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The Impact of Environmental Regulation on Corporate ESG Performance

— Empirical Studies Based on Deterrent Effects

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Abstract: The concept of sustainable development has been increasingly emphasized by all sectors at home and abroad, but the reality is that environmental performance is not satisfactory, and the market mechanism cannot well solve the problem of conflicting interests between enterprises and society. Based on the deterrence theory in criminal economics, this paper analyzes the internal mechanism of environmental regulation from the perspective of peer influence, and empirically investigates the impact of environmental penalties on ESG scores of target companies. The sample of listed heavy polluters from 2009 to 2022 is analyzed with the data of corporate environmental penalties. The empirical results show that target firms increase their ESG composite scores when environmental penalties are observed, i.e., environmental regulation has a deterrent effect through the peer influence path. In addition, factors such as industry competition intensity, media attention, and executive compensation have an impact on the deterrent effect of environmental regulations, which is reflected in the fact that the stronger the industry competition intensity, the more media attention, and the higher the executive compensation, the stronger the deterrent effect of peer firms. The study concludes that when the government imposes environmental penalties on non-compliant companies, it can improve the deterrent effect of environmental regulations by appropriately increasing the typicality and severity of the penalties, and at the same time exerting the roles of public opinion supervision and industry competition.

Keywords: environmental regulation, deterrence theory, ESG score, peer effects.

1. Introduction

In recent years, social issues related to sustainable development, such as climate change, environmental pollution, and public health incidents, have become increasingly prominent, and countries are actively demanding solutions. When the market mechanism is unable to solve the problem of conflicting interests between enterprises and society, environmental regulation can be used to increase the cost of enterprise violations, limit the violations of enterprise behavior, and increase the willingness of enterprises to comply with the law.

The Deterrent Effect of Environmental Regulation[1]. It becomes the key to break the mold. The ideal deterrence effect will make the violating firms regulate their own behaviors, and it can also

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motivate the potential violating firms to give up their willingness to engage in unlawful behaviors and comply with the relevant regulations. In this paper, we explore the deterrent effect of environmental regulation from a peer influence perspective.

The environmental violator is defined in this paper as the firms upstream and downstream of the target firm. In this paper, environmental violators are defined as the upstream and downstream companies of the target company, and potential violators are the target company, which will respond strategically when it observes that the related company's violations are penalized by environmental protection[2].

Based on the deterrent effect theory, this paper examines the impact of environmental regulation tools on corporate ESG scores at the micro-firm level by analyzing the environmental penalty events of Chinese listed firms from 2009 to 2022 as a research scenario from the peer influence perspective. It is found that environmental regulation can improve the ESG composite score of target firms when environmental penalties are observed to be imposed on the firms concerned, and improve the behavior of target firms in various ways, improve internal corporate governance, enhance social reputation[3], and reduce potential violations. Further research on the internal and external factors of the deterrent effect exerted by environmental regulation finds that when the intensity of competition in the industry is stronger, when it receives media attention, and when the compensation of executives is higher, the more incentive a target company has to improve its own ESG score. The marginal contribution of this paper is reflected in the following:

Firstly, this paper explores the impact of environmental regulation on corporate ESG from a more comprehensive perspective, which is highly compatible with China's concept of sustainable development, which is an effective tool for realizing high-quality economic development. Secondly, this paper tries to explore the impact of environmental regulations on the E, S, and G scores of companies from the perspective of deterrence effect. Thirdly, on the basis of verifying that environmental regulation has a deterrent effect, the internal and external factors affecting the functioning of environmental regulation are explored from the perspectives of the industry competition, the media's concern, and the internal incentives[4].

This study explores the deterrent effect of environmental penalties imposed on target firms by the relevant firms from the perspective of corporate ESG scores[5,6], which is conducive to understanding the economic consequences of corporate environmental penalties from a new perspective, and also provides a reference basis for the government to better utilize administrative means for environmental regulation and governance.

