Female Board Directors and Corporate Environmental Investment: A Contingent View

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Abstract: Board diversity has become a major topic in a developed context, yet its impact has not been examined by scholars in emerging economies where the liberalization of women is not equally popular. Based on upper echelons theory, this study explores the impact of female board directors on corporate environmental investment (CEI), as well as its boundary conditions under different institutional backgrounds. Taking 463 A-share listed corporations in Shanghai and Shenzhen Stock Exchange from 2008–2017 as examples, we reveal that female board directors are positively related to CEI. In addition, provincial pollution level and regional legal development strengthen the positive relationship between female board directors and CEI. These findings contribute to upper echelons theory that board diversity facilitates corporate pro-social behaviors, especially under pressure from the external environment, emphasizing the influence of female directors’ characteristics. Our research also has managerial implications that corporations may enhance their representation of female directors for better environmental actions and subsequent better marketing performance as well as improved reputation. Moreover, the government is suggested to put forward regulations that increase the proportion of female directors in order to enhance corporate environmental investment.

Keywords: female board directors; corporate environmental investment; upper echelons theory

1. Introduction
On 9 February 2020, the temperature above 20 °C was measured for the first time in Antarctica. Global warming and other environmental problems are imminent, and all mankind is facing severe challenges. As the largest developing country in the world, in the past few decades, China has actively undertaken environmental responsibility and has taken practical actions to protect the common homeland of mankind. Xi Jinping, general secretary of the CPC Central Committee, proposed in 2017 the nineteenth National Congress of the Communist Party of China that China must establish and practice the concept that “beautiful scenery is treasury” and adhere to the basic state policy of conserving resources and protecting the environment.

In 2008, China’s State Environmental Protection Administration was upgraded to the Ministry of Environmental Protection, which became a component of the State Council, and was reorganized as the Ministry of Ecology and Environment in 2018. Through vertical management and political empowerment, China’s environmental protection agencies are more capable of supervising and punishing the pollution problems of enterprises. According to the study of Chen et al. [1], China’s vegetation growth rate accounted for 25% of global growth from 2000 to 2017, ranking first in the world. In addition, according to the data of the National Bureau of Statistics, the emission of major pollutants in China’s exhaust gas decreased significantly from 2011 to 2017, as shown in Figure 1. China has made remarkable achievements in theoretical guidance, government efforts, and responsibility implementation.
In the actual implementation of environmental protection, enterprises, as the first party responsible for environmental pollution, should bear more responsibility for environmental protection based on the principle of “Whoever pollutes, whoever governs”. However, in the period when the national awareness of environmental protection is generally low and the government’s environmental law enforcement is insufficient, it is easy for enterprises to evade environmental protection investment by legal or illegal means and obtain higher profits by damaging the environment.

In August 2011, Luliang chemical plant in Qujing City, Yunnan Province, illegally piled chromium slag containing highly toxic substances all year round, resulting in serious pollution in Xinglong Village, where the factory was located. As the harmless treatment of chromium slag cannot bring profits to enterprises, enterprises chose to discharge without permission, which caused huge environmental pollution problems.

Two factors faced by enterprises are the main reasons why they are not willing to take responsibility of environmental protection. First, in the market-oriented competition, if enterprises adopt environmental protection strategy, it is bound to reduce the efficiency of enterprises and increase costs. Therefore, enterprises tend to avoid environmental protection responsibilities, thus reducing their own resource pressure. In addition, there is a positive externality in environmental investment, that is, the whole society can benefit from the environmental protection behavior of enterprises, but the enterprises must bear a lot of human resources and financial costs, which leads to the lack of operational funds of enterprises and the loss of market competitiveness [2]. Second, polluting enterprises tend to induce local governments to relax the enforcement of environmental regulations through taxation and other means. At the same time, due to the complexity of environmental pollution monitoring, enterprises and local governments have the motivation to falsely report the environmental condition. To solve the above two problems, we need to systematically analyze the internal and external environment of enterprises, in order to explore the motivation and incentive factors of enterprises to adopt environmental strategy, and to provide implications to the government and enterprises.

The personal traits of board of directors, such as gender diversity, might be an effective tool addressing the problem that corporations’ unwillingness in environmental investment. Prior research has demonstrated that female directors significantly facilitate corporate prosocial behaviors and the boundary conditions at firm and industry levels [3]. However, previous study has not explored the boundary conditions from institution perspective.

By analyzing the environmental protection investment data of A-share listed companies in Shanghai and Shenzhen stock exchanges from 2008 to 2017, this paper reveals the impact of board trait on enterprise environmental strategy, that is, corporations with more
proportion of female boards will make more environmental investment. First, compared with men, female directors have stronger empathy and compassion, pay more attention to ethical problems including environmental problems, and actively take solutions. Second, compared with male directors, female directors tend to be more conservative in strategy making, and tend to abide by environmental regulation to avoid the potential policy and market risks.

