

Original Research

Effect of Environmental Penalties on the Cost of Equity – The Role of Corporate Environmental Disclosures

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Abstract

Environmental administrative penalty is a powerful way for the government to realize environmental pollution control. When a firm is subjected to an environmental administrative penalty, how the penalty affects its equity cost is a hot issue in academia and industry. Using the ordinary least square method and the Bootstrap method, it is found that environmental penalties significantly increase corporate equity costs in the following year through their disclosure increments; the disclosure increment plays a mediating role in the positive effect. It is also found that the reduced negative information disclosures can increase the effect, while the increased positive information can reduce the effect. These findings help us understand environmental management's significance to a firm's financing sustainability and have practical enlightenment on environmental management and environmental pollution control.

Keywords: environmental administrative penalty, environmental information disclosure, the cost of equity, environmental pollution control

Introduction

Severe environmental pollution brought by high-speed economic growth in China caused great attention at home. How to control environmental pollution has been the focus of current policy discussions. There is a consensus that the lack of information transparency and public supervision is bound to be the hotbed of the spread of environmental pollution in enterprises. Therefore, environmental information disclosure is

widely regarded as an effective tool to achieve pollution control.

Like the environmental information disclosure (EID), environmental administrative penalty is also a powerful tool for the government to realize environmental pollution control. China's new Environmental Protection Law was implemented on January 1, 2015. The revised law has strengthened the law enforcement power of the environmental protection departments and the local government. The number of environmental-illegal cases investigated by the national environmental protection departments according to law has increased substantially.

The problems exposed in the process of environmental information disclosure of penalized

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companies are increasingly concerned by society. Some listed companies subjected to environmental administrative penalties reportedly avoid disclosing important issues, make a false statement, or even do not disclose environmental information [1, 2]. These environmental disclosure manipulations have a bad impact on corporate financing and infringe on investors' interests. As such, we question that what is the effect of the environmental administrative penalty on corporate equity financing and whether the penalty affects equity cost through environmental disclosures.

Previous studies provide incomplete answers to these questions. Researches support that non-financial disclosure assumes particular importance [3-6]. Some found that corporate environmental disclosure is negatively correlated with the cost of equity (COE) [7-11]. Others confirmed the negative relation between environmental-related disclosure and COE [3, 12-19]. However, Fonseka et al. (2019) found that the relationship between environmental disclosure and COE varies in different industries, which is positive in some industries and negative in others. Shad et al. (2020) found that environmental sustainability reporting reduces only the cost of debt but does not reduce the cost of equity for Malaysian companies. Dahiya and Singh (2020) found that investors in India do not treat CSR as a value-augmenting factor; thus, manufacturing companies disclosing CSR bear a higher COE. To explain it, Clarkson et al. (2013) argued that if stakeholders are more aware of the company's environmental-related performance, and environmental disclosures cannot provide investors with incremental information, then they will not. In China, many listed companies' annual environmental reports change little in different years, except for specific matters and figures changes, the expression of language is barely adjusted, which can even be deemed a "cloning report". We considered that the truly changing part of EID in the adjacent two years (EID increment) can provide additional information for demanders and is more valuable to equity investors.

Environmental administrative penalties refer to the administrative sanctions imposed by the Chinese local government on the firm that have committed environmental violations. After being penalized by environmental administrations, the quality of EID of these penalized companies will be reduced [1]. Moreover, environmental issues can affect COE [24, 25]. So, how environmental administrative penalty affects the cost of equity? Does environmental administrative penalty affect the cost of equity through the disclosure increment? These problems have not been solved in the existing literature, and are the focus of our study.

By using samples taken from Chinese listed companies in the manufacturing industry, this study aims to reveal the effect of environmental administrative penalties on the cost of equity, as well as the mediating role of EID increments. The contributions of this paper are mainly reflected in the

following aspects. First, although several studies found that corporate financing is affected by punishment from securities regulators, corporate crime, corporate fraud, etc [26-29], less consideration has been given to how the environmental penalty affects COE. We verified the hypothesis that environmental penalties increase the cost of equity in the following year. It helps to identify the effectiveness and consequence of environmental penalties from the perspective of equity financing. Second, this paper reveals the EID increments' mediating role in the relationship between environmental penalty and COE for the first time. Besides, information nature plays different roles in the effect. These findings not only enrich the cognition of the role of environmental disclosure in the existing literature but also have strong practical enlightenment to the practice of corporate environmental management and government environmental regulation.