2. Research design

2.1. Data and variables

This study takes the environmental punishment incidents of listed companies' heavy pollution enterprises from 2009 to 2022 as the background of the study. The data on environmental penalties in this paper comes from the CSMAR database, which defines Chinese A-share listed companies as "environmentally penalized companies" if they are penalized by: 1) the Ministry of Ecology and Environment of the People's Republic of China; 2) provincial-level environmental protection departments; 3) local and municipal-level environmental protection bureaus and water bureaus; and 4) township environmental protection law enforcement brigades. The definition of heavily polluting companies is filtered according to Ailing Pan et al..[7,8,9]

The ESG rating data of listed companies is based on the Huazhi Index, which is online on the ESG rating query platform of Sina Finance, and the total ESG scores and the three pillar scores are manually summarized for the period of 2009 - 2022. Listed companies - upstream and downstream data refer to the practice of Tao Feng in China Industrial Economy[10], matching the data of upstream

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and downstream suppliers and customers of listed companies to form the "upstream supplier-target enterprise-downstream customer-annual data set".

Other financial data come from the CSMAR database, and this paper screens the initial sample as follows: 1) excluding listed companies in the financial industry; 2) excluding ST and *ST samples; 3) excluding samples with missing values of variables and data anomalies (e.g., gearing ratio greater than 1); 4) retaining only firms with polluting emissions in the firm sample; and 5) excluding penalized firms themselves, and finally obtaining 25,008 firms/year observations[11].

2.2. Selection and measurement of variables

2.2.1. ESG Score - Composite Score

The composite ESG score of the explanatory variables in this paper is obtained from Shanghai CSI Index Information Service Co. The ESG performance of A-share listed companies is systematically assessed (total score is 100), and the ESG score can comprehensively measure the fulfillment of social responsibility of listed companies. Finally, 40,506 observations were obtained from 1489 listed companies from 2009 to 2022[12,13].

2.2.2. Whether the listed company's upstream and downstream enterprises have been penalized by environmental protection

2.2.2.1. Measurement indicators

This study measures environmental planning from the perspective of governance and collects data on corporate environmental penalties to measure the impact of environmental regulation enforcement[14]. . Enterprise-year data were obtained for 1297 environmental penalties.

2.2.2.2. Listed company-upstream and downstream data

This paper selects the upstream and downstream enterprises of listed companies as defined as related companies, and the economic behavior and reputation of listed companies will be influenced by the upstream and downstream enterprises. Whether the upstream and downstream enterprises of a listed company are penalized or not will make the listed company's own environmental behavior and social responsibility fulfillment concerned, which in turn will affect its ESG score[15].

If a supplier or customer of a listed company is penalized for environmental protection in the year, then Penalty is assigned a value of 1. If a supplier or customer of a listed company is not penalized for environmental protection in the year, then Penalty is assigned a value of 0.

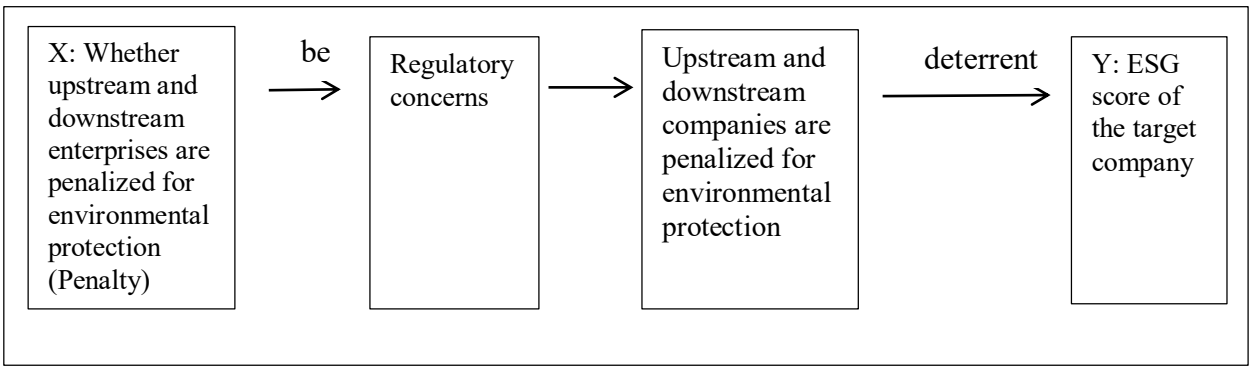

Figure 1: Transmission path of deterrence effect

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2.2.2.3. Factors influencing the deterrent effect of environmental regulation

(1) Media coverage: Based on the CSMAR news database, the number of times the keyword "pollution" appeared in a listed company in a year was counted[16]; a dummy variable was generated, i.e., whether the listed company was concerned by the issue of "pollution" in a year.

