

## Article

# The Influence of Corporate Governance and Operating Characteristics on Corporate Environmental Investment: Evidence from China

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Received: 9 April 2019; Accepted: 11 May 2019; Published: 14 May 2019



**Abstract:** This study mainly explores the relationship between company governance, company operation characteristics, management connection and corporate environmental investment. Based on the theory of stakeholders and principal-agent, it expounds the factors affecting the environmental behavior of companies, and empirically tests the relationship of the involved variables. This study takes the non-financial listed companies of Shanghai Stock Exchange from 2009 to 2011 as a sample, and conducts empirical research on corporate governance, business operation characteristics, management connection and corporate environmental protection investment. The results show that under the same circumstances, if the CEO is also the chairman of the board of directors, it will lead to opportunistic situation of the controlling shareholder, and the degree of willingness to invest in environmental preservation is low, which is negatively related to environmental protection investment. The more redundant resources or the higher the production efficiency exist, the higher the willingness of enterprises to invest in environmental protection will be stimulated.

**Keywords:** shareholding structure; board characteristics; management connect; redundant resources; corporate environmental investment

## 1. Introduction

Since the entry of industrial society, any country has to pay a certain environmental cost in the process of industrialization. However, as the degree of industrialization continues to increase, the environmental awareness of the general public or consumers will gradually strengthen [1–3]. When enterprises face environmental problems, they pay more attention to the environmental efficiency of enterprises. Therefore, enterprises face pressure from various aspects of the environment [4], and corporate environmental responsibility regulation has become an important constraint during the transition period of the society [5]. Ecological civilization has been upgraded to the goal of economic development in the new century. The active environmental protection behavior of enterprises is not only an inevitable trend in line with the development requirements of the times, but also a requirement for ensuring the sustainable development of enterprises themselves. In addition to the external factors mentioned above, internal factors are crucial in explaining why corporates adopt an environmental strategy [6]. Internal factors examined include competitive advantage [7,8], top management commitment [9], executive compensation [10], corporate governance [11] and corporate political connection [12].

While these studies provide insight into internal factors on environmental strategies, no research has examined these internal factors simultaneously. This paper analyzes the relationship between corporate governance, operation characteristics, management connection and environmental performance.

The results provide a possibility to resolve the contradiction of maximizing both shareholder value and a company's performance of environmental responsibility, and provide a solid theoretical basis for corporate shareholders in the decision-making enterprise social environment strategy.

## 2. Literature Review

### 2.1. Literature Review on Corporate Governance

(1) Corporate governance structure. The separation of ownership and management rights of enterprises forms a principal-agent relationship. This is an institutional innovation which is based on the professional development of social division of labor with the comparative advantage of interests. Contract theory is an important part of modern enterprise theory. Enterprises are a combination of series contracts, but they also bring the cost of agency. Most scholars seek to find the optimal corporate governance mechanism by studying the factors that affect agency costs. For the research on the ownership structure affecting the efficiency of corporate governance, scholars mainly focus on the impact of the behavior of major shareholders on the company's daily business activities and strategic choices. Amihud et al. [13] show that companies that are absolutely controlled will be more cautious in corporate mergers and acquisitions. At the same time, Hoskisson et al. [14] show that the higher the shareholding ratio of major shareholders, the more the company tends to specialize in operations.

In terms of the company's management structure, research on whether the chairman of the board also serves as CEO has been studied by scholars. Boyd and Banzhaf [15] studied the relationship between the chairman and CEO and the company's performance, and introduced environmental variables for testing. The results show that the sudden changes in the external environment are positively related to the relationship between the chairman and the CEO. In terms of board composition, the theoretical circles believe that introducing independent directors or increasing the proportion of external directors can have a positive impact on enterprises. Introducing independent directors in the board of directors can improve the objectivity and independence of directors' decision-making, protect the interests of minority shareholders, and benefit the professionalism of board decision-making. Peasnell et al. [16] studied Canadian listed companies. Empirical tests show that independent boards limit the opportunistic behavior of top managers in earnings management.

(2) The characteristics of the board of directors. Perfect corporate governance structure, such as reasonable and moderate number of directors and diversified sources of directors, has a positive effect on promoting corporate environmental behavior and information disclosure [17]. However, when the board of directors is large, it is not easy to coordinate the opinions among the board members, and the board size has a negative relationship with the decision-making efficiency of the board of directors [18]. In terms of the leadership structure of the board of directors, it is difficult for the board of directors to exceed the interests of controlling shareholders in decision-making when the chairman and general manager are combined, which leads to a tendency of the board of directors to pursue short-term corporate performance at the expense of long-term and stable development [19]. Because external independent directors are usually experts in various industries, they can examine the environmental protection behavior of enterprises in a broader perspective. They have rich professional ability and industry experience to participate in the board's major decision-making. The proportion of external independent directors has a positive relationship with the information disclosure of environmental protection behavior of enterprises [20].

(3) Redundant resources. Enterprise redundant resources are generally considered to be more than the actual needs of specific social aggregates. Their purpose is to meet the needs of specific social aggregates to prevent future instability risks. Ooi et al. [21] found that managers tend to diversify their investment and focus more on long-term and stable development when enterprises have sufficient redundant resources. The purpose of enterprises maintaining redundant resources is to cope with the scarcity of social resources caused by emergencies, seize the fleeting opportunities of the market, and quickly form a unique competitive advantage [22].

