# Corporate Environmental Disclosures and the Cost of Equity Capital: Evidence from the High-Polluting Chinese Listed Firms

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***Abstract:*** *As global environmental pollution increases, it has great significance to explore the economic value relevance of environmental disclosure of the polluting firms, especially in emerging markets such as China. From the perspective of the capital market, we explore whether corporate environmental disclosure will reduce the cost of equity capital based on the sample data of Chinese listed companies in the most polluting industries. We find that environmental disclosure can reduce information asymmetry, help companies build a good image, obtain stronger legitimacy and identity, and ultimately reduce investors' risk-reward requirements. Further, we also find that due to differences in information determination, exposure levels, and investor demand, the negative impact of corporate environmental disclosure on the cost of equity capital will be stronger when a company has a high monopoly power or the industry is highly competitive. The conclusions of this study help to enhance the understanding of the economic consequences of corporate environmental disclosure in emerging markets, enrich research results in related fields and promote polluting companies to more actively improve the quality of environmental disclosure.*

***Keywords:*** *environmental disclosure; the cost of equity capital; corporate monopoly power; industry competition*

## 1. Introduction

The "Global Risk Report 2019" published by the World Economic Forum shows that environmental-related risks are more urgent among all risks and need to be paid attention to and resolved urgently. As global environmental issues become more prominent, countries around the world have gradually taken environmental governance as an important part of national development, such as China. The Chinese central government has implemented a series of environmental protection administration and economic incentives. For example, the"Environmental Protection Law of PRC"and the"Law of PRC on Prevention and Control of Atmospheric Pollution"were revised in 2015; the central government's environmental protection inspection team conducted inspections in various provinces from 2016; Enterprises will be levied environmental protection tax from 2018.

As the main organization of social production and resource consumption, enterprises are the main producers of pollution and need to fulfill environmental responsibilities. Stakeholders pay more attention to the environmental risks, and this means except pursuing economic benefits, companies need to take environmental protection into consideration and disclosure relevant information to fulfil stakeholders' requirement. Up to now, some scholars have studied the economic consequences of environmental disclosure, such as corporate financial performance (Qiu, Shaukat & Tharyan, 2016), corporate value (Clarkson, Fang, Li, & Richardson, 2013; Plumlee, Brown, Hayes, & Marshall, 2015), earnings forecasts (Aerts, Cormier & Magnan, 2008), stock price (Lorraine, Collison & Power, 2004), and so on. However, the current research on the impact of environmental disclosure on the cost of capital has not reached a consistent conclusion (Hea, Tangb & Wanga, 2013), and particularly lack valid conclusions and empirical evidence in emerging markets like China. We will conduct supplementary research on this.

Capital is the foundation of a company's survival, and the cost of capital is a key factor affecting firm value (Dhaliwal, Li, Tsang, & Yang, 2011). It means that the strength of an enterprise's financing ability largely determines its business investment activities. Moreover, due to the lack of a sound formal institutional foundation, the capital markets of less-developed countries are more special than developed countries in the West. This study will use Chinese listed polluting companies as a sample to study whether environmental disclosure will affect corporate equity capital costs, what role they

play, and how much value relevance they have in emerging markets.

However, we all know that information asymmetry often exists between companies and external investors, especially in relatively incomplete capital markets. The environmental information reflects the environmental safety situation of the company's operating process and has a very important role. In general, on the one hand, this may help alleviate the information asymmetry between companies and external investors. On the other hand, based on resource-based theory and voluntary disclosure theory, high-quality environmental disclosure can help companies improve their business image and win the favor of external investors and other intermediaries. Therefore, from the perspective of information increment and affective tendencies, we believe that corporate environmental disclosure will help companies obtain equity financing from the capital market at a lower cost. In addition, we believe that this effect will be affected by the characteristics of enterprises and industries.

Compared with the existing literature, the main contributions of this study are: (1) Under the background of China's green development and economic transition, we study the value relevance of the environmental disclosure of China's most polluting enterprises in combination with specific institutional scenarios, provide more empirical evidence about the economic consequences of environmental disclosure in more dimensions, and help to understand better the investor ’s behavioral logic and trading mechanisms in emerging markets; (2) Considering the differences in information release paths, exposure levels and investor concerns of different companies, we further test the impact of individual corporate characteristics (monopoly power) and industry characteristics (industry competition) on the role of environmental information in the capital market. This corroborates the basic logic of the foregoing and further enriches the research and deepens the understanding of investor behavior.

