1.0000					
growth	-0.0242	-0.0087	0.0722	-0.0013	-0.0047	-0.0244	0.0036	-0.0061	-0.0162	1.0000				
inst	0.1461	-0.0318	-0.0569	0.1305	0.4533	0.2192	0.0468	0.0765	0.0645	-0.0092	1.0000			
board	0.1058	-0.0674	-0.0882	0.0675	0.2915	0.1265	0.0115	0.0333	0.1076	0.0239	0.2533	1.0000		
top1	0.0603	-0.0371	-0.0003	0.1145	0.2142	0.0439	0.1471	0.0917	0.0811	-0.0032	0.3576	0.0598	1.0000	
soe	0.1843	-0.0589	-0.1115	0.1301	0.3950	0.2696	-0.0396	-0.0019	0.0945	-0.0136	0.4610	0.2896	0.2791	1.0000
firmage	-0.0121	-0.1052	-0.0750	0.0491	0.2397	0.2135	-0.1010	-0.0386	-0.0550	-0.0094	0.2271	0.1792	0.0370	0.3748

5.3 Empirical Results Regression Analysis

Based on the regression results shown in Table 3, the Environmental Protection Tax (did variable) exerts a significant positive impact on the Total Factor Productivity

(tfp_lp) of enterprises in both Model (1) and Model (2), with coefficients of 0.173 and 0.147 respectively, thereby supporting Hypothesis 1. This indicates that although the Environmental Protection Tax may temporarily increase enterprise costs, it compels enterprises to optimize resource allocation and drive technological upgrades (such as eliminating inefficient production capacities or increasing investments in green innovation) through market competition, ultimately fostering high-quality enterprise development [17]. Additionally, the significant positive effects of control variables in Model (2), such as enterprise size (size coefficient 0.040) and state-owned enterprise attributes (soe coefficient 0.077), as well as the negative impacts of leverage (lev coefficient -0.162) and board size (board coefficient -0.007*), provide indirect evidence for Hypothesis 2: larger enterprises are more capable of absorbing the costs of environmental taxes through green innovation, state-owned enterprises enhance their ESG practices due to policy responsiveness, while managerial short-sightedness (e.g., inefficient decision-making in large boards) may weaken the transformation incentives provided by the Environmental Protection Tax.

Table 3. Regression analysis.

Variable	(1) tfp_lp	(2) tfp_lp	Variable	(1) tfp_lp	(2) tfp_lp
did	0.173**	0.147***	board		-0.007***
	-2.18	(3.29)			(-3.01)
size		0.040***	top1		0.046*
		(11.43)			-1.72
lev		-0.162***	soe		0.077***
		(-6.86)			-7.45
roa		-0.104*	firmage		-0.004***
		(-1.77)			(-6.49)
cashflow		0.01	Constant	0.552***	-0.113
		-0.18		-22.71	(-1.58)
fixed		-0.082***	Observations	4,659	4658
		(-2.73)	R-squared	0.084	0.239
growth		-0.001	industry	Control	Control
		(-0.60)	year	Control	Control
inst		-0.024			
		(-1.20)			
Note:***,**,and*represent the significance levels of 1%,5%,and 10%respectively.					

5.4 Parallel Trends

This paper employs the event study methodology to generate dummy variables for both the experimental group and time periods before and after the policy implementation, with pre1 serving as the benchmark period for regression analysis. As shown in Figure 3, the results indicate that the dummy variables representing the periods prior to the policy, denoted as pre, are not statistically significant, thereby confirming that the

dependent variable changes in the experimental and control groups satisfy the parallel trend assumption before the policy intervention. Furthermore, the dummy variables representing the periods following the policy, denoted as post, exhibit a positive correlation with the dependent variable at a significance level of at least 5%, indicating a significant policy effect with a discernible lag.