(2) Industry competition: This paper uses the Herfindahl Index (HHI Index) to measure the size of the industry competition, the larger the value, the less competitive the industry.

Table 1: List of variable definitions

explanatory variable	*ESG*	CSI ESG Composite Score	
explanatory variable	*Penalty*	Whether upstream and downstream companies are penalized for environmental protection	
control variable	*Lev*	gearing	Total liabilities at year-end divided by total assets at year-end
	ROA	profitability	Net profit after tax/total assets
	Size	Enterprise size	Natural logarithm of total assets for the year
	CAP	capital intensity	Total assets divided by operating income
	FIXED	Fixed assets as a percentage	Net fixed assets to total assets
	Growth	Revenue growth rate	Current year's operating income/previous year's operating income - 1
	ReturnA	stock return	Buy-and-hold rate of return for the 12-month period from May of the current year to April of the following year, based on the monthly individual investment rate of return that takes into account the reinvestment of cash dividends
	TOP1	Number of shares held by thelargest shareholder/totalnumberof shares	Number of shares held by the largest shareholder/total number of shares
	IndDirectorRatio	Percentage of independent directors	Independent directors divided by number of directors
	Mshare	Management shareholding	Management shareholding data divided by total share capital
	Female	Percentage of women in management	Number of women in management divided by total number of management
	nature_propertyright	Nature of property rights	1 for SOEs, 0 otherwise

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Table 1: (continued).

	Dual	two jobs in one	The chairman and general manager are the same person as 1, otherwise 0
	Mfee	management cost ratio	Administrative expenses divided by operating income
	per_yearschooling	Years of schooling per capita	(Number of illiterate persons*1+Number of persons with elementary school education*6+Number of persons with lower secondary school education*9+Number of persons with upper secondary school and middle school education*12+Number of persons with college and bachelor's degree or higher education*16)/Total number of persons over 6 years of age
	actuGDP	Real GDP per capita	Nominal GDP per capita/average index (base period 2000)
	EnterpriseAge	Age of business	

2.3. Descriptive statistics and analysis

The descriptive statistics of the main variables of this study are shown in Table 2, with a total of 25008 firm-year observations in the sample. The mean value of the explanatory variable ESG is 28.35[17,18], which is small under percentage assignment, indicating that many companies do not score well. The main explanatory variable is a 0-1 variable with a small mean value, which indicates that many upstream and downstream firms of the target companies are not penalized for environmental protection, and since the environmental penalties of the firms are not part of the voluntary disclosure, the missing values are treated by filling in the zeros.

Table 2: Descriptive statistics of the main variables

variant	observed value	average value	p50	(statistics) standard deviation	minimum value	maximum values
ESG	25008	28.35	0	35.54	0	90.93
Penalty	25008	0.00100	0	0.0310	0	1
Lev	25008	1.248	0	3.082	0	141.2
ROA	25008	0.0140	0	0.0470	-0.894	0.955
Size	25008	8.091	0	10.78	0	28.64
CAP	25008	0.856	0	6.887	0	1039
BM	25008	0.241	0	0.356	0	1.468
FIXED	25008	0.117	0	0.186	0	0.954

DOI: 10.54254/2754-1169/104/2024.17723

Table 2: (continued)

Growth	25008	0.0820	0	1.177	-0.978	140.2
ReturnA	25008	0.0370	0	0.309	-0.769	8.299
TOP1	25008	12.91	0	19.48	0	89.99
IndDirecto~o	25008	16.29	0	18.78	0	71.43
Mshare	25008	4.196	0	12.76	0	80.80
Female	25008	6.018	0	10.27	0	80
nature pro~t	25008	0.191	0	0.393	0	1
Dual	25008	0.0870	0	0.282	0	1
Mfee	25008	0.0250	0	0.0600	0	4.820
Enterprise~e	25008	6.173	0	9.335	0	46.75
per yearsc~g	25008	2.960	0	4.423	0	12.70
l_actuGDP	25008	3.793	0	5.090	0	11.69

3. Empirical analysis

3.1. Empirical modeling

In order to examine the impact of environmental penalties of upstream and downstream firms on the ESG scores of target firms, this paper constructs the following model[19,20,21,22]:

$$ESG_{idt} = \beta_0 + \beta_1 \cdot Penalty_{idt} + \beta_2 X_{it} + \beta_3 X_{dt} + \mu_i + \delta_t + \varepsilon_{idt} \quad (1)$$