In addition, the positive impact of female board directors on corporate environmental investment is strengthened by pollution level and legal development. When the region is highly polluted, the empathy of female directors will be further stimulated, and then they will pay more attention to the negative impact of environmental problems, and further promote the environmental-friendly behavior of enterprises. At the same time, compared with male directors, female directors tend to reduce the risks faced by enterprises by alleviating environmental pollution and meeting the environmental protection requirements of the government and the public in regions with high pollution levels. In terms of legal development, on the one hand, the regions with a high degree of legal development ensure that female directors’ attention to the environment is not interfered with by external forces. On the other hand, the strengthened degree of law enforcement also further promotes the risk aversion tendency of female directors, thus promoting the environmental protection investment of enterprises.

This paper makes an important theoretical contribution to the relevant literature on corporate environmental strategy. First, the study supports the theoretical view that female board representations facilitate corporate environmental strategy and explores the mechanism. Due to female board directors’ more empathy toward environmental issues and their trait of risk-aversion about environmental problems resulted from corporate activities, corporations with more female board members will adopt a higher degree of environmental strategy. Secondly, the study explores the contingent conditions of the impact of female board representations on corporate environmental strategy. This study finds that when institutional pressure from different sources changes, the degree of environmental strategy adoption of enterprises with more female board directors will change. Specifically, the pollution level and legal development positively moderate this effect. On the one hand, this study provides a solid theoretical basis for the study of the relationship between individual traits of enterprises and environmental strategy in China. On the other hand, by exploring the contingent conditions of the relationship, this study fills the gap in the exploration of contingent conditions of the relationship.

This work has important managerial value and guiding significance to the government and enterprises. Different from directly exerting pressure on enterprises, the government can indirectly promote enterprises to adopt environmental strategy by promoting the diversification of enterprise board of directors or deepening the way of local government promoting the development of the legal system. On the one hand, policymakers should encourage the board of directors to absorb a certain number of female directors, enhance the board’s sense of empathy and social responsibility, and then promote the environmental strategic investment of enterprises. On the other hand, the government’s legal construction helps to create a fair local business environment, increase the influence of female directors on corporate strategic decision-making, and then play the role of female directors in promoting corporate environmental protection behavior.

Enterprises can realize the differentiation of companies and products, establish a good public image, and finally achieve a competitive advantage through environmental strategy. Specifically, enterprises should take the initiative to increase the diversity of the board of directors and attract more female directors to the board of directors, so as to expand the scope of vision of enterprise strategy formulation. Compared with male directors, female directors can pay more attention to the long-term return of corporate environmental strategy, reduce the risk of environmental pollution caused by opportunistic behavior, and help enterprises integrate environmental protection into enterprise and product publicity, so as to obtain the recognition of consumers and finally gain and maintain the dominant
position in the market. For example, Zhuhai Gree Electric Appliance Co., Ltd. ranks 48th in the Chinese corporate social responsibility 500 excellence list in 2019, far surpassing its main competitor Midea Group Co., Ltd. in 115th place. Ms. Dong Mingzhu, chairman of Gree Electric appliances, played a crucial role in this achievement.

2. Literature Review

2.1. The Determinants of Corporate Environmental Strategy

Enterprise environmental strategy is a hot topic in recent years. Scholars usually explore different motivations for enterprises to adopt environmental strategies from the perspectives of institutional theory, stakeholder theory, and resource-based view [4].

Institutional pressure usually promotes corporate environmental strategy through regulatory and social pressure. Regulatory pressure, on one hand, stands for the pressure from central and local governments. Since the government is the main driver of corporate environmental practices [5,6], regulatory pressure, therefore, becomes the central pressure that requires companies to adopt environmental actions. The basic logic is that corporates are unwilling to invest in environmental actions because they consider it benefits society more than themselves. Therefore, it is the government’s responsibility to force or encourage them to adopt environmental strategy through legitimacy [4] and resource [7]. Following the logic of legitimacy, Wang Wijen, and Heugens [8] explore this topic by segmenting the Chinese government into multiple levels and support that the influence from the government is actually heterogeneous because of conflicting objectives between the central and local governments. Following the logic of resource, however, Lin and Ho [7] prove that government support will motivate companies’ environmental strategies.

Social pressure, on the other hand, comes from media and public organizations. The mechanism of social pressure follows the legitimation logic of regulatory pressure, that is, managers have to pay much attention to the environmental information, which helps the companies to adopt proactive environmental strategies to obtain social legitimacy [9]. However, following the idea of stakeholder theory, some scholars propose that social pressure, an indirect influence on the companies, may have a limited impact on corporate environmental strategies in Chinese background [10]. These conflicting results may come from the heterogeneous institutional development in time and space, and future research can explain the conflicting results.

From the perspective of stakeholder theory, stakeholders can influence the company’s decisions [11,12], therefore they are also considered as one of the motivations for enterprises to adopt environmental protection strategies [13]. Scholars have found that different stakeholders have different influences on the environmental behavior of enterprises [14]. The stakeholders who can have a direct impact on enterprises and decide the survival of enterprises are called primary stakeholders (such as consumers, suppliers, and government). However, secondary stakeholders (secondary stakeholders) indirectly influence enterprises through other major stakeholders (such as media and NGOs) [15]. In order to meet the needs of key stakeholders to obtain vital resources, enterprises must adopt positive environmental strategies [16]. Specifically, the pressure from domestic or international consumers, suppliers, competitors, and governments forces enterprises to conduct more environmental behaviors [17,18].