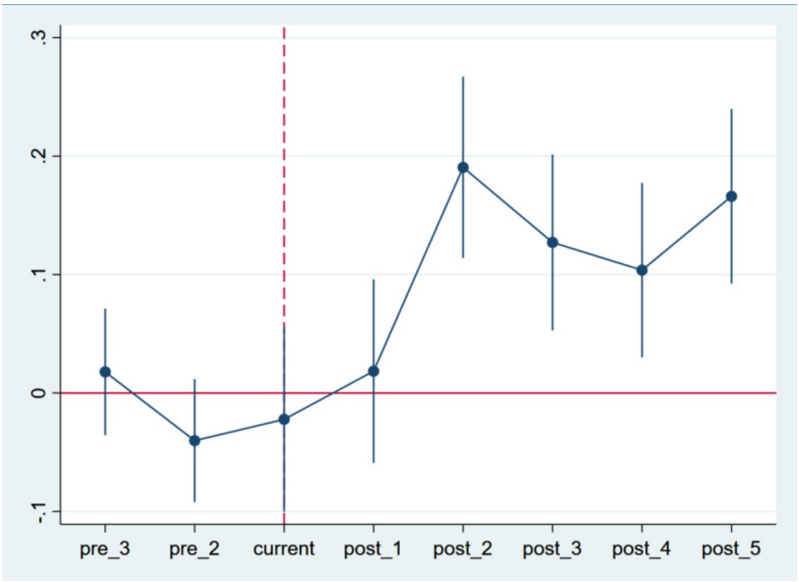

Fig. 3. Parallel Trends Test.

5.5 Robustness Tests

PSM-DID Test.

The PSM-DID test results indicate that, within the matched sample, the coefficient of the Environmental Protection Tax (did) is close to zero and statistically insignificant (radius matching: -0.017, t=-0.854; nearest neighbor matching: -0.016, t=-0.835), contrasting with the significantly positive results observed in the baseline regression. This discrepancy may stem from several factors: Firstly, the balance test (Table 4) reveals that matching significantly enhances the comparability of key characteristics between the treatment and control groups, suggesting that the policy effects observed in the baseline regression might partly arise from inherent differences in firm characteristics rather than purely policy shocks. Secondly, further sub-sample analysis (Table 4) shows that, even within the matched sample, the Environmental Protection Tax still exerts a significantly positive impact on large enterprises and state-owned enterprises, aligning with our heterogeneity hypothesis that policy effects are highly contingent on firms' resource endowments and institutional contexts. Lastly, sensitivity analysis (Table 4) indicates that the PSM-DID estimation results are somewhat sensitive to assumptions about unobserved heterogeneity, which partly explains the differences between methods. Collectively, these findings underscore the conditional and con-

text-dependent nature of the Environmental Protection Tax's impact, rather than a simple average treatment effect. This insight actually deepens our understanding of the policy's mechanism of action.

Table 4. PSM-DID Test.

Variable	(1) PSM	(2) 1:2PSM	Variable	(1) PSM	(2) 1:2PSM
did	-0.017	-0.016	board	0.002	0.004
	(-0.854)	(-0.835)		(0.650)	(1.051)
size	0.064***	0.060***	top1	-0.028	-0.049
	(5.494)	(5.434)		(-0.350)	(-0.658)
lev	-0.083**	-0.079**	soe	0.033	0.015
	(-2.086)	(-2.053)		(0.807)	(0.553)
roa	-0.142**	-0.145**	firmage	0.084***	0.127***
	(-2.209)	(-2.154)		(5.764)	(5.712)
cashflow	-0.056	-0.036	inst	0.038*	0.027
	(-1.258)	(-0.846)		(1.666)	(1.240)
fixed	0.015	0.030	_cons	-2.246***	-2.863***
	(0.265)	(0.549)		(-6.658)	(-6.987)
growth	0.002	0.002	Year	Control	Control
	(0.914)	(0.973)	N	4275	4616
loss	-0.013	-0.015	adj. R-sq	0.286	0.286
	(-1.055)	(-1.231)			
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

Placebo Test Analysis.

Permutation Test Results.