(4) Management connection. Executive management connection includes political and commercial connections, which generally refer to intangible political and commercial social relations owned by senior managers and facilitated by access to social resources by outside enterprises. Sheng et al. [23] used data from 241 listed companies in China to conduct an empirical study on the impact of political and business relevance on corporate performance. There is a negative correlation between the political connection of senior managers and the investment efficiency of enterprises. In addition, Lin et al. [24] investigated whether firms in China use corporate social responsibility (CSR) to build political networks, and how affect firm performance. Furthermore, political connection has positive influence on companies' CSR [24,25] and reduced CSR disclosures [26].

## 2.2. Literature Review on Corporate Environmental Responsibility

At present, the theories have not reached a relatively consistent conclusion on environmental investment. There are two representative viewpoints: the traditional view is that environmental investment is pure cost [27–30] and the current view is that environmental investment is future investment [31–37]. Enterprise environmental investment is an important part of enterprise environmental strategy. In terms of the performance of specific enterprises' investment in environmental protection, there are a great number of aspects related to enterprises' investment in environmental protection, such as: Green fee, sewage discharge fee, environmental protection technology certification fee, environmental protection technology development fee and so on. When the green investors account for a large proportion of investors, they can influence a company's behavior strategy sufficiently to motivate more social responsibility strategies [38,39]. Clement and Meunie [40] studied the impact of social responsibility, green investment, and cultural values on environmental protection. Chuang and Huang's [41] studies show that environmental CSR has significant positive effects on human capital of green information technology, green information structure capital and green relationship capital. In addition, green information technology (IT) capital and green IT relational capital have a positive impact on environmental performance and business competition, and environmental performance has a positive impact on business competition. Research reveals that CSR is related to corporate performance [42–44]. Using data from American companies from 1997 to 2004, Guenster et al. [45] show that corporate environmental performance has a positive impact on corporate valuation. Kim and Statman [46] show that American companies seem to be in the interests of shareholders, and when necessary they adjust their investments in corporate environmental responsibility to improve corporate performance. El Ghouli et al. [47] studied how corporate environmental responsibility affects the cost of equity capital in 30 countries of manufacturing companies. The results show that the cost of equity capital is lower when the company has high corporate environmental responsibility.

## 3. Theory and Hypotheses

### 3.1. Equity Structure and Environmental Protection Investment

The concentration of equity and the existence of controlling shareholders will lead to over-investment of the company, which will further reduce the proportion of cash flow rights (i.e., the involvement of controlling shareholders). La Portal et al. [48] found that ultimately controlling shareholders will make the actual control rights and cash flow rights of listed companies different through the pyramid structure of equity control and cross-shareholding, which will inevitably result in controlling shareholders gaining greater control rights at a lower cost of cash flow rights. This shows that the controlling shareholders' capital of listed companies is far greater than their own capital investment, and the controlling shareholders and their personal risks are constantly externalized. The higher the degree of separation between control rights and cash flow rights, the ultimate controlling shareholder transfers its own risk to other shareholders by choosing high-risk short-term benefit project investment, that is, controlling shareholders can use the capital of small and medium-sized

shareholders to enter projects with high risk and short return period. Under the above theoretical framework, the following assumptions can be made:

**Hypothesis 1 (H1).** *Under the same circumstances, the higher the degree of separation between cash flow rights and controlling shareholder control rights, the higher the willingness of companies to invest in environmental protection, and the degree of separation between cash flow rights and controlling shareholder control rights is positively related to environmental protection investment.*

### 3.2. Characteristics of the Board of Directors and Environmental Investment

According to the company law of China, the board of directors is the most important part of corporate governance. The independence and objectiveness of the board of directors directly determine the quality of corporate governance. The composition of the board of directors mainly includes: Independent directors, board leadership structure, directors' remuneration and board size. This study will theoretically analyze how the characteristics of the board of directors affect the choice of corporate environmental strategies, thus affecting the company's environmental investment.

#### (1) Board size and corporate environmental protection investment

In discussing the correlation between board size and enterprise environmental protection investment, Monk and Walt [49] research conclusion shows that when board size is large, experts from different fields related to company business can be absorbed into decision-making level, and brainstorming is conducive to making high-quality strategic decisions. In addition, when board size is large, it objectively reduces the proportion of directors of controlling shareholders. For example, the controlling shareholder's interest embezzlement is suppressed. It can therefore be assumed that:

**Hypothesis 2a (H2a).** *Under the same conditions, the larger the board size, the higher the willingness of companies to invest in environmental protection, and the size of the board of directors is positively related to the investment in environmental protection of enterprises.*

#### (2) Proportion of independent directors and environmental protection investment

In terms of board composition, Fama and French [50] pointed out that directors representing shareholders' interests often consider their own shareholders' interests when making decisions, which is not conducive to the long-term and comprehensive decision-making of the board of directors, and it is difficult to maintain an objective position in judging major decisions. From the perspective of the composition of companies, most of the lawyers, investment bank analysts, university teachers from outside the company basically come from outside the company, and maintain a good objectivity in form and substance. The extant academic literature examines the relationship between board composition and CSR. Compared to inside directors, outside ones exhibit greater concern about the corporate socially responsibility [51]. Moreover, enterprises that attach importance to external stakeholders (such as green consumers) will be more environmental protection investment [52]. In addition a higher proportion of outside board directors is associated with more favorable environmental CSR [53].