Based on the resource-based view, scholars believe that enterprises will take advantage of the existing resources to adopt environmental strategies, so as to achieve a competitive advantage [19]. Since environmental protection has become the common understanding of human beings, adopting environmental strategy can enhance the ecological efficiency of enterprises, and then enhance the competitiveness of enterprises in the market. In addition, when enterprises are faced with environmental uncertainty, their resources and capabilities will prompt them to adopt positive environmental strategies to predict future events and take countermeasures [20].

Although the research on antecedents of corporate environmental strategy has been paid attention to by academic circles, previous studies usually ignore the influence of
board members on corporate environmental strategy [21], and lack of discussion on how board members design and implement a corporate environmental strategy under different institutional backgrounds.

2.2. The Impact of Individual Traits

As a relatively new mechanism, upper echelons theory bridges the research gap that individuals are sometimes overlooked in the literature of institutional theory [21]. Since the theory itself is still heat in recent years, current literature has only revealed a limited picture of CEOs’ influence on corporate environmental strategies. Other theories may have mentioned the importance of managers’ cognition towards environmental issues, yet upper echelons theory focuses on the critical minority who can influence the firm with their great power. Following the critical work of Hambrick [22], CEOs’ individual characteristics have been tested in the literature of corporate environmental strategy. In the following paragraph, the characteristics including CEOs’ power, political ideology, and educational background will be discussed.

CEOs’ power is the essence of the mechanism since their other characteristics will have no impact if they cannot make orders. Specifically, if CEOs have a full understanding of environmental problems and the know-how to solve them, they will result in better adoption of a corporate environmental strategy to the company with their formal and informal power [23]. Based on this logic, the work of Chin, et al. [24] has demonstrated that Democratic CEOs will emphasize CSR more than will republican ones because it is Democrats’ common appeal that the environment should be protected, and the CEOs will be consistent with this idea and enhance the adoption of corporate environmental actions. In addition, CEOs’ educational background is also tested in the literature [25]. The paper explains that a CEO with an MBA degree is more skilled in strategic decision making and will present higher risk-taking behaviors compared with ones that are lawyers.

Although the individual characteristics of CEOs have been primarily revealed by scholars, the influence of other characteristics of CEOs, and the characteristics of the top executive team and board directors are equally important yet unrevealed. Besides the focus on CEOs, it is also necessary to shed light on board directors’ influence because the power of CEOs might be limited if they are not entitled to enough managerial discretion [22].

2.3. The Impact of Board Gender Diversity

Prior research has examined the effects of gender diversity issues from the perspective of agency theory and stakeholder theory. First, scholars based on agency theory has revealed that board gender diversity has a positive impact on integrated reporting quality [26] and intellectual capital disclosure quality [27]. Since female board directors are more likely to pay attention to sustainable issues, corporations with more female board directors will hence improve disclosure quality [26].

Second, from the perspective of stakeholder theory, scholars have also examined the effects of board gender diversity on greenhouse gas disclosure [28], environmental, social and governance disclosure [29], and human capital disclosure [30]. Female board directors, compared with male ones, are considered to be more sensitive about life quality improvement than worldly success [28]. Following this social pressure, female board directors tend to initiate corporate environmental strategy based on their characteristics.

Furthermore, prior study has examined the relationship between board gender diversity and corporate social responsibility (CSR). Board gender diversity has a positive impact on corporate voluntary climate change disclosure because of female board directors’ more concerns about business ethics than male ones [31]. Board gender diversity can also improve corporate social performance by female board directors’ initiating empathetic behaviors [32].

To conclude, the traits of female board directors facilitate the disclosing behaviors and quality of corporations. In the following section, we will propose the potential relationship between female board directors and corporate environmental investments, as well as the
contingent factors of the relationship. The conceptual model of this study is presented in Figure 2.

![Conceptual Model](image)

**Figure 2. Conceptual Model.**

3. Theory and Hypotheses

We propose that female board directors will facilitate corporate environmental strategy. First, enterprises with a higher proportion of female directors are more likely to notice the negative impact of corporate pollution on the environment, so they are more motivated to adopt environmental strategies. When the proportion of female members in the board of directors increases, the impact of female directors on corporate strategy is enhanced. Because women are inherently more selfless and more concerned about others than men, companies with a high proportion of female directors are more likely to pay attention to the negative impact of corporate behavior on the external environment [33]. Specifically, during the meeting of the board of directors, female directors are more likely to put relieving the pressure of stakeholders into the discussion agenda, thus prompting the board to pay more attention to the handling of stakeholder relations [34]. The characteristics of female directors help enterprises pay attention to their own behavior on the environment and then promote enterprises to take action to solve environmental problems, that is, to adopt environmental strategy.