The follow-up arrangement is as follows: the second part is theoretical analysis and research Hypothesis, combined with relevant literature to conduct theoretical analysis and put forward the research specific Hypothesis; the third part is data source and research design, select data samples and define relevant variables, and construct regression models; the fourth part is the empirical result analysis, report the main data analysis results; the last is the conclusion and inspiration, summarize the research results of this study and look forward to the follow-up research.

## 2. Theoretical analysis and research assumptions

2.1 Corporate environmental disclosures and the cost of capital

Information disclosure is one of the most basic institutional arrangements in the capital market. Information disclosure of listed companies mainly includes financial information disclosure and non-financial information disclosure. With the continuous development of the capital market, not only financial information disclosure, but the non-financial information disclosure is also a hot topic in the research field related to the company. At present, the Chinese government's environmental control measures have become stricter, citizens' environmental awareness has been greatly improved, and the need and attention for corporate environmental information have become more intense and sensitive. Therefore, it is very important for enterprises to disclose non-financial information about environmental impacts and environmental governance measures in their production and operation processes, and it is the main way to meet the information needs of stakeholders, especially for the high-polluting enterprises. Based on existing research (Dhaliwal, Li, Tsang, & Yang, 2011), on the one hand, such non-financial information can reduce the cost of equity capital of enterprises by increasing the amount of information and stock liquidity and alleviating the information asymmetry between external investors and enterprises; on the other hand, this kind of non-financial information can influence the decision and judgment of external investors through semantic content. For example, the company's positive attitude towards environmental issues can help external investors reduce expected risks and increase expected returns, thereby reducing the cost of equity capital.

According to the externality theory, the environmental impact of corporate economic activities on other economic entities in society has obvious external characteristics. Enterprise pollution emissions will cause losses that are difficult to compensate for others or society, while corporate environmental protection will give others and social benefits that are not compensated at their inherent costs (Pigou, 2017). Regardless of pollution emissions or environmental protection, it is difficult for external investors to obtain specific information from the audited corporate financial statements directly, and it is even more difficult to investigate and obtain evidence by themselves from the production and operation of the enterprise.

The cost of doing this is very high. Therefore, the content and quality of corporate environmental disclosure have become increasingly prominent in the capital market, and have become the focus of attention of various stakeholders and the basis for their decision-making. In emerging capital markets, we believe that the mechanism of the quality of corporate environmental disclosure on the cost of equity capital is as follows:

First, in emerging capital markets where development is not yet complete and mechanisms are not perfect, compared with poor environmental disclosure, good environmental disclosure can generate greater information increment effect in the capital market, thereby help external investors make more accurately value assessments for the entire enterprise, and ultimately improve market effectiveness and reduce market transaction costs. Second, in China with a long history and deep traditional culture, people mostly advocate Confucian culture and pay more attention to morality than laws and regulations. In the context of the deteriorating natural environment, information related to corporate environmental governance can help companies improve their image and gain external investors' perception and recognition of corporate social responsibility. Companies will receive more reputational capital, higher legitimacy, and better capital support (Cho & Patten, 2007; Cormier & Magnan, 2015). In addition, the ability of companies to collect and disclose comprehensive information demonstrates the refinement and standardization of the firm's production and operation, and high effectiveness of internal corporate governance. This will also enhance external investors' positive expectations for the company, which will allow companies to obtain lower-cost equity capital. Third, in emerging capital markets with high levels of irrationality, the important role of institutional investors and analysts needs to be focused on. In the investor structure with a large number of retail investors, they often play a key role in draining market capital allocation. Existing research shows that because of their professional knowledge and judgment, institutional investors and analysts will pay more attention to polluting companies with high-quality environmental disclosure and produce more accurate analysis reports (Aerts, Cormier & Magnan, 2008), which will alleviate the problem of information asymmetry and help companies get more positive responses from investors.

Therefore, in general, higher-quality environmental disclosure will help companies obtain lower-cost equity financing in the capital market. Conversely, for companies with little or no disclosure of environmental information, investors will analyze the potential operating risks of the company, then request higher risk returns. Based on this, the following first Hypothesis is made:

***$H_1$: The quality of corporate environmental disclosure is negatively related to the cost of equity capital.***

2.2 Moderating Effects of Corporate Monopoly Power

According to the resource-based theory, an enterprise is a collection of resources, and the resources owned and controlled by an enterprise are fundamental to gaining a competitive advantage and improving economic benefits (Barney, 1991). In the capital market, the resources owned by an enterprise usually largely reflect its current operating conditions and future stock expectations, which is an important basis for investors and participants in the capital market to make decisions. In the Chinese stock market, the vast majority of participants are retail investors, and the phenomenon of "voting with their feet" is serious. The basis for their investment comes from their perception of the corporate image or their understanding of the market position of the enterprise. Therefore, the monopoly power of enterprises in the market is very influential, especially in capital markets with low effectiveness and inadequate mechanisms. We believe that when there is a difference in the monopoly power of an enterprise, the effect of environmental disclosure on the cost of equity capital will be significantly different.