**Hypothesis 2b (H2b).** *Under the same conditions, the higher the proportion of independent directors in board structure, the higher the willingness of enterprises to invest in environmental protection warfare, and it is positively correlated with environmental protection investment.*

#### (3) Leadership Structure of Board of Directors and Environmental Protection Investment of Enterprises

Theorists have different opinions on whether chairman concurrently serving as general manager can promote corporate governance. When chairman and general manager are concurrent, there is a potential risk of internal control failure. Secondly, the integration of CEO and chairman will bring the potential of centralized control and conservatism. In addition, when the CEO and the

chairman are the same person, the chairman has absolute control over the board of directors, and the objective independence of the board of directors will be significantly affected. It is difficult for directors representing minority shareholders to express their opinions in the board of directors, and opportunistic behavior of controlling shareholders is more likely to occur.

**Hypothesis 2c (H2c).** *Under the same conditions, the concurrent employment of CEO and chairman will lead to the opportunism of controlling shareholders, and the willingness of enterprises to invest in environmental protection will be low, which is negatively related to the investment in environmental protection.*

#### (4) Directors' compensation and corporate environmental protection investment

Directors' remuneration is a reasonable return for their contribution to the company. According to the principal-agent theory, director's remuneration can stimulate directors' enthusiasm for work, promote the efficient operation of the board of directors, and ensure the effectiveness of corporate governance mechanism. If directors' remuneration is too low, it will inevitably lead to directors' enthusiasm for work and inefficiency. It may also lead to directors' actions harming the company for their own interests. A sound incentive system for directors can stimulate their working potential and ensure their diligent and supervisory functions in decision-making. Under China's specific national conditions, whether the board's strategic decision-making keeps pace with the times is one of the most important factors affecting enterprises' investment in environmental protection. There is a stream of research discussing the relationship between executive compensation and CSR. McGuire et al. [54] show that there is no relationship between incentives and CSR. However, Mahoney and Thorn [55] find significant positive or negative relationship between CSR and executive compensation. Furthermore, there is evidence of a positive relationship [10,56–58]. Consequently, we expect the following:

**Hypothesis 2d (H2d).** *Under the same conditions, the higher the compensation of directors, the higher the willingness of enterprises to invest in environmental protection, which is positively related to environmental protection investment.*

### 3.3. Enterprise Operation Characteristics and Enterprise Environmental Protection Investment

(1) Redundant resources of enterprises are mainly manifested in the fact that enterprises have sufficient cash and fail to find projects with appropriate return on investment. If the enterprise has sufficient redundant resources, it will inevitably invest more funds in environmental protection for the good reputation of the enterprise, which will create an atmosphere conducive to the long-term development of the enterprise.

**Hypothesis 3a (H3a).** *Under the same conditions, the more redundant resources an enterprise has, the more willingly it will invest in environmental protection, which is positively related to its investment in environmental protection.*

(2) Enterprise productivity is an index reflecting the growth ability of endogenous redundant resources of an enterprise, and it is also one of the basic elements to support the sustainable development of an enterprise. Only when enterprises have the potential of sustainable development, will they invest more on other projects in exchange for the guarantee of their future development.

**Hypothesis 3b (H3b).** *Under the same conditions, the higher the production efficiency of enterprises, the higher the willingness of enterprises to invest in environmental protection, and the production efficiency of enterprises is positively correlated with the investment in environmental protection.*



### 3.4. Management Connection and Enterprise Environmental Protection Investment

Management connection in enterprises is manifested as the political and commercial connections of corporate management. First of all, both political and commercial connections of management are a kind of relationship asset of the company, which can not only bring benefits to the company, but also private benefits to the executives themselves to a certain extent. Executives with management links are now or used to be government officials, deputies of the People's Congress and, to a certain extent, they also represent the interests of the public. At the same time, the public investors have higher expectations on the environmental responsibility and environmental ethics of these highly managed enterprises. They hope that the companies they represent will be more active in fulfilling their environmental responsibility. There exists some literature that investigates the relationship between management connection and CSR. Li et al. [59] found that compared with non-politically connected firms, politically connected firms are more likely to contribute and to a greater extent. Moreover, there is evidence of a positive relationship between political connection and private companies' CSR [25]. Wang et al. [60] show that the existence of politically connected board chairmen positively affects Environmental protection investment. We therefore propose the following:

**Hypothesis 4 (H4).** *Under the same conditions, the higher the correlation degree of executives, the higher the willingness of enterprises to invest in environmental protection. The correlation degree of executives has a positive correlation with environmental investment.*

## 4. Research Methodology

### 4.1. Data and Sample

The data of this study are from Shanghai Stock Exchange of China, and the listed companies on the Shanghai Stock Exchange from 2009 to 2011 are taken as the research objects. The following principles are followed in selecting sample companies: (1) Deleting listed companies of financial and insurance securities; (2) excluding Special Treatment (ST, \*ST, SST) of heavily polluted listed companies because of their continuous loss during the past 2 or 3 years to avoid recording those with financial abnormality and abnormal situations of data; (3) excluding companies that do not disclose environmental protection data, because the government has no mandatory regulations; and (4) research sample selection is mainly for listed companies in 2005, the main purpose of which is to ensure data stability. The data is manually collected, including 633 sample data from 211 listed companies in 3 years. In data analysis, this paper will use SPSS to carry out descriptive statistical analysis and variance analysis of the relationship between the variables studied in this paper, and through the establishment of a model for correlation analysis.