Second, compared with male directors, female directors will pay more attention to risk control in the process of corporate strategy formulation, so they will pay more attention to government regulation and public attention, and then take environmental strategies to avoid administrative punishment and reputation loss caused by corporate pollution. Previous studies have shown that women are less confident than men, so they are more risk-averse in corporate strategy and decision-making [33]. Due to the pressure from the government, the public, and other stakeholders in the business process, the immoral behavior (such as environmental pollution) of enterprises will be punished by all stakeholders, such as the decline of government subsidies, environmental pollution fines, corporate reputation damage, and consumer loss. In the face of this situation, the female board of directors is more inclined to predict and take measures to avoid these risks in advance, so it will urge enterprises to adopt environmental strategies.

To sum up, corporations with a high proportion of female board directors will adopt a higher degree of environmental strategy because of female directors’ trait of stakeholder-communicating and risk-aversion. Based on this inference, this paper puts forward the following hypotheses:

**Hypothesis 1.** There is a positive relationship between female board directors and corporate environmental investment.
We propose that the pollution level strengthens the positive impact of female board directors on corporate environmental strategy. First, in areas with high pollution levels, environmental pollution and destruction can further stimulate the empathy and sense of responsibility of female directors of enterprises, and can more actively promote the interaction between enterprises and stakeholders, so as to increase the degree of environmental strategy adopted by enterprises. In areas with a high degree of environmental pollution, female directors are more likely to be directly exposed to the impact of corporate activities on the environment. Because female directors are more empathic and selfless than male directors, they are more likely to care about the negative impact of environmental pollution on the community and society, and thus produce negative emotions. In order to alleviate their own sense of guilt and enhance the legitimacy of enterprises, women’s boards of directors actively promote the environmental protection behavior of enterprises, that is, they require enterprises to adopt a higher degree of environmental strategy.

Second, in areas with high pollution level, due to the increasing environmental pressure of stakeholders, women’s boards of directors further force enterprises to adopt environmental strategies to reduce potential environmental risks. The improvement of pollution level will lead to the local government and the public’s perception of environmental protection. When the pollution level rises to a certain level, the government and the public will take positive efforts to force enterprises to take environmental protection actions, so as to improve the environment. Compared with male directors, female directors are more sensitive to stakeholders such as the government and the public. They will actively encourage enterprises to adopt environmental strategies to avoid potential government environmental fines and public criticism of enterprises, so as to reduce the risk of huge losses.

To conclude, pollution level strengthens the positive impact of female board directors on corporate environmental strategy, because female directors are more empathetic towards environmental problems and more sensitive towards stakeholder pressure. Thus, we propose that:

**Hypothesis 2.** For firms in regions with higher pollution level, the positive relationship between female board directors and corporate environmental investment is strengthened.

We predict that legal development strengthens the positive relationship between female board members and corporate environmental strategy. First, legal development can ensure that female directors’ attention to environmental issues is not disturbed, thus promoting enterprises to adopt environmental strategies. Legal development can improve the local market environment, and then promote enterprises to abide by the rules and fair competition [35]. In this case, the value of female directors being good at dealing with stakeholder relationship can be reflected, because female directors are not easily affected by other directors’ short-term income goals. Due to the existence of female directors, enterprises are more likely to actively relieve the pressure of stakeholders in areas with high legal development, so they will adopt a higher degree of environmental strategy.

Second, the development of law strengthens the degree of regional law enforcement, further promotes the risk aversion tendency of female directors, and therefore enhances the degree of enterprises adopting environmental strategies. In areas with a high degree of law development, the law enforcement ability of regulatory authorities is stronger [36]. Enhanced law enforcement increases the institutional pressure on enterprises. If enterprises cause environmental pollution problems, it will be difficult to escape the government’s punishment [35]. At the same time, the public’s tolerance of environmental problems of enterprises is lower in areas with a high degree of legal development. In this case, the behavior of enterprises will always be subject to public supervision. When enterprises pollute the environment, they are more likely to be perceived by the public, which will lead to the damage of enterprise reputation and the decline of market competitiveness [37]. Faced with the above two risks, female directors are more motivated than male directors to avoid possible losses by forcing enterprises to adopt environmental strategies.
In summary, legal development strengthens the positive impact of female board directors on corporate environmental strategy, because female directors can get rid of other factors while facilitating corporate environmental strategy and have to reduce risks under strong legal monitoring. Thus, we propose that:

**Hypothesis 3.** For firms in regions with a higher level of legal development, the positive relationship between female board directors and corporate environmental investment is strengthened.

### 4. Methods

#### 4.1. Sample and Data Collection

Our sample covers Chinese A-share listed manufacturing companies on the Shanghai and Shenzhen Stock Exchanges in the period between 2008 and 2017. To test the causal relationship, we employ a one-year lag for the independent variables in the models (2008–2016). We exclude firms labeled as ST or *ST because these firms are facing a potential risk to be delisted by the two stock exchanges. We also drop missing values during the time period from our data. Finally, we obtain a sample of 3174 firm-year observations from 463 listed companies, classified by the three-digit Chinese Industry Code.

