

A Study of the Impact of Informal Board Hierarchy on Corporate Environmental Investments

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Abstract. Using a sample of non-financial firms listed in Shanghai and Shenzhen A-shares from 2014-2021, this paper examines the impact of board informal hierarchy on environmental investment and explores the moderating effect of media attention on the relationship between the two. The regression results show that board informal hierarchy is significantly and positively related to firms' environmental investment, and the relationship between board informal hierarchy and firms' environmental investment will be facilitated when firms receive more media coverage.

Keywords: informal hierarchy of boards; environmental investments; media attention.

1. Introduction

With the expansion of the global economy, the development of economic prosperity is accompanied by environmental pollution problems. The impact of environmental pollution on human beings can no longer be ignored, and investment in environmental protection has gradually received widespread attention from all sectors of society. Although China has issued many documents related to environmental protection, continuously increased investment in environmental protection, and introduced the corresponding tax incentives, but at present China's environmental protection is generally characterized by low investment enthusiasm, less amount of investment and other issues. Enterprises, as an important part of the national economy, consume resources and emit pollutants while creating wealth and realizing corporate value. Therefore, enterprises should pay attention to the environmental pollution problem, actively invest in environmental management work, and consciously assume social responsibility. However, the resources of enterprises are scarce, and enterprises need to invest a lot of money in environmental protection equipment, pollution control, innovative technology research and development, etc., and the period of profitability is long and risky[1]. Enterprises investing funds in environmental protection will crowd out funds used for other investment projects, reducing the profit level of enterprises in the short term, so enterprises lack initiative in environmental protection. Based on this, this paper studies how to promote enterprises to increase their environmental protection investment.

The board of directors belongs to the decision-making level in the company and has a key position in implementing green concepts and making environmental investment decisions. It has been shown that differences in social resources, expected contribution to the company[2], personal characteristics[3] and other aspects of board members cause differences in the expected status of board members, which suggests that there is an informal hierarchy in the board[4]. There is less literature examining the relationship between informal hierarchies within the board of directors and environmental investments. Therefore, this paper takes the board perspective as an entry point to study the impact of informal hierarchy in the board of directors on environmental investment. In addition, in the era of extensive use of big data, news reported by the media has become the main source of public access to information, companies are subject to public attention, corporate information has become more public, and media reports on corporate environmental investment, among other things, form an effective regulatory force for the external governance of the company. Therefore, this paper introduces media attention as a moderating variable to further explore how it affects the relationship between the informal hierarchy of the board of directors and environmental investment.

2. Literature review and research hypothesis

2.1 Informal Board Hierarchy and Environmental Investments

He and Huang (2011) believe that the informal hierarchy of the board of directors is an informal hierarchical order formed automatically between members based on their recognition of each other's ability and social influence, which clarifies the definition of the informal hierarchy of the board of directors[4]. Due to the unclear division of hierarchical relationships in the board of directors, each member of the board of directors is a one-person, one-vote system, which to a large extent will result in the phenomenon of the collision and integration of multiple opinions in the decision-making process, at which time the formal coordination mechanism can not be effectively guided, and the informal hierarchy plays a major role in corporate governance[5].

First, the informal hierarchy can improve decision-making efficiency. Based on the theory of relational contract, the relational contract is established on the basis of trust formed by long-term interaction between people, and after the trust mechanism is established, it is no longer necessary to rely on the formal system to regulate and restrain. Therefore, compared with the formal system, the informal system formed on the basis of trust and respect is more likely to play a coordinating mechanism, which helps the board of directors to reach a unanimous opinion. When the board of directors has internal differences of opinion in decision-making, the high directors have rich social resources and can provide more information in the board of directors, and the low directors often choose to respect and trust the strategic decisions of the high directors[6]. And the high-ranking directors will also utilize their position to ease the conflicts among the members, so that the directors can participate in the discussion of environmental protection issues, promote the exchange of information and the sharing of resources, and strengthen the concept of environmental protection. Secondly, the informal hierarchy can enhance the supervision of management. Enterprises need to invest large sums of money in environmental protection, and the payback period is long and the amount of return is uncertain. Managers may reduce their investment in environmental protection out of self-interested behavior, which will hinder the development of the enterprise in the long run. High-level directors, who have more part-time jobs and strong influence, will pay attention to maintaining their personal reputation and high social influence, so they will take the initiative to fulfill their supervisory function and increase the enterprise's environmental protection investment. Accordingly, the hypothesis is proposed:

H1: Informal board hierarchy has a positive effect on corporate environmental investment.