The paper is structured as follows. Section 2 presents the material and methods, including theoretical foundations, hypotheses development, and empirical research designs. Section 3 presents results and discussion. Section 4 is the conclusion.

Material and Methods

Theoretical Foundations and Hypotheses Development

Asset Pricing Theory attempts to explain the price or value of assets paid in the future under uncertain conditions, where assets usually refer to financial instruments, and the price refers to the price when the market is in equilibrium. In a deterministic market, an asset's current price can be directly discounted by its future earnings with a risk-free return rate. However, in reality, capital markets are filled with considerable uncertainty, creating risks. Therefore, asset pricing must consider the investor's attitude towards risks and the additional reward given to investors to compensate for the risks they bear.

The risk premium is one of the core concepts of financial economics, which means that investors require higher investment returns to compensate for the uncertainty, and the compensation is the risk premium. Equity capital is also a kind of risky asset because the return of equity capital has great uncertainty. Fisher and Hall (1969) found that rational man is risk-averse; for low risk, the required return is lower; for high risk, the required return is relatively high. Following common sense, when facing high risk, equity investors will raise the minimum return rate of the equity capital, and the equity cost will increase; when facing lower risk, the required return rate will be lower, and the COE will be reduced.

Risk is the part of the uncertainty that can be quantified. Environmental risk refers to the potential that inaccurate or incomplete environmental information

may be disseminated to those considering an investment in the firm. Two common forms of investment are the purchase of bonds or the purchase of stocks. Some researches provide evidence that a decrease in environmental risk can lower the cost of equity capital. For example, Sharfman and Fernando (2008) found that firms can reduce their equity capital cost by improving their environmental risk management. Berry-Stölzle and Xu (2018) considered that risk management reduces the probability that a firm has to raise expensive external financing, thus reducing its expected cost of capital. Ahmed et al. (2019) found that firms with social and environmental practices have lower risk and cost of equity capital.

Corporate capital providers generally incorporate the firm's environmental risk or carbon risk into their capital allocation decisions or credit management processes [33-35]. Jung et al. (2018) considered that since a firm's exposure to carbon risk increases the uncertainty of its future cash flows, it likely influences default risk and leads the lenders to integrate carbon risk into their overall risk assessment. Besides, some researches indicate that environmental concerns or events may impact COE [24, 25]. For example, Chava (2014) found that investors demand significantly higher expected returns on stocks than firms without environmental concerns.

According to the above literature, investors usually increase the required return when faced with environmental risks. Furthermore, adverse environmental events or environmental concerns will increase future environmental risk and operating risk. If equity investors perceive higher environmental and economic risks brought by environmental penalties, then they will require a higher return on equity capital.

We propose the following hypothesis 1: Environmental administrative penalty has a positive impact on the cost of equity.

Some researchers have proven a correlation between COE and corporate environmental disclosure, CSR disclosure, and voluntary carbon disclosure [8-10, 12, 16, 34]. On the interpretation of how environmental disclosure is related to COE, four kinds of views are generalized as follows. First, environmental disclosure reduces the investment risk perceived by investors, bringing a decrease in the required return on investment. Second, environmental disclosure improves stock demand and liquidity, thus reducing COE [10, 13, 37]. Third, high-quality environmental disclosure improves the accuracy of analysts' earnings forecasts, which reduces the cost of equity financing by reducing information risk [38]. Forth, firms with higher COE in the previous year tend to start disclosing CSR activities in the current year, with the consequence that its COE decreases [3, 7]. The above researches imply that investors attach importance to the environmental information disclosed in the company's annual report in the investment decision, so the environmental disclosure can reduce its COE.