The permutation test distribution reveals that the estimated treatment effects after random permutation approximate a normal distribution, centered close to zero. This indicates that, in the absence of a causal relationship between environmental protection taxes and high-quality corporate development, we would expect to observe treatment effects close to zero. However, the treatment effect observed in our baseline regression is significantly positive (coefficient = 0.147*), far exceeding the random estimates within the permutation distribution. The two-sided test p-value, calculated as the probability of observing our actual treatment effect (or more extreme values) within the random permutation distribution, is considerably less than the conventional 5% significance level.

Overall, As shown in Figure 4, the results of the Monte Carlo permutation test demonstrate that it is highly improbable to observe the magnitude of the treatment effect found in our actual data under random conditions. This strongly supports the conclusion that environmental protection taxes have a genuine causal effect on high-quality corporate development, further substantiating the robustness of the baseline regression results.

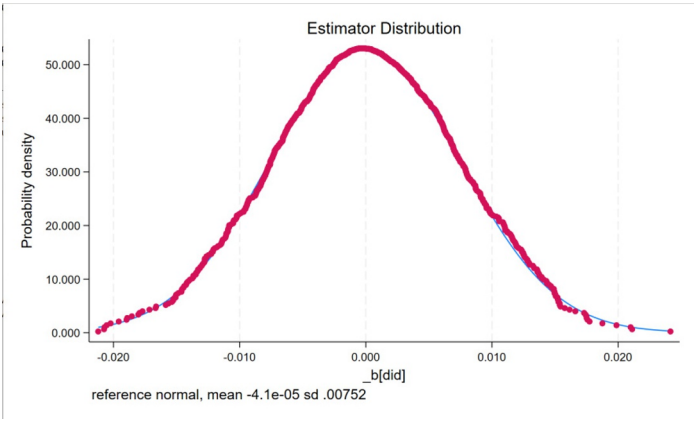

Fig. 4. Distribution plot of estimators.

Time Placebo Test Analysis.

To ascertain the causal impact of environmental protection tax on the high-quality development of enterprises, this study conducts a time placebo test, advancing the policy time dummy to 2017 (did1) and 2016 (did2). As shown in Table 5, the results indicate that the did1 coefficient is -0.011 (insignificant), while the did2 coefficient is -0.064 (significant at the 5% level with an opposite direction), suggesting that the positive effect of the policy in the baseline regression is not driven by temporal trends or anticipations, thus supporting a causal interpretation.

Additionally, the results of the control variables remain robust: Enterprise size (Size) consistently shows a significant positive effect, reflecting economies of scale; the leverage ratio (Lev) is significantly negative, and variables such as ROA, Cashflow, and Growth exhibit directions and significance levels consistent with the baseline model, further validating the reliability of the model specification.

Table 5. Temporal placebo analysis.

Variable	(1) Policy Advanced 1 Year	(2) Policy Advanced 2 Year	Variable	(1) Policy Advanced 1 Year	(2) Policy Advanced 2 Year
did1	-0.011 (-0.470)		top1	-0.041	-0.039
size	0.061***	0.061***		(-9.567)	(-0.530)
	(5.656)	(5.735)	soe	0.016	0.015
lev	-0.082**	-0.085**		(0.606)	(0.580)
	(-2.119)	(-2.193)	firmage	0.127***	0.126***
roa	-0.153**	-0.149**		(5.622)	(5.557)
	(-2.427)	(-2.390)	inst	0.029	0.031
cashflow	-0.034	-0.032		(1.357)	(1.433)
	(-0.809)	(-0.749)	did2		-0.064**
fixed	0.029	0.036			(-2.489)
	(0.527)	(0.658)	_cons	-2.898***	-2.873*

growth	0.000	0.000		(-6.982)	(-6.943)
	(1.550)	(1.582)	Year	Control	Control
loss	-0.015	-0.015	N	4659	4659
	(-1.256)	(-1.234)	adj. R-sq	0.286	0.287
board	0.003	0.003			
	(0.900)	(0.913)			
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

6 Heterogeneity Analysis

6.1 Heterogeneity Analysis Based on Enterprise Size

As shown in Table 6, the results indicate that the Environmental Protection Tax exerts a significant positive impact on the high-quality development of large enterprises (did=0.061), suggesting that it enables cost sharing through economies of scale and accelerates transformation through policy synergies such as R&D subsidies and green credit. The scale effect (size=0.114), state-owned enterprise attribute (soe=0.046), and board governance (board=0.006, top1=-0.081) collectively drive green investments and technological upgrades, enhancing total factor productivity.