### 4.2. Variables

The variables and measurements of this study are shown in Table 1.

**Dependent Variable.** The company's environmental investment data mainly comes from the non-operating business disclosure and management fees disclosed by the listed company's annual report. Its main components are corporate environmental protection investment = greening fee + sewage charges + environmental protection certification fee + environmental protection technology development fee + environmental protection association sponsorship fee + flood control fund and river bank maintenance fund. In order to verify the sustainability and robustness of the company's environmental investment, this study uses different annual corporate environmental investment growth rate to be explained variables.

**Independent Variable.** In this study, the ownership structure, the characteristics of the board of directors and the characteristics of the enterprise itself, as well as the connection between senior management and corporate governance, are selected as independent variables affecting corporate environmental investment. To some extent, corporate governance guarantees the effectiveness of the

operation of the company. Corporate ownership structure is the key to corporate governance structure, while control rights and cash flow rights are the core of ownership structure. Shleifer et al. [61] use the dynamic model and the measurement method in the research of La Porta et al. [48] to discuss the problem of ultimate controlling shareholders using control rights to encroach on the interests of other shareholders, and explain the internal mechanism of ownership structure affecting corporate governance. Therefore, this study will adopt the calculation method of La Porta et al. [48], which is to multiply and sum the proportion of each floor of the pyramid structure controlled by the actual controller's equity.

**Table 1.** Variable measurement.

Variable	Measurement
<b>Dependent variables</b>	
Enterprise environmental protection investment	Enterprise environmental protection investment = greening fee + sewage charges + environmental protection certification fee + environmental protection technology development fee + environmental protection association sponsorship fee + flood control fund and river bank maintenance fund
Environmental investment growth rate	(Environmental input for the current year – environmental input for the previous year)/environmental input for the previous year
<b>Independent variables</b>	
Cash flow rights	The sum of the products of the control chain of each layer of the ultimate controlling shareholder
Control rights	The sum of the controlling shareholder's direct and indirect controlled equity
Separation of control rights and cash flow rights	Control rights/cash flow rights
Director compensation	The natural logarithm of the sum of the top three returns of directors
Board size	Number of board members
Ratio of independent directors	Number of independent directors/board of directors
Board leadership structure	Whether the chairman and general manager position and one
Redundant assets	Net cash flow/net assets
Business productivity	Net asset turnover
Executive business relevance	Whether directors, supervisors and senior management have served either full- or part-time in peer business partners
Executive political relevance	Whether the directors, supervisors and senior management have served in the government agencies either full- or part-time
<b>Mediator variable</b>	
Management environmental willingness	Green marketing expenses/sales expenses
<b>Control variables</b>	
Industry	If the enterprise belongs to the dirty industry (which has a relatively greater negative impact on the natural environment than “clean” industry, such as service industry), it will be 1, otherwise it will be 0
Year	Dumb variable, 1 if the sample data belongs to the year, 0 otherwise
Company Size	Natural logarithm of final assets
Actual controller type	State-owned holding is 1, otherwise 0
Operating income growth rate	(Business income for the current year – operating income for the previous year)/operating income for the current year

The board of directors is the decision-making body of the company's operation, thus it plays a central role in corporate governance and strategic decision-making. Generally speaking, the board of directors is the bridge between stakeholders and investors. This bridge is always under the double pressure of internal management and external regulation. Its internal structure characteristics will inevitably affect the overall effectiveness of the bridge. By reviewing the relevant literature, it is found that the characteristics of the board of directors generally include the size of the board, the proportion of independent directors, the leadership structure of the board of directors and the remuneration of directors.

Bromiley [62] used cash flow turnover rate to measure redundant resources, and Singh [63] used cash equivalents/current liabilities index to measure available redundant resources. Therefore, this paper chooses the company's redundant resources and production efficiency as the financial characteristics of enterprise operation.

The management connections of company executives can be divided into commercial connections and political connections. Executives with a good business background and a government background can rely on their business partners or governments by a "familiar face" and have easier access to social resources than others. Similar to the measurement, of Sheng et al. [23], of business relationships, we use whether the company's directors, supervisors and senior management have been employed by the company's intimate business partners. Chen et al. [35] and Ma et al. [64] define the political connection of executives in the Chinese environment, that is, whether the manager is or has been in the government, including (1) government official; (2) military officer; (3) member of the Chinese People's Congress (CPC); and (4) member of the Chinese People's Political Consultative Conference (CPPCC).

**Mediator variable.** Enterprise environmental strategies are generally divided into forward-looking and reactive ones [65], but the managers does not show obvious forward-looking and reactive [66]. Therefore, it is difficult to absolutely divide the enterprise environmental protection strategy into two extremes. Measuring the environmental willingness of management can reflect the environmental attitude adopted by enterprises to a certain extent, so we can measure the environmental willingness of management by investigating the green marketing cost in the marketing cost. Because Chinese law does not disclose green marketing costs, we can only choose environmental packaging, recycling expenditure and waste disposal expense as green marketing expenditure, and use green marketing expense/sales expense to measure the management's environmental protection willingness.