We manually collect the dependent variable, Corporate environmental investment, from the appendices of firms’ annual reports. For individual-, firm-, and industry-level variables, following prior research [38], we use the China Stock Market and Accounting Research Database (CSMAR) to gain the necessary data. We downloaded the provincial data, pollution level, from China Statistical Yearbook. Besides, the information on legal development came from the National Economic Research Institute (NERI) that provides marketization indexes of all 31 provinces in China. All detailed measures are listed in Table 1.

#### Table 1. Measurement table.

| Variable                          | Measurement                                                                                                                                 |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| **Dependent Variable**           |                                                                                                                                          |
| Corporate Environmental Investment | The corporate environmental investment of listed companies from 2008 to 2017 is manually collected from the annual reports of listed companies, and the results are taken as a natural logarithm. |
| **Independent Variable**         |                                                                                                                                          |
| Female Board Directors           | The proportion of female directors in the total number of directors.                                                                       |
| **Moderators**                   |                                                                                                                                          |
| Pollution Level                  | Standardized average emission of waste gas, wastewater, and waste solid in each province.                                                |
| Legal Development                | A sub-index of NERI. It is measured by the average ratings of the development of market intermediaries, the legal environment of the market, and the protection of intellectual property. |
| **Control Variables**            |                                                                                                                                          |
| CEO Duality                      | If the CEO and chairman are the same people, the variable is recorded as “1”, otherwise recorded as “0”.                                   |
| Firm Size                        | The natural logarithm of the number of employees.                                                                                           |
| Ownership Concentration          | The years since a corporation is established.                                                                                              |
| State Ownership                  | The shareholding ratio of the largest shareholder.                                                                                           |
| Industry Growth Rate             | According to the judgment of the ultimate controllers of listed companies. State-owned enterprises are recorded as “1” and private-owned enterprises as “0”. |
| Industrial Competition           | The growth rate of the average annual income of the industry compared with the previous year.                                               |
|                                  | 1 minus the Herfindahl index, in which Herfindahl index is the proportion of the company’s operating revenue to the market share of its industry. |

#### 4.2. Measure

We present the measures of the variables used in our study in Table 1.

Dependent Variable. Referring to previous studies [39,40], this paper manually collected the annual corporate environmental investment from the “notes to financial statements” and “environmental protection tax” in the annual report of enterprises. If the enterprise’s expenditure indicates “environmental protection”, “greening fee”, “sewage fee”, “mineral resources compensation fee” or “environmental protection tax” and other descriptions related to environmental protection, the expenditure is regarded as environ-
mental protection investment. The environmental protection investment of the enterprise in that year was summed up and then logarithmized.

Independent Variable. Following prior research, we measure female board directors by the ratio of the number of female directors to the number of all directors [33].

Moderators. First, we measure the pollution level by the average standardized coefficient of wastewater, waste gas, and waste solid produced in each province in that year [41].

Second, we measure legal development by using the NERI sub-index. Specifically, we use the average ratings of the development of market intermediaries, legal environment of the market, and the protection of intellectual property [35].

Control Variables. We control variables at individual, firm, and industry levels to control the impact of them on the dependent variable. At the individual level, we control CEO duality, measured by using a dummy variable that is coded as “1” if CEO and chairman are the same people, and “0” otherwise [42].

At the firm level, we control firm size and firm age by using the natural logarithm of the number of employees [43] and the years since a corporation is established [44], respectively. Moreover, we control ownership concentration by using the shareholding ratio of the largest shareholder. Finally, we control state ownership by the ultimate controllers of listed corporations. We code state-owned enterprises as “1” and private-owned enterprises as “0” [45].

At the industry level, we control industry growth rate and industrial competition. The industry growth rate is measured by using the growth rate of the average annual income of the industry compared with the previous year [43]. Industrial competition is measured by using 1 minus the Herfindahl index, in which the Herfindahl index is the proportion of the company’s operating revenue to the market share of its industry [35].

5. Results
5.1. Empirical Models
In this paper, OLS regression is used to test the hypothesis. This study includes 27 three-digit industry code dummy variables and 8-year dummy variables. In addition, we centralize all independent variables and moderators when generating cross multiplicative terms [46]. Stata 15.0 was used as the software for regression analysis. The correlation table is presented in Table 2.

In order to test multicollinearity, the variance expansion factors (VIFS) of each variable are calculated. All the variance expansion factors of variables ranged from 1.14 to 1.71, which was far lower than the usual critical standard of 10.0. In addition, according to the correlation coefficient table, the correlation coefficients between the variables are lower than 0.4. Both results prove that there is no multicollinearity problem in this study [47].