The increment of EID is the variation of EID in adjacent years. When subjected to an environmental penalty, the companies' manipulation of disclosures will affect the quality of EID [1, 2]. Under the penalty, whether the increment of EID can reduce the COE of a company depends on whether the equity investor can identify the increment of the company's disclosure. The following studies provide evidence that equity investors can identify incremental disclosures. Healy et al. (1999) found that the share price of firms that increased environmental disclosure rises significantly in the same period, and this rise was not related to the company's earnings performance in the current period. Dhaliwal et al. (2011) found that firms with higher COE in the previous year tend to disclose CSR information from the current year, with the consequence that its COE also decreased. Raimo et al. (2020) found that increased levels of ESG disclosure are linked to improved access to financial resources for firms. Therefore, we suppose that the increment of EID of penalized companies will be identified by equity investors and used for decision-making.

When the increment of EID is negative under the environmental penalty, it shows that the penalty intensifies the information asymmetry between the management and investors. It increases the investment risk perceived by equity investors. Then, equity investors will increase the minimum of the required return on investment, which will increase the COE of the company. Whereas, when the increment of EID is positive, it increases the amount of information that equity investors can refer to when making decisions, reduces the degree of information asymmetry, and the investment risk perceived by investors. Then, equity investors will reduce the required return on investment, which will reduce the COE. Based on the above analysis, we argued that the positive increments of EID might reduce the positive effect between environmental penalties and COE, while the negative increments of EID are more likely to increase such an effect.

Therefore, hypothesis 2 is proposed: Environmental administrative penalty affects the cost of equity through the mediating role of incremental environmental information disclosure.

Empirical Research Designs

We performed the following design to test the two hypotheses: collecting samples and data, determining the variables and measuring them, and building metrological models for testing the mediating effect.

Sample and Data

The investigated companies are all manufacturing firms in Stock markets at Shanghai and Shenzhen stock exchanges in China. Manufacturing was chosen because it produces more waste pollution than other industries, has a higher environmental impact.

In recent years, China's environmental protection authorities have increased environmental law enforcement efforts. The central government's emphasis on environmental protection at the legislative level has led to a significant increase in environmental penalty cases between 2015 and 2017. As such, more official data on the environmental violations of listed firms can be obtained. Besides, policy changes may have an impact on EID [40, 41]. To avoid changes in environmental regulations that may harm the findings, so we adopted 2015 as the starting year. We started collecting data in early 2019. At that time, the latest data available to us was in the fiscal year 2017.

We derived Data on EID from CSR reports and environmental reports disclosed on listed companies' official websites. Data on environmental administrative penalties are from the Institute of Public & Environmental Affairs database. We derived financial data from the CSMAR database. After data collection, we found that 334 manufacturing listed companies have disclosed environmental information since 2015. We excluded the companies that lack relevant data and got 316 samples.

Variables and Measurement

COE refers to the cost that the company needs to pay to obtain equity capital, and it is also the minimum return on capital required by shareholders. Botosan et al. (2011) suggested that the modified PEG measure (MPEG) is the best, for measures employing analyst forecasts. Thus, we focus on MPEG as our primary method to calculate COE. Following Easton (2004) and consistent with Botosan et al. (2011) and Clarkson et al. (2013), we measure COE by MPEG as follows.

$$MPEG = A + \sqrt{(A^2 + (EPS_2 - EPS_1) / P_0)}$$

...where $A = dps_t / 2P_0$, P_0 is the price per share, dps_t is the current year dividends, and EPS_1 and EPS_2 are one- and two-period ahead analysts' forecast of earnings per share.

This paper takes the increment of EID level (ΔEID) as a mediator variable. EID level is measured first, and then the increment of EID level (ΔEID) is calculated. Content analysis is the most authoritative and widely recognized method to measure the EID level. The EID level is identified according to the content and degree of disclosure [44]. According to the studies of Meng et al. (2014), we determine the measurement contents of EID level. As shown in Table 1, we set a total of seven categories. These categories reflect the realistic regulatory background of Chinese corporate environmental disclosure and reflect the regulations of the Chinese Ministry of Environmental Protection [2]. Among the categories, pollution control and environmental compliance, significant environmental impacts, events, and risk management

are the information categories that the Ministry of Environmental Protection requires the listed companies in the heavy pollution industry to disclose, most of which belong to negative (hard) information. Therefore, this paper divides the quantification of EID into negative (hard) EID and positive (soft) EID. The level of positive EID (PEID) and negative EID (NEID) are quantified, respectively. The seven categories contain 43 items, which are shown in Table 1.