**Control variable.** This study mainly studies the relationship between the company's shareholding structure, board characteristics, business operation characteristics, executive management and corporate environmental investment. Therefore, it is necessary to explore the influence of other factors on the environmental protection investment of enterprises. Control variables include industry type, company size, actual controller type, operating income growth rate and year.

(1) Industry. This study uses the "dirty" industry to represent industries that have a relatively greater negative impact on the natural environment than "clean" industry, such as the service industry. Therefore, the dirty enterprises are under pressure to be regulated by outside laws or public opinion, and they have more environmental protection investment than other industries. The dirty industry includes petrochemicals, tobacco, mining and metallurgy, food industry, real estate construction and medicine.

(2) The actual controller type. The actual controllers of different types of enterprises have different considerations for the operation decisions of listed companies. In combination with China's actual situation, if the listed company is ultimately controlled by the state, the company will consider the social benefits and long-term development of the company when making decisions, regulate the company's various behaviors, and even advance the environmental regulation to enhance the corporate image. Therefore, this study introduces the actual controller of the enterprise as a control variable.

(3) The size of the company. The decision-making behavior of the board of directors will be affected to a certain extent by the size of the company. Large-scale companies have huge resources and have the ability to invest more environmentally friendly equipment to improve the relationship between enterprises and consumers. In addition, the size of the company will affect the company's profitability in a competitive environment. Large-scale companies can exchange high-efficiency environmental



benefits with low-cost environmental protection due to economies of scale. In this study, the size of the company's total assets will be used to measure the size of the company.

(4) Growth rate of the company's operating income. The company's growth and stability are important factors affecting the company's continued investment in the future. A company with low growth and weak stability is unable to continue to survive and develop. It has no ability to consider improving its corporate image through corporate environmental protection investment. Therefore, the growth rate of listed business income is used to measure the growth of the company, and the growth of the company is taken as the control variable of this study.

(5) Year dummy variable. Taking into account the impact of the year on the regression model, the environmental behavior of enterprises in different years is different, so the year dummy variable is added to control the fixed effects of different years.

#### 4.3. Model Estimation

Based on the above theoretical combining and theoretical framework, we use the OLS regression analysis to explore the relationship between the above variables. Moreover, the residual tests show that the OLS regression model is reasonable. Our regression models are shown below:

$$\ln EPI = \beta_0 + \beta_1 Stockr + \beta_2 Boardc + \beta_3 Operc + \beta_4 Mgt + \beta_5 Envir + \beta_6 Controls + \varepsilon, \quad (1)$$

$$\ln \Delta EPI = \beta_0 + \beta_1 Stockr + \beta_2 Boardc + \beta_3 Operc + \beta_4 Mgt + \beta_5 Envir + \beta_6 Controls + \varepsilon. \quad (2)$$

where EPI represents the enterprise environmental protection investment,  $\Delta EPI$  represents the environmental protection investment growth rate, *Stockr* refers to the equity structure variable matrix, *Boardc* represents the board of directors characteristic variable matrix, *Operc* represents the business operation characteristics, *Mgt* represents the management connection variable matrix, *Envir* represents the enterprise environmental strategy selection variable, *Controls* represents the control variable matrix, and  $\varepsilon$  is residual term.

## 5. Empirical Result

### 5.1. Descriptive Statistics

This study selected the Shanghai Stock Exchange's 2009–2011 sample, a total of 633 sample data. First, descriptive statistical analysis of these sample data was performed using SPSS software (IBM, Armonk, NY, USA).

As the descriptive statistics of the variables in Table 2 show:

(1) In terms of corporate environmental protection investment, the descriptive statistical results of the enterprise environmental protection input are: The maximum value is 17.79, the minimum value 9.41, the average value 14.172, and the standard deviation 1.568. In terms of the degree of willingness to invest in environmental protection, descriptive statistics are: Maximum value of 0.188, minimum value of 0.001, mean value of 0.038, and standard deviation of 0.034. As can be seen, the investment in environmental protection investment by listed companies in different industries in China is very different, which is related to China's current stage of mandatory non-enforcement of environmental protection investment. Since China's environmental protection investment is mainly funded by the government, the company's investment is fully self-issued by the enterprise to fulfill its social responsibility, which will inevitably lead to uneven investment in environmental protection.

(2) In terms of ownership structure, the descriptive statistical results of the degree of separation of control rights and cash flow rights are as follows: The maximum value is 7.698, the minimum value is 1, the mean value is 1.630, and the standard deviation is 1.233. This shows that the majority of listed companies in China generally have the phenomenon of controlling shareholders transferring their own risks through pyramid control. This study chooses the first largest shareholder as the ultimate controller, and ultimate shareholders increase their control. At the stock level, the higher cash flow

right ratio can be controlled with less equity proportion. At the same time, the company law provides that large shareholders have more opportunities to control company property through management, ignoring or even infringing on the interests of small shareholders.