In contrast, the policy effect on small and medium-sized enterprises is insignificant and negative (did=-0.014), reflecting their limited transformation capabilities. Small scale (size=-0.004) and negative effects of fixed assets (fixed=-0.107) constrain technological upgrades, while high leverage (lev=-0.027) and reliance on cash flow (cashflow=0.079) exacerbate financial pressures. Inefficient governance (board=-0.010, top1=0.112) further hinders long-term green transformation.

Table 6. Analysis of firm size heterogeneity.

Variable	(1) LE	(2) SME	Variable	(1) LE	(2) SME
did	0.061***	-0.014	board	0.006***	-0.010***
	(2.777)	(-0.539)		(3.224)	(-6.488)
size	0.114***	-0.004	top1	-0.081**	0.112***
	(18.519)	(-1.055)		(-2.421)	(4.320)
lev	-0.147***	-0.027**	soe	0.046***	0.002
	(-6.683)	(-2.348)		(3.633)	(0.206)
roa	-0.271***	-0.109***	firmage	-0.073*	0.099***
	(-7.823)	(-7.063)		(-1.795)	(2.682)
cashflow	-0.070***	0.079***	cons	-1.244**	-0.490
	(-2.794)	(5.658)		(-1.999)	(-1.382)
fixed	0.007	-0.107***	Year	Control	Control
	(0.215)	(-5.817)	N	2322	2313
growth	0.004***	-0.003***	adj. R-sq	0.953	0.966
	(5.793)	(-4.091)			
inst	-0.010	0.011			
	(-0.863)	(1.209)			
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

6.2 Heterogeneity Analysis Based on Ownership Nature

As shown in Table 7, the results indicate that the Environmental Protection Tax exerts a significant positive impact on the development quality of state-owned enterprises (SOEs), with a coefficient of did=0.084, suggesting that SOEs can leverage policy support and resource integration to transform tax burdens into transformational momentum. SOEs benefit from subsidies and green credit (inst=0.123), reduce short-term behaviors through concentrated ownership (top1=0.274) and efficient board governance (board=0.013), and effectively counteract financial pressure (lev=-0.101) by combining scale (size=0.084) and maturity advantages (firmage=0.190).

In contrast, non-state-owned enterprises (non-SOEs) exhibit weaker responsiveness, with an insignificant did coefficient of 0.028, reflecting their challenges under high leverage (lev=-0.067), low profitability (roa=-0.084), and heavy reliance on fixed assets (fixed=0.162). Faced with environmental costs squeezing and insufficient policy support (soe ineffective), non-SOEs lack sufficient transformational impetus. Their governance mechanisms are less effective, and the control of major shareholders weakens the long-term strategy (top1=-0.098).

Table 7. Analysis of heterogeneity in enterprise property rights.

Variable	(1) SOE	(2) Non-SOE	Variable	(1) SOE	(2) Non-SOE
did	0.084***	0.028	board	0.013***	0.006***
	(3.198)	(1.117)		(4.924)	(3.791)
size	0.084***	0.047***	top1	0.274***	-0.098***
	(10.849)	(13.294)		(6.520)	(-3.662)
lev	-0.101***	-0.067***	soe	0.000	0.000
	(-3.158)	(-5.044)		(.)	(.)
roa	-0.116**	-0.084***	firmage	0.190***	-0.060
	(-2.055)	(-4.643)		(4.460)	(-1.232)
cashflow	0.034	-0.009	_cons	-2.353***	-0.121
	(0.996)	(-0.542)		(-5.547)	(-0.270)
fixed	-0.034	0.162***	Year	Control	Control
	(-0.893)	(7.364)	N	1308	3342
growth	-0.019***	0.000	adj. R-sq	0.995	0.938
	(-3.275)	(0.975)			
inst	0.123***	0.062***			
	(6.855)	(7.085)			
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