Where subscripts i, d, and t denote the sample individual, region, and time, respectively, and the explanatory variable ESG denotes the firm's CSI ESG composite score. The explanatory variable *Penalty* is whether the upstream and downstream enterprises of the target company are penalized by environmental protection, while the sample in which the target company is penalized is excluded. Control variables at the regional level and firm level are added, respectively. μ_i Indicates the individual effect, which reduces the influence of the differences existing between individuals on the research results;δ_t denotes the time effect, as the society's awareness of environmental protection generally improves and the government regulates more strictly in environmental protection[23], the increase in ESG scores observed in the test may only be due to the hostage of the social trend, which is insufficient to account for the impact of whether upstream and downstream enterprises are penalized for environmental protection on ESG scores, therefore, in order to reduce the impact of the time trend on the results of the study, the time fixed effect is controlled; ε denotes the random error term[24].

3.2. Analysis of empirical results

3.2.1. Baseline regression results

Table 3 reports the results of the benchmark regressions of whether upstream and downstream firms are subject to environmental penalties on the composite ESG scores of target firms. The first three columns of Table 3, in order, show the results without controlling for individual and year fixed effects, controlling for time fixed effects, and controlling for individual fixed effects, while columns (4)-(6) all control for individual and time fixed effects. In column (1) of Table 3, when individual and time fixed effects are not added, whether upstream and downstream firms are subject to environmental penalties does not have a significant effect on ESG scores; and after adding time fixed effects[25], as shown in column (2) of Table 3, the coefficient of whether upstream and downstream firms are subject to environmental penalties is 1.623, i.e., upstream and downstream firms subject to environmental

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penalties are more likely than the related firms not subject to environmental penalties to make the target firm's ESG score is 1.623 higher, and this result is significant at the 10% level[25,26], indicating that after eliminating the shock of unobservable homoscedasticity in the time dimension, the independent variables can better explain the changes in the dependent variable; only when there is an individual fixed effect, the core explanatory variables become insignificant again, so it is clear that the time factor exerts a great influence on the regression. Columns (4)-(6) of Table 3 sequentially add the regional level control variables, financial indicators, corporate governance indicators, the results are all significant at the 1% level, whether upstream and downstream enterprises are subject to environmental penalties on the target company's ESG composite score of the impact of the target company is increasingly large, it can be seen that the behavior of the target company will be affected by the upstream and downstream enterprises whether to be subject to environmental penalties, so as to urge the enterprise to environmental and social responsibility in terms of improve their own image, the results support hypothesis 1.

Table 3: Benchmark regression results

variant	(1)	(2)	(3)	(4)	(5)	(6)
	ESG	ESG	ESG	ESG	ESG	ESG
Penalty	1.999	1.623*	0.908	2.521***	2.654***	2.788***
	(2.952)	(0.842)	(0.874)	(0.635)	(0.620)	(0.641)
Lev	0.315***	0.097	0.075		-0.032	-0.03
	(0.037)	(0.072)	(0.070)		(0.032)	(0.032)
ROA	29.252***	26.939***	27.264***		15.942***	15.985***
	(2.222)	(3.123)	(3.236)		(4.246)	(4.322)
Size	2.185***	1.133***	0.581		1.386***	1.490***
	(0.065)	(0.311)	(0.456)		(0.300)	(0.330)
CAP	0.033**	0.015***	0.000		0.040	0.001
	(0.014)	(0.003)	(0.005)		(0.035)	(0.091)
FIXED	-1.134	-3.142	-5.256**		5.600**	5.691**
	(1.015)	(2.082)	(2.243)		(2.218)	(2.204)
Growth	-0.108	-0.215**	-0.218**		-0.080**	-0.074**
	(0.079)	(0.101)	(0.109)		(0.034)	(0.034)
ReturnA	0.447	0.478***	0.085		0.368	0.377
	(0.303)	(0.157)	(0.140)		(0.245)	(0.238)
TOP1	-0.032***	0.056**	0.073**			-0.006
	(0.011)	(0.026)	(0.029)			(0.015)
IndDirectorRatio	-0.210***	-0.174***	-0.124***			0.087***
	(0.009)	(0.012)	(0.012)			(0.030)
Mshare	0.222***	0.311***	0.343***			0.026**
	(0.009)	(0.024)	(0.027)			(0.012)
Female	0.107***	0.034	0.045			0.002
	(0.015)	(0.030)	(0.032)			(0.014)
nature_propertyright	15.363***	14.263***	7.703***			0.587
	(0.315)	(0.968)	(1.101)			(0.658)
Dual	0.604	1.634***	1.967***			0.404
	(0.378)	(0.628)	(0.647)			(0.557)
Mfee	5.737***	-4.029	-7.074**			1.607

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Table 3: (continued).