**Table 2.** Descriptive statistics (N = 633).

	Variable	Min.	Max.	Mean	Std. dev
Equity structure	Cash flow rights	0.026	0.843	0.321	0.175
	Control	0.0745	0.843	0.395	0.149
	Separation of cash flow rights and control rights	1	7.698	1.630	1.233
Board characteristics	Board size	5	15	10.096	1.881
	Board leadership structure	0	1	0.325	0.469
	Director compensation	4.519	17.912	13.758	1.215
	Ratio of independent directors	0.222	0.6	0.365	0.056
Business operation characteristics	Redundant resources	0.002	2.250	0.205	0.244
	Productivity	0.041	11.005	1.679	1.458
Management connection	Executive political relevance	0	1	0.474	0.500
	Executive business relevance	0	1	0.572	0.495
Mediator variable	Degree of willingness to invest in environmental protection	0.001	0.188	0.038	0.034
Control variable	Industry	0	1	0.578	0.494
	Actual controller type	0	1	0.589	0.492
	Company Size	18.702	26.393	22.251	1.317
	Operating income growth rate	−0.876	1.290	0.110	0.304
Explained variable	Environmental protection investment	9.41	17.790	14.172	1.568

(3) In terms of board characteristics, the maximum size of the board of directors of listed companies in China is 15 and the minimum value is 5, which conforms to the provisions of the Company Law of China; the average value of independent directors is 0.365, indicating that the proportion of independent directors of listed companies in China has basically met the requirements of China Securities Regulatory Commission.

(4) In terms of business operation characteristics, the maximum value of redundant resources of Chinese listed companies is 2.250, the minimum value is 0.022, and the average value is 0.205. It can be seen that Chinese listed companies generally face the problem of insufficient cash flow and need external financing. This indirectly restricts China's listing and increases its enthusiasm for environmental protection.

## 5.2. Correlation Analysis between Research Variables

In this study, the Pearson double test was used to test the correlation between the explanatory variables, control variables and interpreted variables in the study. The data analysis results are shown in Table 3 below.

Table 3 Correlation coefficient table between variables in Model 1.

## 5.3. Regression Results and Analysis

Variable correlation analysis explores the close relationship between unknown variables. In general, there is no distinction between independent variables and dependent variables. Regression analysis explores the specific relationship between unknown variables, determines the reasons for their existence, and uses specific mathematical models to measure their specific relationship. This study uses linear regression to judge the relationship between research variables.

Table 3. Pearson's correlations (N = 633).

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Separation of cash flow rights and control rights	1																
2. Environmental protection investment	0.308 *	1															
3. Cash flow rights	−0.595 **	−0.241 **	1														
4. Control	−0.225 **	0.326 **	0.859 **	1													
5. Board size	−0.054	0.220 **	0.079 *	0.087 *	1												
6. Board leadership structure	0.165 **	−0.23 *	−0.041	0.084 *	−0.281 **	1											
7. Director compensation	0.112 **	0.125 **	−0.072	−0.006	0.043	0.116 **	1										
8. Ratio of independent directors	−0.057	0.127 **	0.006	−0.020	−0.253 **	0.043	0.042	1									
9. Redundant resources	−0.027	0.089 *	0.022	0.002	−0.061	−0.004	−0.160 **	0.014	1								
10. Productivity	−0.079 *	0.345 **	0.152 **	0.092 *	0.185 **	−0.147 **	−0.175 **	0.018	0.368 **	1							
11. Executive political relevance	−0.200 **	0.170 **	0.291 **	0.249 **	0.113 **	−0.153 **	0.142 **	−0.001	−0.076	−0.057	1						
12. Executive business relevance	−0.129 **	−0.035	0.034	0.030	0.111 **	0.076	−0.105 **	0.020	0.025	0.132 **	−0.023	1					
13. Degree of willingness to invest in environmental protection	−0.003	−0.238 **	−0.213 **	−0.292 **	−0.063	−0.136 **	−0.069	0.000	−0.020	−0.096 *	−0.014	0.090 *	1				
14. Industry	0.034	0.049	−0.043	−0.054	−0.027	−0.007	−0.011	0.029	0.017	−0.005	−0.017	0.025	−0.047				
15. Actual controller type	−0.168 **	0.135 **	0.271 **	0.212 **	0.147 **	−0.099 *	−0.051	0.029	−0.058	0.089 *	0.149 **	0.043	−0.024	−0.123 **	1		
16. Company Size	−0.016	0.616 **	0.376 **	0.461 **	0.240 **	−0.139 **	0.048	−0.154 **	0.020	0.174 **	0.258 **	0.062	−0.157 **	0.075	0.111 **	1	
17. Operating income growth rate	−0.052	0.143 **	0.048	0.069	0.193 **	−0.075	0.057	0.083 *	0.057	0.088 *	0.062	−0.071	−0.098 *	−0.024	0.122 **	0.141 *	1

Note: \*\*  $p < 0.01$ , \*  $p < 0.05$ .

According to the regression model 1, linear regression analysis was made between the degree of the enterprise's willingness to invest in environmental protection and the explanatory variables. Then we used linear regression to analyze the enterprise environmental investment and explanatory variables. The regression coefficients and regression models of explanatory variables are summarized in Table 4.