The content analysis measures the degree of disclosure by assigning each measurement item from 0 to 3. Quantified disclosure values 3, the specific but not quantified values 2, simple description values 1, and no description values 0 [45, 46]. In this paper, each assignment of different measurement items is summed and then divided by the full score of all measurement items; the value of the annual EID is obtained. Next, the EID value in the adjacent two years is subtracted, and finally, the increment of EID is obtained.

The explanatory variable (PENALTY) is a dummy variable. If a company is subject to an environmental penalty, the value is 1; otherwise, the value is 0.

This paper refers to the relevant literature to select control variables [7, 8, 10]. Considering the impacts of enterprise size, financial situation, profitability, development ability, operating ability, and other factors on the COE, we select asset size (SIZE), asset-liability ratio (LEV), return on total assets (ROA), growth of operating income (GROW), turnover of total capital (TURN) and book-to-market ratio (BM) as control variables.

Besides, the Beta coefficient can reflect the systemic risk of stock and the stock price fluctuation, which is an essential factor affecting COE. Hence, this paper sets it as a control variable. Environmental performance is also an essential factor affecting COE [9, 23, 45]. Meng et al. (2014) designed a method to rank the environmental performance in three categories: poor, mixed, and good. We adopt this method and set two dummy variables, namely GEP and PEP. Descriptions of variables are described in Table 2 below.

Referring to the studies of Dhaliwal et al. (2011) and Edwards et al. (2016), this paper takes the change rate of COE as the explained variable. The variable design using the rate of change is based on two reasons. On the one hand, the design of using a change rate can better reflect the effect of the environmental penalty on COE and is more in line with the theoretical expectation of this study. On the other hand, it can effectively avoid metrological problems caused by the omission of relevant variables, and endogenous problem of the model to a certain extent [7, 47]. So, the use of first-order difference as a dependent variable is better than using the level of the variable.

Models for Testing the Mediating Effect

Sobel method and the Bootstrap method are the two commonly used methods to test the interaction items.

Table 1. Measurement items of environmental information.

Category	Items
Environmental values, policies, and organization	1. Environmental values 2. Environmental protection policies and objectives 3. Relevant environmental organizations
Environmental management system and initiative	1. Environmental certifications 2. Voluntary cleaner production 3. Education and training 4. Working environment and plant greening 5. Environmental information exchange 6. Environmental accounting 7. Environmental conservation projects 8. Honors 9. Third-party environmental audit
Environmental technology, investment, and expenditure	1. R&D of environmental technology 2. Waste treatment and technology 3. Construction of environmental protection facilities 4. Environmental loans or environmental investments 5. Environmental-related grants and subsidies, etc. 6. Recurrent expenditure
Resource consumption and environmental performance	1. Total resource consumption 2. Total pollution discharge 3. Resource consumption, etc. 4. Wastewater, emissions of major pollutants, etc. 5. Environmental benefits. 6. Social benefits of reducing emissions
Environmental protection and public welfare activities	1. Environmental-related activities 2. Potential environmental impacts 3. Others
Environmental compliance and pollution control	1. Discharge of pollution up to standard 2. Emission reduction tasks 3. Implementation of the “three simultaneous” system 4. Status of sewage charges 5. Legal disposal of industrial solid and hazardous wastes 6. Applications for discharge permit 7. Noise condition 8. Environmental impact assessment
Significant environmental impacts, events, and risk management	1. Environmental violation and contamination in accident 2. The environmental risk management system 3. Construction projects with significant environmental impact 4. In the list of serious pollution enterprises 5. Major risk sources 6. Resident complaint 7. The impact of environmental laws and regulations on firm’s operation 8. An emergency plan for environmental emergencies

The confidence interval estimated by the Bootstrap method is more accurate and has higher test power than that estimated by the Sobel method [48, 49]. Hence, this paper uses the Bootstrap method to test interaction terms.