2.2 Informal Board Hierarchy, Media Attention and Environmental Investments

The media not only conveys information, but also plays the function of external supervision[7]. On the one hand, the media is a bridge of communication between enterprises and the government, which can convey information about the environmental governance of enterprises to the outside world. According to scholars such as Guan Jian and Que Yi (2020), the media report on enterprises' pollution control, energy saving and emission reduction, and convey information to stakeholders, which can establish a good environmental image for enterprises[8]. On the other hand, the more media reports, the more attention enterprises receive, and the more they are supervised and restrained by the outside public. When an enterprise has an environmental violation, the possibility of the enterprise being negatively reported by the media increases, which will bring a negative impact on the enterprise's reputation and hinder its long-term development. Cu Weihua and Li Peigong (2012) showed that when the negative news of a company is exposed by the media, the company may face penalties from the relevant regulatory authorities, which will make the company's image in the public decline[9]. In the board of directors, directors in high positions will pay more attention to maintaining their reputation due to their rich social resources. Therefore, when the enterprise receives higher attention from the media, they will guide the board of directors to make correct decisions, consciously fulfill their social responsibilities, and increase

environmental protection investment in order to maintain their reputation. Based on this, the hypothesis is proposed:

H2: The higher the media attention, the stronger the role of the informal level of the board of directors in promoting corporate environmental investments.

3. Research design

3.1 Sample Selection

In this paper, the companies listed in Shanghai and Shenzhen A-shares from 2014 to 2021 are selected as the sample companies, and the relevant data are downloaded from the Cathay Pacific database. In order to ensure the accuracy of the research results, the raw data are processed as follows: (1) exclude the financial industry; (2) exclude the samples of ST and *ST companies; (3) exclude the observations with missing data of the variable indicators. In order to avoid the influence of extreme values, this paper applies 1% and 99% shrinkage to all continuous variables. The sample data for the study in this paper comes from the Cathay Pacific CSMAR database, using Stata17 and Excel as the main statistical and analytical software.

3.2 Selection of variables

3.2.1 Explained Variables

Environmental protection investment. From the notes of the annual report of listed companies in the "construction in progress" and "administrative expenses" subject line items to search for environmental protection investment-related expenditures, such as desulfurization projects, decommissioning projects, sewage treatment, energy saving, sewage charges and greening fees, etc., the total of these items that is to get The data of the increase of environmental protection investment of the enterprise in the year. Referring to the practice of Wang Yun et al. (2020), the natural logarithm of the total amount of environmental protection investment of the enterprise in the year is used as the level of environmental protection investment of the enterprise[10].

3.2.2 Explanatory variables

Board Informal Hierarchy. This paper draws on previous studies (He and Huang, 2011; Chen Shihua and Zhang Ruibin, 2020)[4,11] to calculate the clarity of the informal hierarchy of the board of directors using the Gini coefficient.

$$Gini = \frac{2 \text{cov}(y, r_y)}{N\bar{y}}$$

y denotes the board status indicator. Two measures are chosen: (1) the number of board members who are part-time directors; and (2) political affiliation. If a board member has political affiliation with the local level government, the value is taken as 1; if a board member has political affiliation with the central level, the value is taken as 2; and the other values are taken as 0. The above 2 indicators are synthesized using principal component analysis to obtain the board member's status indicator, y . It is the mean value of y , and N denotes the size of the board of directors, which indicates the ranking of the director's status indicator among the board of directors. The Gini coefficient takes values between 0 and 1. The closer the value is to 1, the clearer the informal hierarchy of the board is.

3.2.3 Moderating variables

Media attention. Aggregate the reports of the target company appearing in the headlines of the quantitative statistics of online news in the China Research Data Service Platform (CNRDS), and take the natural logarithm of the number of media reports by adding 1 to measure the media attention of the company.

3.2.4 Control variables

In this paper, we select shareholding concentration, firm size, gearing ratio, total asset margin, management shareholding, board size, firm age, and proportion of independent directors, while fixing industry and year effects.

Table 1. Definition of variables

Variable type	variable name	variable symbol	Variable Definition
Explained variable	environmental investment	EPI	Natural logarithm of the total environmental protection investment of the enterprise in the year
Explanatory variable	Board Informal Hierarchy	Gini	Gini coefficient
Regulatory variables	Media attention	Media	The number of media reports plus one takes the natural logarithm
control variable	shareholding concentration	Hold	Shareholding ratio of the largest shareholder
	firm size	Size	The number of employees is taken as a natural logarithm
	gearing ratio	Lev	Total liabilities/total assets
	Total asset margin	ROA	Net profit/total assets at the end of the period
	Management shareholding	Mshare	Number of shares held by management/total shares
	Board size	Board	The number of board members is taken as a natural logarithm
	Age of business	Age	Difference between the current year and the year of establishment of the enterprise
	Proportion of independent directors	Indep	Number of independent directors/board of directors

3.3 Model construction

A linear regression model was constructed to test the effect of H1 board informal hierarchy on environmental investment:

$$EPI_{i,t} = \alpha_0 + \alpha_1 Gini_{i,t} + \alpha_2 Hold_{i,t} + \alpha_3 Size_{i,t} + \alpha_4 Lev_{i,t} + \alpha_5 ROA_{i,t} + \alpha_6 Mshare_{i,t} + \alpha_7 Board_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Indep_{i,t} + \sum Year + \sum Ind + \varepsilon_{i,t}$$