7 Mechanism Analysis

7.1 Mediating Role of ESG: Environmental Cost Internalization → ESG Optimization → Development Quality Leap

As shown in Table 8, the ESG score serves as a crucial mediating variable in the promotion of high-quality corporate development by the Environmental Protection Tax (1.721*, t=3.42). In Model (1), the regression coefficient of the Environmental Protection Tax (did) on the ESG score is 1.721 and is statistically significant at the 1% level (t=3.42), indicating that environmental regulatory pressure significantly drives companies to optimize their ESG scores, thereby validating the transmission path of "internalization of environmental costs → ESG optimization" [21]. Furthermore, Model (2) reveals that the regression coefficient of the ESG score on the indicators of technological innovation and development quality (TIP_IP) is 0.002 (t=2.42), also significant, suggesting that an increase in the ESG score can directly enhance corporate innovation and development quality by strengthening social legitimacy (soc coefficient 0.026, t=3.36) and governance transparency (top1 coefficient -0.033, t=-1.68). Simultaneously, the direct effect coefficient of the Environmental Protection Tax decreases from 1.721 in Model (1) to 0.092 in Model (2), demonstrating that the ESG score partially mediates the positive impact of the environmental tax, aligning with the theoretical logic of "environmental costs → ESG optimization → development quality." Although the direct impact coefficient of ESG is relatively small, its dynamic cumulative effects (such as reduced financing costs and brand premium) can be amplified by the long-term sustainability of policies [18].

Table 8. The mediating role of ESG.

Variable	(1) esg	(1) tfp_lp	Variable	(1) esg	(1) tfp_lp
did	1.721***	0.092***	inst	-1.013***	0.019
	(3.42)	(2.79)		(-2.96)	(1.28)
esg		0.002**	board	-0.075*	-0.008***
		(2.42)		(-1.76)	(-4.61)
s1ze	1.577***	0.048***	top1	1.332***	-0.033*
	(24.50)	(17.44)		(2.79)	(-1.68)
lev	-5.493***	-0.117***	soe	0.386**	0.026***
	(-12.94)	(-6.63)		(2.04)	(3.36)
roa	6.713***	-0.010	firmage	-0.004	-0.002***
	(6.67)	(-0.22)		(-0.31)	(-3.48)
cash flow	1.543*	0.009	Constant	27.097***	-0.464***
	(1.69)	(0.24).		(12.78)	(-7.87)
fixed	-0.224	0.012	Observations	4,657	4,658
	(-0.35)	(0.56)	R-squared	0.259	0.328
growth	-0.050	-0.001	industry	Control	Control
	(-1.29)	(-0.40)	year	Control	Control
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

7.2 Mediating Role of Green Innovation: Technology Innovation Path Driven by Environmental Tax

As shown in Table 9, the Environmental Protection Tax (did) significantly promotes green innovation in Model (1) (gin coefficient = 0.121, t = 4.31), indicating that enterprises proactively increase green technology investments (e.g., patents for clean production) in response to environmental tax costs. In Model (2), the direct impact of did on Total Factor Productivity (tfp-lp) is weak but still positively significant (coefficient = 0.087, t = 1.75), suggesting that the environmental tax still compels enterprises to restructure their production processes (e.g., the fixed asset ratio fixed shifts from -0.228 in Model 1 to 0.070 in Model 2). It can be inferred that initial transformation costs are offset by subsequent efficiency improvements brought about by technological innovation, ultimately leading to market competitiveness reshaping through the establishment of technological barriers such as green patents.