This paper uses the PROCESS plug-in of SPSS.24 to test the mediating effect. The process of testing is divided into two parts. The first part is to test the main effect of the penalty on COE to verify hypothesis 1.

The second part is to test the mediating effect of the EID increment, which is to verify hypothesis 2. We employ the following models:

$$\Delta EID = \beta_0 + \beta_1 PENALTY_t + \beta_1 Control + \sum INDUSTRY + \sum YEAR + \varepsilon \quad (1)$$

Table 2. Description of main variables.

Category	Variables	Symbols	Descriptions
Explained variable	Cost of equity	$\Delta\%COE$	Estimated by MPEG model
Explanatory variable	Environmental administrative penalty	$PENALTY$	Dummy variable, if penalized, value 1; otherwise 0.
Mediator variable	EID increment	ΔEID	Difference between values of EID in adjacent years
Control variables	Firm size	$SIZE$	Natural logarithm of the total assets
	Asset-liability ratio	LEV	Total liability/total asset
	Book-to-market ratio	BM	Total assets at the end of year/(market value of equity + market value of debt)
	Return on total assets	ROA	Net profit/total assets at the end of the year
	Growth of operating income	$GROW$	(Current operating profit - last year operating profit)/last year operating profit
	Systematic risk	$BETA$	β coefficient
	Turnover of total capital	$TURN$	Turnover of total capital
	Environmental performance	GEP	Dummy variable, if good environmental performance, value 1; otherwise 0.
		PEP	Dummy variable, if poor environmental performance, value 1; otherwise 0.

$$\Delta\%COE_{i,t+1} = \alpha_0 + \alpha_1 PENALTY_t + \alpha_i Control + \sum INDUSTRY + \sum YEAR + \varepsilon \quad (2)$$

$$\Delta\%COE_{i,t+1} = \gamma_0 + \gamma_1 PENALTY_t + \gamma_2 \Delta EID + \gamma_i Control + \sum INDUSTRY + \sum YEAR + \varepsilon \quad (3)$$

Results and Discussion

Mediating Effect Test

We test the mediating effect by using the Bootstrap method. The Bootstrap samples are set to be 5000, and the confidence interval is 95%. As shown in Table 3, in the total effect model, the variable *PENALTY* ($\alpha_1 = 0.269$) and explained variable $\Delta\%COE$ are significantly positive correlative, which verifies the hypothesis that environmental administrative penalty has a positive impact on COE in the following year.

The coefficient *PENALTY* ($\beta_1 = -0.244$) is significantly negative, indicating that the environmental administrative penalty is negatively correlated with EID. In regression (3), the ΔEID coefficient ($\gamma_2 = -0.176$) is significantly negative, and the *PENALTY* coefficient ($\gamma_1 = 0.226$) is significantly positive. The coefficient

$\beta_1\gamma_2$ is the same sign as the coefficient γ_1 . The test result of the mediating effect does not contain 0 at 95% confidence intervals, which indicates that the mediating effect of the increment of EID is significant. The mediating effect's value is 0.043. These results verify hypothesis 2: the environmental administrative penalty has a positive impact on COE in the following year through the mediating effect of the EID increment.

We also distinguished environmental information's nature and then measured it from negative, sensitive (hard) information and positive (soft) information aspects. In this paper, the mediating effect of the negative information increment ($\Delta NEID$) and the positive EID increment ($\Delta PEID$) are tested, respectively.

Table 4 shows the results of the mediating effect test on the PEID increment. The coefficient of *PENALTY* ($\beta_1 = 0.110$) is positive, indicating that the penalty has a positive impact on PEID. The coefficient $\beta_1\gamma_2$ (-0.019) has the opposite sign as the coefficient γ_1 , and the test result of the mediating effect does not contain 0, which indicates that the mediating effect of the PEID increment is significant.