**Table 4.** Regression coefficient.

Model		Non-Standardized Coefficient		T	Sig.	95.0% Confidence Interval for Beta	
		Beta	Standard Error			Lower limit	Upper limit
(constant)	(constant)	−2.447	1.08	−2.267	0.024	−4.567	−0.327
Equity structure	Cash flow rights	−1.817	0.878	−2.068	0.039	−3.542	−0.092
	Control	1.582	0.862	1.834	0.067	−0.112	3.275
	Separation of cash flow rights and control rights	0.068	0.065	1.036	0.03	−0.196	0.061
Board characteristics	Board size	0.042	0.027	1.528	0.012	−0.012	0.096
	Board leadership structure	−0.49	0.107	4.567	0	0.279	0.701
	Director compensation	0.137	0.039	3.526	0	0.061	0.213
	Ratio of independent directors	1.326	0.843	1.573	0.116	−2.982	0.329
Business operation characteristics	Redundant resources	0.005	0.2	0.027	0.978	−0.387	0.398
	Productivity	0.322	0.036	9.036	0	0.252	0.391
Management connection	Executive political relevance	0.144	0.098	1.473	0.141	−0.048	0.336
	Executive business relevance	−0.354	0.096	−3.69	0	−0.542	−0.166
Mediator variable	Degree of environmental investment willingness	3.593	1.387	2.59	0.01	−6.317	−0.869
Control variable	Industry	0.083	0.092	0.903	0.036	−0.097	0.262
	Actual controller type	0.238	0.096	2.469	0.014	0.049	0.428
	Company Size	0.64	0.042	15.389	0	0.558	0.722
	Operating income growth rate	0.047	0.155	0.304	0.761	−0.257	0.351
		Change statistics					
R square		Adjust R square	Standard estimated error	R square change	F change	Sig. F change	
0.764		0.735	1.1129705	0.51	39.943	0	

(1) The regression analysis of ownership structure and environmental protection investment of enterprises. According to the regression results in Table 4, the regression coefficient of cash flow right and control right segregation is 0.068 and F value is 0.030, which shows that the results are consistent with the hypothesis H1 in this paper.

(2) The regression analysis of board characteristics and enterprise environmental protection investment. The regression coefficients of board size, proportion of independent directors, board leadership structure and directors' remuneration are 0.042, 1.326, −0.490 and 0.137, respectively, and their F values are less than 0.05, which verifies the hypotheses of H2a, H2b, H2c and H2d, respectively.

(3) An enterprise's own operating characteristics and environmental protection investment. The regression coefficients of redundant resources and production efficiency are 0.005 and 0.322, respectively, and the F value is less than 0.05, which is in line with the hypotheses of H3a and H3b in this study.

(4) Management connections of senior managers and environmental investment in enterprises. The regression coefficients of top managers' political and business correlation degree to enterprises' environmental protection investment are 0.144 and −0.354, respectively, but only the F value of political correlation degree is less than 0.05, which partially validates the hypothesis H4 in this paper.

From the regression coefficients of many variables and enterprises' environmental investment in this study, the regression coefficients of enterprises' willingness to invest in environmental protection are

3.593 and the F value is 0.01, which shows that it has the greatest impact on enterprises' environmental investment. From the above table, the adjustment decision coefficient of the whole regression model is adjusted to 0.735, which shows that the regression model explains 73.5% of the total variation, and its F value level is significantly less than 0.05, so it can be considered that the regression effect of the model is significant.

#### 5.4. Robustness Check

In the above analysis, the absolute number of enterprises' environmental investment is used as the dependent variable, but considering that enterprises' environmental investment will change in different years, the annual growth rate of enterprises' environmental investment is used as the dependent variable to test the stability of the regression model (model 2).

Table 5 shows the regression coefficients between each research variable and the growth rate of environmental investment. The separation of cash flow rights and control rights has a significant negative impact on the growth rate of environmental investment, and its marginal impact increases with the increase of separation degree, which is basically consistent with the above conclusion. The board characteristics and the growth rate of environmental investment of enterprises are basically consistent. Rate correlation coefficient has not changed in the direction of symbols, but the magnitude of coefficient has been adjusted. For example, the regression coefficient of independent directors has increased significantly. This shows that with the increasing intensity of external environmental regulation in China, independent directors' status of maintaining independent customers in board decision-making has been greatly improved, and independent participation in corporate decision-making pays more attention to the external environmental benefits of enterprises. Therefore, in general, the data in the table above further validate the hypothesis and regression model of this study.

**Table 5.** Regression coefficient.

Model		Non-Standardized Coefficient		T	Sig.	95.0% Confidence Interval for Beta	
		Beta	Standard Error			Lower limit	Upper limit
(constant)	(constant)	2	3.02	0.066	0.05	−3.931	7.931
Equity structure	Cash flow rights	−2.88	2.458	1.172	0.024	−1.946	7.707
	Control	0.149	2.412	0.062	0.095	−4.886	4.588
	Separation of cash flow rights and control rights	0.147	0.183	0.804	0.042	−0.212	0.505
Board characteristics	Board size	0.014	0.077	0.177	0.046	−0.164	0.137
	Board leadership structure	−0.452	0.3	1.504	0.013	−1.041	0.138
	Director compensation	0.12	0.109	1.108	0.026	−0.093	0.334
	Ratio of independent directors	1.593	2.358	0.676	0.05	−6.225	3.038
Business operation characteristics	Redundant resources	0.715	0.559	1.278	0.02	−1.813	0.383
	Productivity	0.018	0.1	0.184	0.054	−0.177	0.214
Management connection	Executive political relevance	0.351	0.273	1.285	0.019	−0.888	0.186
	Executive business relevance	−0.184	0.268	0.685	0.049	−0.343	0.711
Mediator variable	Degree of environmental investment willingness	7.291	3.881	1.879	0.061	−0.33	14.911
Control variable	Industry	0.227	0.256	0.886	0.037	−0.73	0.276
	Actual controller type	0.534	0.27	−1.977	0.048	−1.064	−0.004
	Company Size	0.132	0.116	1.136	0.025	−0.361	0.096
	Operating income growth rate	0.652	0.433	1.507	0.032	−0.198	1.503
R square		Adjust R square	Standard estimated error	Change statistics			
				R square change	F change	Sig. F change	
0.612		0.602	1.113631	0.03	1.175	0.283	