The regression coefficient and standard error of each variable are shown in Table 3. Model 1 includes only control variables. Model 2 includes independent variables and control variables. Model 3 contains the interaction between female board members and pollution level. Model 4 contains the interaction between female board members and legal development. Model 5 is a total model with all independent variables and interactions.
Table 2. Descriptive statistics.

| Panel A: DV & IV                  | Mean    | Std. Dev. | Median | Min | Max | No. of Obs. |
|----------------------------------|---------|-----------|--------|-----|-----|-------------|
| Corporate environmental investment | 9.62    | 7.10      | 13.40  | 0   | 19.40 | 3174        |
| Female board directors           | 0.12    | 0.11      | 0.11   | 0   | 0.6  | 3174        |

Panel B: Moderators

|                    | Mean    | Std. Dev. | Median | Min | Max | No. of Obs. |
|--------------------|---------|-----------|--------|-----|-----|-------------|
| Pollution Level    | 0.56    | 0.90      | 0.42   | −1.34 | 2.23 | 3174        |
| Legal development  | 7.47    | 4.97      | 5.84   | −0.70 | 20.61 | 3174        |

Panel C: Control variables

|                      | Mean    | Std. Dev. | Median | Min | Max | No. of Obs. |
|----------------------|---------|-----------|--------|-----|-----|-------------|
| CEO Duality          | 0.21    | 0.41      | 0      | 0   | 1   | 3174        |
| Firm Size            | 7.88    | 1.19      | 7.90   | 1.10 | 11.59 | 3174        |
| Firm Age             | 14.62   | 5.09      | 15     | 1   | 35  | 3174        |
| Ownership Concentration | 36.35 | 14.84      | 35.38  | 3.89 | 95.1 | 3174        |
| State Ownership      | 0.05    | 0.14      | 0      | 0   | 0.84 | 3174        |
| Industry Growth Rate | 0.00    | 0.02      | −0.00  | −0.07 | 0.13 | 3174        |
| Industrial Competition | 0.79 | 0.27       | 0.91   | 0   | 1   | 3174        |

Table 3. Correlations.

| Variable                  | 1    | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  |
|---------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. Corporate Environmental Actions\textsubscript{t+1} | 1.00 |     |     |     |     |     |     |     |     |     |     |
| 2. Female board directors\textsubscript{t} | 0.04* | 1.00 |     |     |     |     |     |     |     |     |     |
| 3. Provincial pollution level\textsubscript{t} | 0.00 | 0.10** | 1.00 |     |     |     |     |     |     |     |     |
| 4. Legal development\textsubscript{t} | −0.06** | 0.16** | 0.24** | 1.00 |     |     |     |     |     |     |     |
| 5. CEO duality\textsubscript{t} | 0.01 | 0.08** | 0.06** | 0.17** | 1.00 |     |     |     |     |     |     |
| 6. Firm size\textsubscript{t} | 0.22** | −0.11** | −0.06** | −0.14** | −0.17** | 1.00 |     |     |     |     |     |
| 7. Firm age\textsubscript{t} | 0.02 | 0.00 | −0.02 | 0.02 | −0.07** | 0.13** | 1.00 |     |     |     |     |
| 8. Ownership concentration\textsubscript{t} | 0.09** | −0.07** | −0.06** | −0.01 | −0.08** | 0.18** | −0.16** | 1.00 |     |     |     |
| 9. State ownership\textsubscript{t} | 0.05** | −0.10** | −0.14** | −0.18** | −0.13** | 0.16** | −0.05** | 0.17** | 1.00 |     |     |
| 10. Industry growth rate\textsubscript{t} | 0.02 | 0.03 | −0.07** | 0.02 | −0.01 | 0.01 | 0.05** | −0.02 | 0.04 | 1.00 |     |
| 11. Industrial competition\textsubscript{t} | −0.02 | 0.01 | −0.02 | 0.05** | −0.03 | −0.05* | 0.00 | −0.02 | −0.01 | 0.03 | 1.00 |
| Mean                      | 9.62 | 0.12 | 0.56 | 7.47 | 0.21 | 7.88 | 14.62 | 36.35 | 0.05 | 0.00 | 0.79 |
| Std. Dev.                 | 7.10 | 0.11 | 0.90 | 4.97 | 0.41 | 1.19 | 5.09 | 14.84 | 0.14 | 0.02 | 0.27 |

* p < 0.05, ** p < 0.01, two-tailed test.
5.2. Regression Results

Hypothesis 1 suggests that corporations with a high proportion of female board directors will adopt a higher degree of environmental strategy. From the results of Model 2, we can see that female board directors have a significant negative impact on Enterprise Environmental Strategy ($b = 3.92; p < 0.01$). Model 5 also verifies the significant negative impact of enterprise nature on Enterprise Environmental Strategy ($b = 2.87; p < 0.05$), thus verifying Hypothesis 1.

Hypothesis 2 points out that for firms in regions with higher pollution level, the positive relationship between female board directors and corporate environmental investment is strengthened. In model 3, the coefficient of the interaction between female board directors and corporate environmental investment is significantly positive ($b = 6.14; p < 0.01$). The coefficient of the interaction is also significant in Model 5 ($b = 5.63; p < 0.01$), which supports Hypothesis 2.

Hypothesis 3 proposes that for firms in regions with a higher level of legal development, the positive relationship between female board directors and corporate environmental investment is strengthened. The results show that the coefficient of interaction between female board directors and legal development is significantly positive in model 4 ($b = 0.60; p < 0.01$), and also significantly positive in Model 5 ($b = 0.43; p < 0.05$), therefore Hypothesis 3 is verified.