Table 5 shows the results of the mediating effect test on the NEID increment. The coefficient of *PENALTY* ($\beta_1 = -0.22$) is significantly negative. In regression (3), the coefficient $\beta_1\gamma_2$ (0.062) has the same sign as the coefficient γ_1 , and the confidence interval does not

Table 3. Test results of the mediating role of the EID increment.

Variables	ΔEID	$\Delta\%COE_{i,t+1}$	$\Delta\%COE_{i,t+1}$
<i>Constant</i>	-0.150(-1.13)	-1.159***(-3.94)	-1.186***(-2.03)
<i>PENALTY</i>	-0.244***(-10.09)	0.269*** (5.01)	0.226*** (4.01)
ΔEID			-0.176***(-3.25)
<i>SIZE</i>	0.006(0.98)	0.048*** (3.45)	0.049*** (3.54)
<i>LEV</i>	-0.038(-0.87)	-0.133(-1.37)	-0.140(-1.45)
<i>ROA</i>	0.154(1.34)	0.113(0.45)	0.140(0.55)
<i>GROW</i>	0.00(-0.65)	0.000(0.31)	0.00(0.30)
<i>BETA</i>	0.043(3.26)	0.075*** (4.53)	0.082*** (2.78)
<i>TURN</i>	-0.01(-0.89)	-0.023(-0.94)	-0.025(-1.01)
<i>BM</i>	0.001(0.14)	0.002(0.48)	0.007(0.37)
<i>GEP</i>	0.009* (1.99)	-0.022** (-2.37)	-0.024** (-2.44)
<i>PEP</i>	0.055 (1.61)	0.062** (2.69)	0.072** (2.71)
<i>INDUS</i>	YES	YES	YES
<i>YEAR</i>	YES	YES	YES
Adj-R ²	0.068	0.156	0.167
F-value	4.53***	9.83***	10.56***
Mediating Effect	Boot SE	Boot LLCI	Boot ULCI
0.043	0.018	0.015	0.085

Notes: * p<0.1, ** p<0.05, *** p<0.01.

Table 4. Test results of the mediating role of the PEID increment.

Variables	$\Delta PEID$	$\Delta \%COE_{i,t+1}$	$\Delta \%COE_{i,t+1}$
<i>Constant</i>	-0.018(-1.32)	-1.159***(-3.94)	-1.152***(-3.90)
<i>PENALTY</i>	0.110*** (7.08)	0.269*** (5.01)	0.262*** (4.75)
$\Delta PEID$			-0.172** (-2.65)
<i>SIZE</i>	-0.003(-1.46)	0.048*** (3.45)	0.052*** (4.75)
<i>LEV</i>	-0.022(-1.02)	-0.133(-1.37)	-0.132(-1.36)
<i>ROA</i>	0.075(0.43)	0.113(0.45)	0.111 (0.44)
<i>GROW</i>	0.000*** (-2.80)	0.000(0.31)	0.00(0.37)
<i>BETA</i>	0.022(0.14)	0.075*** (4.53)	0.075*** (5.58)
<i>TURN</i>	-0.011(-1.10)	-0.023(-0.94)	-0.024(-0.96)
<i>BM</i>	0.001(0.96)	0.002(0.48)	0.007(0.39)
<i>GEP</i>	0.003** (2.29)	-0.022** (-2.37)	-0.021** (-2.75)
<i>PEP</i>	-0.004* (-1.72)	0.062** (2.69)	0.061** (2.58)
<i>INDUS</i>	YES	YES	YES
<i>YEAR</i>	YES	YES	YES
Adj-R ²	0.104	0.156	0.175
F-value	6.56***	9.83***	11.09***
Mediating Effect	Boot SE	Boot LLCI	Boot ULCI
-0.019	0.012	-0.028	-0.019

Notes: * p<0.1, ** p<0.05, *** p<0.01.

Table 5. Test results of the mediating role of the NEID increment.