Simultaneously, enterprise size (size) is significantly positive in both models (coefficient 0.096 → 0.043), confirming that large enterprises leverage their resource integration capabilities to convert short-term costs into technological barriers. The leverage ratio (lev) shifts from positive (0.200) in Model 1 to negative (-0.107*) in Model 2, revealing the dynamic adjustment process of highly leveraged enterprises optimizing their capital structure through green innovation. This outcome demonstrates the chain reaction of the environmental tax through the "cost pressure → green innovation → efficiency compensation" mechanism, achieving a transition from short-term constraints to long-term competitiveness. It validates the "innovation compensation effect" proposed in the Porter hypothesis.

Table 9. The mediating role of green innovation

Variable	(1) gin	(2) tfp_lp	Variable	(1) gin	(2) tfp_lp
did	0.121***	0.087*	inst	-0.042	0.011
	(4.31)	(1.75)		(-0.68)	(1.06)
gin		0.004	board	-0.016***	-0.002
		(1.29)		(-3.69)	(-1.43)
size	0.096***	0.043***	top1	-0.073	-0.063***
	(11.66)	(22.33)		(-1.46)	(-4.49)
lev	0.200**	-0.107***	soe	0.024	0.021***
	(2.95)	(-8.49)		(0.80)	(3.73)
roa	-0.066	0.018	firmage	-0.008***	-0.001*
	(-0.40)	(0.61)		(-10.32)	(-1.79)
cashflow	0.083	-0.061**	Constant	-1.518***	-0.302***
	(0.78)	(-2.24)		(-10.20)	(-4.80)
fixed	-0.228**	0.070***	Observations	4,658	4,657
	(-2.90)	(3.76)	R-squared	0.234	0.522
growth	-0.000	-0.002*	industry	Control	Control
	(-0.45)	(-1.77)	year	Control	Control
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

7.3 Suppression of Managerial Short-termism: Long-term Oriented Governance Restructuring

Managerial myopia exerts a significant inhibitory mediating effect between environmental protection taxes and high-quality development. As shown in Table 10, in Model (1), the regression coefficient of environmental protection tax (did) on myopic behavior (myopia) is -0.134 (t = -2.75), indicating that environmental taxes significantly curb managerial myopic decision-making (e.g., reducing environmental investment) by enhancing compliance constraints and long-term strategic orientation. Model (2) further reveals that the regression coefficient of myopic behavior on the development quality indicator (TIP_LP) is -0.001 (t = -2.91), suggesting that a reduction in myopic tendencies can directly enhance the firm's total factor productivity.

Table 10. The mediating role of managerial myopia.

Variable	(1) myopia	(2) tfp_lp	Variable	(1) myopia	(2) tfp_lp
did	-13.445***	0.128***	inst	4.001	0.122***
	(-2.75)	(3.08)		(1.20)	(6.71)
myopia		-0.000***	board	0.772*	0.006***
		(-2.91)		(1.85)	(2.87)
size	2.993***	0.036***	top1	-7.452	-0.123***
	(4.79)	(10.91)		(-1.61)	(-4.99)
lev	3.935	-0.118***	soe	-1.146	0.019**
	(0.95)	(-5.24)		(-0.62)	(1.97)
roa	21.331**	-0.017	firmage	-0.514***	-0.003***
	(2.18)	(-0.31)		(-4.51)	(-4.83)
cashflow	-11.549	0.008	Constant	-53.972***	-0.122*
	(-1.30)	(0.15)		(-2.62)	(-1.83)
fixed	-9.305	-0.079***	Observations	4,658	4,658
	(-1.51)	(-2.81)	R-squared	0.837	0.307
growth	1.990***	-0.005**	industry	Control	Control
	(5.33)	(-2.57)	year	Control	Control
Note: ***, **, and * represent the significance levels of 1%, 5%, and 10% respectively.					

7.4 Synergistic Effects and Dynamic Feedback of Triple Mechanisms

The core pathway through which the environmental protection tax promotes high-quality corporate development is constituted by ESG optimization, green innovation, and the suppression of managerial myopia. Green innovation provides technological support for ESG enhancement, while ESG optimization, in turn, reinforces innovation investment. Concurrently, ESG and governance upgrades mutually reinforce each other, curbing short-sighted behaviors (myopia = -0.134) and ensuring the sustainability of innovation. These three mechanisms operate through a virtuous cycle of "Environmental Tax → Technological-ESG-Governance Synergy → Productivity

Improvement" [16], facilitating the transformation from short-term cost constraints to long-term competitive advantages.