	(1.906)	(2.626)	(3.254)			(2.611)
EnterpriseAge	0.567*** (0.012)	0.844*** (0.040)	0.703*** (0.045)			0.057 (0.063)
per_yearschooling	0.042 (0.046)	0.095** (0.041)	-0.035 (0.037)	-0.193 (0.238)	-0.174 (0.211)	-0.182 (0.216)
l_actuGDP	0.625*** (0.122)	1.769*** (0.653)	2.673*** (0.946)	-1.353 (1.947)	-1.978 (1.834)	-2.282 (1.842)
_cons	3.109*** (0.123)	4.318*** (0.427)	7.331*** (0.419)			
YEAR	NO	YES	NO	YES	YES	YES
INDUSTRY	NO	NO	YES	YES	YES	YES
N	25008	25008	25008		9049	9049
R-squared	0.835		0.714	0.676	0.683	0.684
Adj-R2	0.835		0.714			

Note:*,** , and*** indicate that the regression coefficients are significant at the 10%, 5%, and 1% levels, respectively, and the standard errors clustered to the firm level are in parentheses, as follows.

3.2.2. Robustness test

Table 4: Robustness test

variant	(1)	(2)	(3)	(4)	(5)	(6)
	E	S	G	ESG	ESG	ESG
recpyp_times						
recpymny_sum						
recpyp_pro						
Penalty	1.034 (0.791)	2.916*** (0.868)	3.612*** (0.997)	3.349*** (0.871)	2.785*** (0.640)	108.947* (64.743)
l_Penalty						
year2018_Penalty				-2.618** (1.128)		
control variable	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	9049	9049	9049	9049	9072	19,095
R-squared	0.69	0.631	0.664	0.684	0.684	0.864

3.2.2.1. Replacement of explanatory variables

In this paper, we will explore the effect of the variable whether upstream and downstream firms are subject to environmental penalties on the three aspects of environment (E), society (S), and corporate governance (G), which is expected to be significantly positive for all three, but as shown in columns (2)(3) of Table 4, the deterrent effect of the environmental penalties on the target firm's social and corporate governance is significant, which may be due to the fact that when the target firm's associated firms are subject to environmental penalties, it will affect the target firm's social image, so the target firm will focus on the operation of its social image and improve the score of S. At the same time,

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environmental penalties of upstream and downstream firms are likely to affect cooperation with the target firm, and the target firm will focus on the consequent issues of risk control, external penalties, and disclosure of information within the firm, and optimize its internal management in a timely manner, which will all significantly affect the score of These will significantly affect the ESG scores of the target companies; while in column (1) of Table 4, the reason why the impact of environmental regulations on the environment is not significant may have something to do with the selection of indicators for CSI's ESG ratings[26], as the 17 indicators have more to do with the pollution itself, and for the target companies, despite the existence of the indicator of "environmental penalties" in the scoring criteria, in order to observe the impact of environmental penalties on the ESG scores of the target companies, we will not use this indicator in this paper. Although there is the indicator of "environmental penalties" in the scoring criteria for the target company, this paper excludes the cases where the target company is penalized in order to better observe the impact of environmental penalties on the ESG score of the target company, which is different from the scoring criteria of CSI; at the same time, the fact that the upstream and downstream companies' manufacturing and process involves the pollution-related malpractices does not mean that there are environmental problems in the production and manufacturing of the target company, and therefore the impact on the target company's environmental score is insignificant; the target company is also more cautious and careful to try to improve the environmental protection performance of the target company as a result of the penalties on the related companies The target company has also been penalized for the related companies, and has been more cautious and careful in trying to improve its environmental score in order to leave a better impression to the public and prevent bundling with the impression of the penalized companies, which will affect its reputation.