Variables	$\Delta NEID$	$\Delta \%COE_{i,t+1}$	$\Delta \%COE_{i,t+1}$
<i>Constant</i>	-0.020(-1.56)	-1.159***(-3.94)	-1.182***(-3.91)
<i>PENALTY</i>	-0.22*** (-5.08)	0.269*** (6.01)	0.250*** (3.75)
$\Delta NEID$			-0.282** (-2.65)
<i>SIZE</i>	-0.004(-1.41)	0.048*** (3.45)	0.056*** (4.75)
<i>LEV</i>	-0.002(-1.02)	-0.133(-1.37)	-0.136(-1.36)
<i>ROA</i>	0.057** (1.86)	0.113(0.45)	0.131 (0.43)
<i>GROW</i>	0.000 (0.74)	0.000(0.31)	0.00(0.37)
<i>BETA</i>	0.012(0.13)	0.075*** (4.53)	0.075** (2.57)
<i>TURN</i>	-0.011(-0.98)	-0.023(-0.94)	-0.064(-0.56)
<i>BM</i>	0.001(0.96)	0.002(0.48)	0.007(0.35)
<i>GEP</i>	0.002*** (4.99)	-0.022** (-2.37)	-0.033*** (-3.75)
<i>PEP</i>	-0.004*** (-3.78)	0.062** (2.69)	0.063** (2.57)
<i>INDUS</i>	YES	YES	YES
<i>YEAR</i>	YES	YES	YES
Adj-R ²	0.097	0.156	0.159
F-value	6.14***	9.83***	10.03***

Table 5. Continued.

Mediating Effect	Boot SE	Boot LLCI	Boot ULCI
0.062	0.012	0.017	0.029

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

contain 0, which indicates that the mediating effect of the NEID increment is significant.

The above results show that the penalty has a positive impact on PEID. The positive increment of PEID can reduce the positive effect between the penalty and COE. However, the penalty negatively affects NEID, and the negative NEID increment reduces the positive effect between the penalty and COE.

Conclusions

This paper studied the effect of the environmental administrative penalty on COE and tested the mediating role of the EID increment in this relationship.

First, it is found that the environmental administrative penalty can increase COE in the following year. The reason that investors demand a higher expected return may lie in that they consider firms with environmental penalties have a higher risk than the others.

Second, the EID increment plays a mediating role in the relationship between environmental administrative penalty and COE. Specifically, the negative increment of NEID can increase the effect between the penalty and COE, while the positive PEID increment can reduce the effect. This study shows that the penalty reduces NEID, which intensifies information asymmetry between investors and companies and increases the risk of estimating future returns and an increase in the expected return required by equity investors. However, the penalty increases positive disclosures, and then they reduce the information asymmetry between equity investors and companies, leading to a decrease in the risk of estimating future returns and decreasing equity investors' expected return.

These findings help us to understand the significance of environmental management to a firm's financing sustainability and enrich our cognition of the role of environmental disclosure. First, environmental penalties lead to higher equity costs in the following year. Thus, it can infer that compliance with environmental regulations helps the firm secure stable equity financing and avoid financing difficulties. Second, environmental disclosure increment plays a mediating role, which reflects that equity investors in China have been able to distinguish the differences of corporate environmental disclosure in adjacent years. Actually, Chinese companies' management tends to take opportunistic actions, such as concealing or reducing

some information to reduce the negative impact of environmental penalties on their companies. However, the reduced disclosures increase the financing cost in the following year. Therefore, after being penalized, the most favorable strategy for corporate financing may be to improve environmental reporting. From the perspective of environmental governance, we also have two enlightenments. First, environmental administrative penalty harms equity financing. It will force firms to protect the environment and control pollution emissions not to be penalized again. Second, the environmental penalty can deter the firm's environmental illegal behavior by damaging the firm's equity financing, which also indicates that environmental administrative penalty can effectively control environmental pollution and curb environmental violations.

This research is subject to the constraint on the choice of samples. In future studies, the number of samples can be increased. Besides, environmental penalties also may affect the debt cost. So, what role does environmental disclosure plays in the processes? It needs further study.

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Conflict of Interest

The authors declare no conflict of interest.

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