This synergistic effect validates the hypothesis proposed in this paper. Although the environmental protection tax increases corporate costs in the short term, it drives corporate transformation through three mechanisms (especially green innovation and ESG optimization), which supports Hypothesis 1. Green innovation, ESG scores, and the suppression of managerial short-sightedness are not only independent mediating variables but also form a closed-loop transmission of "policy pressure → multidimensional response → qualitative development" through synergistic effects, which supports Hypothesis 2.

8 Conclusions and Recommendations

8.1 Research Conclusions

Based on data from Shanghai and Shenzhen listed companies from 2015 to 2023, this paper employs the multi-period difference-in-differences method to systematically examine the impact of environmental protection taxes on the high-quality development of enterprises. The main findings are as follows: Firstly, the overall effect: Environmental protection taxes have significantly enhanced the total factor productivity of heavily polluting enterprises, indicating that the policy promotes enterprise efficiency while balancing environmental protection and development, aligning with the "Porter Hypothesis." Secondly, robustness: The conclusions remain stable and reliable through methods such as parallel trends, pseudo-policy, PSM-DID, and alternative variables. Thirdly, heterogeneity: The policy effects vary significantly among different enterprises. Large enterprises and state-owned enterprises benefit more significantly, while small and medium-sized enterprises and non-state-owned enterprises experience limited positive impacts, with some even showing negative effects. Fourthly, the mechanism of action: Green innovation, ESG improvement, and governance upgrades mediate the policy's effects. These mechanisms demonstrate that environmental taxes ultimately enhance development quality by driving enterprise innovation, strengthening accountability, and optimizing governance. Overall, while environmental taxes increase enterprise costs in the short term, they achieve efficiency compensation and competitiveness enhancement through long-term mechanisms, validating the positive effects of the policy.

8.2 Policy Recommendations

Based on the findings of the research, the following strategies are proposed to further enhance the role of environmental protection tax in promoting high-quality corporate development: Firstly, optimize the tax system design. While maintaining the overall rigidity of the environmental protection tax, differentiated tax burdens should be implemented according to the characteristics of industry pollution and the differences in enterprise scale. Subsidies, tax credits, or green credit support should be provided to small and medium-sized enterprises to mitigate the burden caused by a

"one-size-fits-all" approach. Secondly, strengthen ESG (Environmental, Social, and Governance) and market incentives.

To enhance the ESG disclosure framework and establish a unified rating system, it is essential to closely link ESG performance with financing interest rates, government procurement, and capital market evaluations, thereby transforming external regulations into market incentives. Third, improving corporate governance structures involves embedding green metrics in equity, board operations, and incentive mechanisms, such as aligning executive compensation with environmental performance to curb short-term profit-seeking behaviors and encourage long-term investments and green strategies. Fourth, constructing a policy coordination system requires integrating environmental protection taxes with other policy tools like green credit, carbon emission trading, green bonds, and digital regulation to create a closed-loop development model characterized by "regulatory pressure, technological compensation, and capital empowerment.".

8.3 Research Deficiencies and Prospects

Despite the empirical examination of the microeconomic effects of environmental protection taxes in this paper, certain limitations remain: Firstly, the data primarily focuses on listed companies, limiting the coverage and failing to represent the overall situation of small and medium-sized enterprises. Secondly, the long-term dynamic effects of environmental protection taxes require further observation over extended time series. Lastly, considering the existing discrepancies in the measurement standards for green innovation and governance improvements, future research could optimize indicator construction from a more comprehensive range of dimensions. Subsequent studies could incorporate regional policy differences into comparative frameworks or integrate tools such as the carbon market and green credit to investigate the comprehensive impact of multiple policy overlaps on corporate behavior and strategies.

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