## 6. Discussion and Conclusions

Taking Shanghai A-share non-securities financial or insurance listed companies from 2009 to 2011 as samples, this paper makes an empirical study on the relationship between corporate governance, corporate characteristics and environmental protection investment of listed companies. The study tries to explain the internal factors that affect the environmental protection investment of enterprises from four perspectives: The characteristics of the board of directors, the ownership structure, the operating characteristics of enterprises and the management connection of senior managers. Empirical research results show that the research in this paper is basically supported, and the specific conclusions are as follows:

(1) In terms of board characteristics. Through empirical analysis, the study found that the overall indicators of the company's board of directors have different degrees of significance to the company's environmental protection investment: The proportion of independent directors has the highest impact on the company's performance of environmental responsibility, the director's remuneration and the board's leadership structure is second, and the board of directors is the smallest. Among the four variables of the selected board characteristics, the proportion of independent directors and the regression coefficient of corporate environmental protection investment are the most significant. This shows that the space atmosphere for independent directors of Chinese listed companies to express independent professional opinions in the decision-making of the board of directors has improved. However, to fully play their independent supervisory function and stop the behavior of controlling shareholders' interest embezzlement, there is still a long way to go.

The regression coefficient between board size and corporate environmental investment is the smallest among the four characteristic variables of board characteristics, which indicates that board size has a relatively small impact on corporate environmental investment. According to the theory of social basic resources, large-scale board of directors can accommodate multi-stakeholders, provide more comprehensive and objective decision-making consultation, and help enterprises to obtain public relations resources to a certain extent. However, if the board of directors is too large, there will be inefficient decision-making of the board of directors, and the agency costs between board members are too high. The empirical results of this study support that a large-scale board of directors is conducive to promoting environmental protection behavior of enterprises.

(2) In terms of company operation characteristics. Redundant resources and production efficiency of listed companies in China are both positive regression coefficients, indicating that financial redundancy is an important factor affecting environmental investment. Enterprise redundant resources are idle resources which exceed the actual operation needs of the enterprise, and are used by enterprise managers to deal with the buffer of uncertainty in future operation. Due to the uncertainty of expected earnings of enterprises' environmental protection behavior and the influence of stable expected earnings brought by enterprises' environmental protection behavior greatly weakened by the changes of internal and external environment after the occurrence of environmental protection investment behavior, enterprise redundant resources can enhance the ability of enterprises to resist risks and reduce the pressure of uncertain expectations faced by enterprise managers after making decisions on environmental protection behavior. The empirical test of this study shows that under the support of abundant redundant resources, managers of enterprises can rationally make decisions on various environmental protection behaviors of enterprises and make rational use of redundant resources.

(3) In terms of management connection of senior management of enterprises. The political correlation degree of senior executives of listed companies in China is positive for the environmental protection input coefficient of enterprises, and the commercial correlation degree of senior managers is negative for the environmental protection input coefficient of enterprises. This indicates that the political association of senior managers has a positive impact on the environmental protection investment of enterprises, but the impact of business connection on corporate environmental protection investment is negative. The political connection of senior executives as an intangible social capital of enterprises provides convenience for enterprises to obtain social public institutional resources.

However, senior executives need to exchange reciprocal returns to the government and society to get the public's approval. Executives have the enthusiasm to promote the environmental protection behavior of their companies, and bring huge external benefits to the public and the government. It is the best and most effective way for senior executives to continue to obtain government positions or to promote.

This study puts forward some practical suggestions on how to improve the enthusiasm of enterprises in environmental protection investment. Firstly, the companies should improve the company's ownership structure and the source of board members, let more stakeholders enter the company's decision-making bodies, and reduce the risk of controlling shareholders by controlling the board of directors. Secondly, for market regulators, it is their duty to reduce the proportion of controlling shareholders' cash flow rights, improve the separation of control rights and cash flow rights and effectively avoid controlling shareholders' blind decision-making to choose short-term self-interest opportunism because of protecting their own interests. Thirdly, the government should properly protect and guide enterprises' enthusiasm for environmental protection investment. Finally, importance should be attached to environmental cooperation between government and enterprises.

**Author Contributions:** The authors have participated and contributed to this work. Conceptualization, D.Y.; Methodology, D.Y., Z.W. and F.L.; software, Z.W. and F.L.; Formal analysis, D.Y.; Writing—Original Draft Preparation, Z.W. and F.L.; Writing—Review and Editing, D.Y. and Z.W.; Supervision, D.Y.; Project administration and funding acquisition, D.Y.

**Funding:** This research was funded by the National Natural Science Foundation of China (71472074, 71872073), the Fundamental Research Funds for the Central Universities and the Institute of Enterprise Development Research of Jinan University.

**Conflicts of Interest:** The authors declare no conflict of interest.

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