5.3. Robustness Test

We replace legal development with a reversed variable, regional corruption, to examine the robustness of the main results because regional corruption is negatively associated with legal development. We measure regional corruption by the ratio of the number of corruption, bribery, and malfeasance cases registered in each province in that year to the number of local civil servants (cases per 10,000 people), and the results are taken with logarithm [48].

The robustness test results are shown in Table 4. The results of Model 2 illustrate that female board directors have a significantly positive impact on corporate environmental investment ($b = 3.82; p < 0.01$). Model 5 also presents a positive relationship between female board directors and corporate environmental investment ($b = 3.07; p < 0.01$), thus supporting Hypothesis H1. From the results of model 3, the coefficient of interaction between female board directors and pollution level is significantly positive ($b = 5.97; p < 0.01$), and Model 5 shows the same results ($b = 6.11; p < 0.01$), which supports Hypothesis 2. The results of Model 4 shows that the coefficient of interaction between female board directors and legal development is marginally significant ($b = -0.32; p < 0.10$), and it is significantly negative in Model 5 ($b = -0.37; p < 0.05$), supporting Hypothesis H3.

The results of the above robustness test are basically consistent with the results of the original model, which proves that the results of this paper have passed the robustness test and the regression results are reliable (Table 5).
Table 4. Regression analysis for corporate environmental investment.

| Control Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|-------------------|---------|---------|---------|---------|---------|
| CEO duality \(t\) | 1.15**  | 1.09**  | 1.18**  | 1.12**  | 1.20**  |
| (0.31)            | (0.31)  | (0.31)  | (0.31)  | (0.31)  | (0.31)  |
| Firm size \(t\)  | 1.10**  | 1.12**  | 1.12**  | 1.12**  | 1.11**  |
| (0.11)            | (0.11)  | (0.11)  | (0.11)  | (0.11)  | (0.11)  |
| Firm age \(t\)   | -0.07*  | -0.07** | -0.07*  | -0.07*  | -0.07*  |
| (0.03)            | (0.03)  | (0.03)  | (0.03)  | (0.03)  | (0.03)  |
| Ownership concentration \(t\) | 0.02†  | 0.02†  | 0.02†  | 0.02†  | 0.02†  |
| (0.01)            | (0.01)  | (0.01)  | (0.01)  | (0.01)  | (0.01)  |
| State ownership \(t\) | 1.18  | 1.24  | 1.02  | 1.16  | 0.98  |
| (0.92)            | (0.92)  | (0.92)  | (0.92)  | (0.92)  | (0.92)  |
| Industry growth rate \(t\) | -4.70  | -4.98  | -5.53  | -4.88  | -5.42  |
| (6.58)            | (6.57)  | (6.55)  | (6.56)  | (6.54)  |         |
| Industrial competition \(t\) | -0.03  | -0.04  | -0.07  | -0.02  | -0.06  |
| (0.47)            | (0.47)  | (0.47)  | (0.47)  | (0.47)  | (0.47)  |
| Industry and Year dummy | Yes | Yes | Yes | Yes | Yes |

Independent Variables

| Pollution level \(t\) | 0.25†  | 0.23  | 0.28†  | 0.22  | 0.27†  |
| (0.14)            | (0.14)  | (0.14)  | (0.14)  | (0.14)  | (0.14)  |
| Legal development \(t\) | -0.02  | -0.03  | -0.04  | -0.04  | -0.03  |
| (0.03)            | (0.03)  | (0.03)  | (0.03)  | (0.03)  | (0.03)  |
| H1: Female board directors \(t\) | 3.92** | 3.23** | 3.35** | 2.87*  |         |
| (1.15)            | (1.15)  | (1.16)  | (1.16)  |         |         |
| Interactions

| H2: Female board directors \(t\) × Provincial pollution level | 6.14**  | 5.63**  |
| (1.30)            | (1.32)  |
| H3: Female board directors \(t\) × Legal development | 0.60**  | 0.43*  |
| (0.21)            | (0.21)  |
| F                | 12.08  | 12.11  | 12.42  | 12.05  | 12.25  |
| R²               | 0.140  | 0.143  | 0.149  | 0.145  | 0.150  |
| N                | 3174   | 3174   | 3174   | 3174   | 3174   |

Table 5. Robustness test: replacing legal development with regional corruption.