3.2.2.2. Policy shocks

The reason why this paper selects 2018 for the analysis of moderating effect is, firstly, the completion of the first round of inspections and "look back", and secondly, the "Law of the People's Republic of China on Environmental Protection Tax" was formally implemented on January 1, 2018, replacing the "Regulations on the Administration of the Collection and Use of Sewage Charges", and the new environmental protection tax law changes the "sewage charge" to "environmental tax". Sewage Charge" to "Environmental Tax", which is more stringent than the "Regulations on the Administration of the Collection and Use of Sewage Charge" in terms of levy and management measures, levy standards and segmentation. These initiatives have a certain impact on the main effect, and the results in column (4) of Table 4 are in line with the expectation that the moderating variable has a significant inhibitory effect on the relationship between whether upstream and downstream firms are subjected to environmental penalties and the ESG of the target firms. The state's strict attention to environmental protection issues at the legislative and inspection levels makes target companies raise their awareness, so the impact of whether upstream and downstream companies are penalized for environmental protection on ESG scores will be relatively weaker.

3.2.2.3. Accession to the target company itself is penalized

As shown in column (5) of Table 4, adding the observation that the target company itself is penalized to the observations, this paper finds that whether upstream and downstream firms are penalized for environmental protection makes the impact of the target company's ESG score still significant, but the coefficient is changed from 2.788 to 2.785, probably because being penalized for environmental protection reduces the target company's own ESG score, and thus the impact from the core explanatory variables will be weakened. .

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3.2.2.4. Instrumental Variable Method

As shown in column (6) of Table 4, the estimation results of using the lagged term of environmental regulation indicator as an instrumental variable of environmental regulation. In this paper, using the Anderson canon. corr. LM test, the p-value is 0.0000, which rejects the original hypothesis, that is, there is no unrecognizable situation, and the F-statistic in the Cragg-Donald Wald F-test is 35.692, which is greater than 10, which rejects the original hypothesis of "the existence of weak instrumental variables", and there is no need to worry about the problem of weak instrumental variables. The original hypothesis can be rejected, and there is no need to worry about the problem of weak instrumental variables. Therefore, the instrumental variables selected in this paper are reasonable.

3.3. Heterogeneity analysis

Table 5: Heterogeneity analysis

variant	(1)	(2)	(3)
	ESG	ESG	ESG
Penalty	2.666***	4.106**	58.045*
	(0.660)	(1.959)	(31.850)
HHI_A		-1.448	
		(2.573)	
Penalty_HA		-22.846*	
		(13.378)	
medattention	-0.462***		
	(0.084)		
Penalty_medattention	2.772***		
	(0.766)		
ER100			
Penalty_ER100			
ln_TOP3SumSalary			0.705*
			(0.381)
Penalty_ln_TOP3SumSalary			-3.923*
			(2.269)
Penalty_size			
newsize			
control variable	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes
N	9049	9019	7502
R-squared	0.684	0.684	0.713

3.3.1. Deterrent effect

3.3.1.1. Media attention

The medattention in column (1) of Table 5 represents the number of times the target firm's environmental penalties have media coverage. From the results, the more media coverage of environmental penalties of target firms and the more times they are reported, whether upstream or downstream firms are penalized significantly and positively increases the ESG scores of target firms.

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It indicates that public opinion coverage of environmentally penalized firms significantly enhances the deterrent effect of environmental regulation. Secondly, negative news affects corporate reputation, which can bring financing difficulties and pressure on management. In addition, the pursuit of green products under the media agenda-setting function makes consumers resistant to environmentally polluting enterprises and reduces the competitive advantage of their products. Therefore, social opinion constrains firms' violations, and media coverage of firms' environmental violations enhances the deterrent effect of environmental regulation, supporting Hypothesis 2.

3.3.1.2. Intensity of competition in the industry

In column (2) of Table 5, the cross-multiplier term between the core explanatory variables and industry competitive intensity (HHI) is added, and the coefficient of the cross-multiplier term is expected to be negative, i.e., when the intensity of industry competition is greater, the smaller the HHI is, and the greater the likelihood that the target firms will make efforts in ESG to gain competitive advantage; when the intensity of industry competition is smaller, the target firms are in a relatively monopolistic position, and the reputational considerations are smaller, and thus the efforts in When the intensity of industry competition is small, the target firm is in a relatively monopolistic position and has less concern about reputation, so it may make less ESG efforts. The results are consistent with the expectation that the intensity of competition in the industry enhances the deterrent effect of environmental regulation, and this effect is significant, supporting Hypothesis 3.