To test H2, the model is constructed as follows by adding media attention to the above model, as well as the cross-multiplier term between the informal hierarchy of the board and media attention:

$$EPI_{i,t} = \alpha_0 + \alpha_1 Gini_{i,t} + \alpha_2 Media_{i,t} + \alpha_3 Gini \times Media_{i,t} + \alpha_4 Hold_{i,t} + \alpha_5 Size_{i,t} + \alpha_6 Lev_{i,t} + \alpha_7 ROA_{i,t} + \alpha_8 Mshare_{i,t} + \alpha_9 Board_{i,t} + \alpha_{10} Age_{i,t} + \alpha_{11} Indep_{i,t} + \sum Year + \sum Ind + \varepsilon_{i,t}$$

4. Empirical analysis

4.1 Descriptive statistical analysis

As can be seen from the descriptive statistics in Table 2, the maximum value of enterprise environmental protection investment is 21.84, the minimum value is 10.41, and the standard deviation is 2.419, indicating that the level of environmental protection investment among listed

companies varies greatly, and that the overall level of China's investment in environmental protection is low, and still needs to be further improved. The maximum value of the board of directors' informal hierarchy is 0.342, the minimum value is 0, and the average is 0.141, indicating that the board of directors of listed companies in China has a fuzzy informal hierarchy. The maximum and minimum values of media attention are 6.62 and 1.099 respectively, indicating that there is a big difference in the amount of media coverage received by enterprises.

Table 2. Descriptive analysis

variable	sample size	mean	median	sd	min	max
EPI	5428	16.33	16.27	2.419	10.41	21.84
Gini	5428	0.141	0.141	0.0760	0	0.342
Media	5428	4.421	4.494	1.060	1.099	6.620
Hold	5428	34.28	32.28	14.56	9.310	74.98
Size	5428	8.093	8.023	1.179	5.537	11.37
Lev	5428	0.461	0.462	0.188	0.0860	0.894
ROA	5428	0.0340	0.0340	0.0590	-0.242	0.185
Mshare	5428	9.791	0.296	16.24	0	63.04
Board	5428	2.139	2.197	0.197	1.609	2.708
Age	5428	19.80	19.58	5.501	7.670	33.67
Indep	5428	37.43	35.71	5.326	33.33	57.14

4.2 Regression analysis

Column (1) of Table 3 shows the regression results of the informal hierarchy of the board of directors and firms' environmental investment. The empirical results show that the board of directors informal hierarchy and environmental protection investment are significantly positive at the 1% significance level, i.e., the clearer the board of directors informal hierarchy is, the higher the level of environmental protection investment of the company, and H1 is verified. The clearer the informal hierarchy of the board of directors is, the more favorable it is to play the coordinating mechanism and increase the firm's environmental investment. Column (2) of Table 3 shows the regression results of board formal hierarchy on corporate environmental investment after taking media attention as a moderating variable. The results show that the coefficient of the cross-multiplier term between media attention and the informal hierarchy of the board of directors is 0.743, which is significantly positive at the 5% level, i.e., media attention enhances the promotion effect of the informal hierarchy on corporate environmental protection investment, and H2 is verified.

Table 3. Regression analysis

	(1)	(2)
	EPI	EPI
Gini	1.047***	1.083***
	(0.393)	(0.393)
Media		0.150***
		(0.031)
Gini x Media		0.743**
		(0.346)
control variable	control	control
_cons	8.811***	8.312***
	(0.623)	(0.632)
N	5428	5428
r ²	0.260	0.265
r ² a	0.256	0.260
Year	Yes	Yes
Ind	Yes	Yes

4.3 Robustness Tests

Column (1) is the result of replacing the explanatory variables with "total environmental investment/total assets at the end of the period" instead of "total environmental investment in natural logarithms". The regression results are significantly positive at the 1% level. Column (2) shows the results after lagging the explanatory variables by one period. The regression results are significantly positive at the 10% level. This is consistent with the previous findings and proves the robustness of the findings.

Table 4. Robustness test

	(1)	(2)
	EPI	EPI
Gini	0.011***	
	(0.004)	
L. Gini		0.791*
		(0.469)
control variable	control	control
_cons	0.017***	8.898***
	(0.006)	(0.735)
N	5428	3875
r ²	0.098	0.261
r ² _a	0.093	0.255
Year	Yes	Yes
Ind	Yes	Yes

5. Conclusion

Environmental protection is a matter of national livelihood and is crucial to the realization of sustainable social development. Although our government has invested a lot of resources in pollution control and environmental protection, the environmental problems are still not optimistic. In today's big data era, corporate information has become more and more transparent, and media reports have become a powerful external monitoring channel, prompting corporations to fulfill their social responsibility of environmental protection and actively invest in environmental protection. The results of this paper show that informal layers in the board of directors can reduce the cost of information communication, improve the quality of board operation, strengthen the directors' need for reputation, prompt their supervision of management, and promote the environmental protection investment of enterprises. And when media attention is high, the positive relationship between informal hierarchy in the board of directors and environmental protection investment will be enhanced.

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