| Control Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|-------------------|---------|---------|---------|---------|---------|
| CEO duality \(t\) | 1.10**  | 1.04**  | 1.12**  | 1.01**  | 1.09**  |
| (0.20)            | (0.30)  | (0.30)  | (0.30)  | (0.30)  | (0.30)  |
| Firm size \(t\)  | 1.12**  | 1.14**  | 1.14**  | 1.14**  | 1.14**  |
| (0.11)            | (0.11)  | (0.11)  | (0.11)  | (0.11)  | (0.11)  |
| Firm age \(t\)   | -0.07** | -0.07** | -0.07*  | -0.07*  | -0.07*  |
| (0.03)            | (0.03)  | (0.03)  | (0.03)  | (0.03)  | (0.03)  |
| Ownership concentration \(t\) | 0.01†  | 0.02†  | 0.02†  | 0.02†  | 0.02†  |
| (0.01)            | (0.01)  | (0.01)  | (0.01)  | (0.01)  | (0.01)  |
| State ownership \(t\) | 1.26  | 1.34  | 1.15  | 1.32  | 1.11  |
| (0.92)            | (0.92)  | (0.92)  | (0.92)  | (0.92)  | (0.92)  |
| Industry growth rate \(t\) | -4.64  | -4.88  | -5.38  | -4.88  | -5.05  |
| (6.58)            | (6.57)  | (6.55)  | (6.57)  | (6.54)  |         |
| Industrial competition \(t\) | -0.05  | -0.04  | -0.07  | -0.03  | -0.06  |
| (0.47)            | (0.47)  | (0.47)  | (0.47)  | (0.47)  | (0.47)  |
| Industry and Year dummy | Yes | Yes | Yes | Yes | Yes |

Independent Variables

| Pollution level \(t\) | 0.21  | 0.18  | 0.22  | 0.18  | 0.22  |
| (0.14)            | (0.14)  | (0.14)  | (0.14)  | (0.14)  | (0.14)  |
| Regional corruption \(t\) | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  |
| (0.02)            | (0.02)  | (0.02)  | (0.02)  | (0.02)  | (0.02)  |
| H1: Female board directors \(t\) | 3.62** | 3.11** | 3.00** | 3.07** |
| (1.14)            | (1.15)  | (1.14)  | (1.15)  | (1.15)  |
| Interactions

| H2: Female board directors \(t\) × Provincial pollution level | 5.97**  | 6.11**  |
| (1.30)            | (1.30)  |
| H3: Female board directors \(t\) × Legal development | -0.32†  | -0.37*  |
| (0.19)            | (0.19)  |
| F                | 12.11  | 12.13  | 12.41  | 11.93  | 12.23  |
| R²               | 0.140  | 0.143  | 0.149  | 0.144  | 0.150  |
| N                | 3174   | 3174   | 3174   | 3174   | 3174   |

Standard errors in parentheses, † p < 0.10, * p < 0.05, ** p < 0.01, two-tailed test.
6. Discussion and Conclusions

6.1. Conclusions

Gender diversity in the board of directors has potential benefits to the operation of corporations [31]. Currently, female board directors suffer discrimination from male ones under many circumstances. For example, Tokyo Olympics chief Yoshiro Mori complained that board meetings with too many female board members will lower the efficiency of the meetings. However, under much pressure from stereotype and stigma, female board directors have significantly positive influence on corporate performance, especially in the domain of corporate ethics.

This project focuses on the role of female directors in environmental protection investment and its boundary conditions. Compared with male directors, female directors pay more attention to the external influence of corporate behavior, thus promoting enterprises to actively adopt environmental strategies. In addition, compared with men, female directors can pay more attention to the long-term strategic return of the enterprise, reduce the opportunistic behavior of the enterprise, and promote the enterprise to realize the long-term benefits brought by the environmental strategy, and finally promote the enterprise to make environmental protection investment. At the same time, the project also attempts to explore the regulatory role of the degree of regional pollution and the development of the regional legal system.

6.2. Theoretical Contributions

This work has important implications and guiding significance for the government and enterprises. In the context of emerging countries, corporate board diversification is often ignored by business owners. For the government, compared with directly exerting environmental protection pressure on enterprises, they can enhance the empathy and social responsibility of enterprises by promoting the board of directors to absorb more female directors, so as to promote the environmental strategic investment of enterprises. On the other hand, the government should actively promote the development of the legal system, optimize the business environment, help female directors to eliminate the interference of other factors, and focus on dealing with the relationship between stakeholders, so as to promote enterprises to adopt environmental strategies.

6.3. Managerial Implications

This paper also has managerial implications for enterprises. Specifically, enterprises should take the initiative to improve the degree of diversification of the board of directors and absorb more female directors into the board of directors, so as to reduce the risk related to stakeholders in enterprise operation. Compared with men, female directors pay more attention to the relationship between enterprises and stakeholders, reduce the government punishment and public pressure brought by enterprises’ pollution behavior, help enterprises integrate environmental protection into enterprise and product publicity, so as to obtain public recognition, and finally obtain and maintain the dominant position in the market.

6.4. Limitations and Future Research Research Ideas

This study has several limitations and related future research directions. First, since only listed companies disclose the financial statements audited by the third party, this paper selects A-share manufacturing companies listed on Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE). In view of the fact that enterprises must meet some requirements of the stock exchange before they can be approved for listing, the sample selected in this paper has certain limitations, and it is difficult to represent the environmental protection strategy choice of unlisted small and medium-sized enterprises (SMEs). Future research can focus on the background of SMEs.

Second, this research has not examined the contingent factors at firm and industry level. In addition to institutional factors, the strategic decisions made by board directors
may also be influenced by firm and industry factors. For example, the expected financial performance and industrial competition may have significant impact on the relationship between female board directors and corporate environmental investment. Future research may further examine the contingent factors at these two levels.

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