3.3.1.3. Internal incentives

In column (3) of Table 5 this paper adds the cross-multiplier term between the core explanatory variables and the logarithm of the total compensation of the top three management (ln_TOP3SumSalary). When the total compensation of the top three management in the target company is higher, the company may have more funds for ESG investment; conversely, the financial situation within the company is tighter and the investment in ESG will be reduced. The environmental penalties of upstream and downstream firms and the compensation of the top three management of the target company have a certain substitution effect in positively affecting the ESG scores of the target firms, i.e., when the executives' compensation is higher, they will spontaneously pay attention to the company's ESG situation to improve the company's reputation, and the effect of environmental penalties of the upstream and downstream firms on the ESG scores will become less obvious, and this substitution effect is significant.

4. Conclusion

In recent years, the concept of sustainable development has received widespread attention, but the improvement of actual indicators (e.g., PM2.5) is slightly slow, and when the market mechanism fails to balance the interests of enterprises and society, environmental regulation becomes the key to solve this problem. Based on the micro-data of environmental penalties, this paper collects the composite ESG scores of listed companies in Huazhou from 2009 to 2022, and empirically analyzes the efforts of ESG scores performance of target companies in response to environmental penalties imposed on them when they are observed to be imposed on the relevant companies from the theory of the deterrent effect, and explores whether the peer influence is an important way for environmental regulation to exert a deterrent effect, as well as internal and external influences on the functioning of the deterrent effect. factors. The main conclusions are as follows: First, it is verified that environmental regulation can play a deterrent effect under the path of peer influence, which can significantly affect the ESG composite score of target companies. Secondly, environmental regulation affects corporate decision-making and improves ESG performance in three dimensions: environment, society and corporate

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governance. Third, the internal and external factors affecting the deterrent effect of environmental regulations are examined, and target firms are more motivated to improve their ESG scores when the intensity of competition in the industry is stronger, when they receive media attention, and when the compensation of executives is higher.

Based on the above findings, the paper makes the following recommendations:

Firstly, regardless of their own size, enterprises should follow the policy guidelines closely, and under the guidance of the overall goal of "carbon peak, carbon neutral", do a good job of their own development planning, do not take any chances, and do not try to escape from the law just because of their own small size; large enterprises should lead by example, and actively respond to the policy, and play an exemplary role. In addition, it is possible to increase the remuneration of executives in such a way that executives will have an endogenous motivation to think about the company's long-term strategy, deal with the relationship between their own company and its stakeholders, such as customers, suppliers, media, employees, etc., and actively engage in the construction of ESG, improve the quality of their own internal corporate governance, integrate internal and external resources, weaken the impact of agency problems on the development of the company, and contribute to the need for the high-quality development of the enterprise.

Secondly, the government should increase the probability of disclosure of environmental regulations, so as to make polluting enterprises fearful and prevent any enterprises from having a lucky break, and to play a deterrent role; or to increase the intensity and typicality of punishment, so as to serve as an example to others, in order to curb the occurrence and proliferation of environmental violations. In addition, the government can make use of the role of media reports, pay attention to the deterrent effect of environmental regulation combined with media disclosure, and increase public opinion reports on the deterrent strength. Improve the freedom of the media and the transparency of information, and at the same time, strengthen the punishment for the media and corporate collusion, so that media reports can be more impartial and objective.

Thirdly, the pressure of public opinion, as reflected in the tendency of media reports, helps to promote the disclosure of environmental information by enterprises, thus urging them to improve their environmental performance. However, in the data collection, it is found that the number of media reports on the environmental performance of enterprises in China is relatively small, and there are very few negative reports reflecting the problems. Therefore, in order to better utilize the role of public opinion supervision, the media should report more actively on the environmental performance of enterprises, exert the power of public opinion supervision, help the deterrent effect and assist the implementation of government policies.

In the process of empirical analysis, there are some shortcomings in this paper:Firstly, among the several indicators provided in the current literature for measuring the intensity of environmental regulation, all of them are flawed to some extent, and the indicators selected in this paper are no exception; secondly, the ESG scores of this paper are based on the data of CSI ratings, which can be examined with the data of Runling Global and Shangdao Ronglv. How to further improve the above problems will be my next research direction.

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