First of all, the strong monopoly power reflects that enterprises have higher market bargaining power and market share, which indicates that enterprises usually have lower operating risks, good operating prospects and higher product quality. On this basis, the environmental information disclosed by the company is more likely to be trusted by investors, that is, investors believe that the information is accurate, objective, and true, and it is not a “greenish” behavior with an inductive nature. Secondly, due to their representativeness and influence, as the leading companies with strong monopoly powers, they are often the focus of the attention of capital market participants such as institutional investors and analysts. The environmental information disclosed by such companies will be more professionally interpreted and widely disseminated, which will greatly enhance the exposure of the information and get more positive responses from investors. Therefore, from the perspective of information identification and exposure, if a company has strong monopoly power, the role of

environmental disclosure in the capital market may be strengthened, thereby obtaining a lower cost of equity capital.

However, the strong monopoly power of the company may also reduce the role of environmental disclosure in the capital market. Due to the company's excellent performance, such as high profitability and competitive market advantages, it is sufficient to help investors make decisions and judgments. The disclosure of corporate environmental information does not have a significant information supplement effect for investors. After all, when the overall social value of a company (including employment, products, and economic growth) is large and it can bring more economic benefits to investors, the negative environmental impacts of the company's production and operation process may be ignored. Therefore, from the perspective of the information supplement effect, if a company has strong monopoly power, the role of environmental disclosure in the capital market may also be weaker. Based on this, the following second Hypothesis is made:

***$H_{2a}$: When the corporate monopoly power is strong, the negative correlation between corporate environmental disclosure and the cost of equity capital will be increased significantly.***

***$H_{2b}$: When the corporate monopoly power is strong, the negative correlation between corporate environmental disclosure and the cost of equity capital will be weakened significantly.***

2.3 Moderating Effects of Industry Competition

In addition to the monopoly power of the enterprise at the micro level, the degree of industry competition at the macro level is an important part of the business environment of the enterprise, and it is also a key factor for investors to make decisions. It reflects the potential threats and non-systemic risks of business operations. We believe that the degree of industry competition will significantly affect investors' demand for corporate information disclosure, then affect the value relevance of corporate environmental disclosure in the capital market.

When industry competition is fierce, the idiosyncratic risks of enterprises are greater (Irvine & Pontiff, 2009). In highly competitive industries, the barriers to entry for companies are low, changes in market demand have a greater impact on companies. Due to the relatively unstable future yield and cash flow, companies are more likely to face operational difficulties in terms of costs and differences. At this time, due to the consideration of return on investment, external investors usually conduct more risk assessments of the company (Merton, 1987). This will cause external investors and other market participants such as analysts to become more cautious, and their reactions to company information announcements will be more sensitive and rapid. In this case, the environmental information disclosed by the enterprise can be captured and analyzed more timely and obtain more market feedback. In addition, in a mixed industry, environmental information disclosed by companies is more helpful to inform external investors of their differences and advantages from other companies in the same industries. Therefore, when the competition in the industry is fierce, the role of corporate environmental disclosure may be more obvious, and the impact on capital costs will be more significant. Based on the above analysis, the following third Hypothesis is made:

***$H_3$: When the degree of industry competition is high, the negative correlation between corporate environmental disclosure and the cost of equity capital will be increased significantly.***

## 3. Research Design

In this section, we describe our date sources, variable definition and model design in our analysis.

3.1 Sample Selection and Data Source

The study sample consists of Shanghai and Shenzhen A Share listed companies which belong to high-polluting industries[1] for the period of 2012-2017. The corporate environmental disclosure data is collected manually. The rest of the data is obtained from the China Stock Market and Accounting Research (CSMAR) Database. The CSMAR Database is an economic and financial database developed in conjunction with China's actual conditions. It is mainly based on the needs of academic research, drawing on the professional standards of the internationally renowned databases such as CRSP,

[1] According to the "Guide to Environmental disclosure of Listed Companies" (2010) issued by the China Securities Regulatory Commission, heavily polluting industries mainly include mining, brewing, fermenting, textile, leather, papermaking, petroleum, chemical raw materials, chemical fibers, medicine, rubber and plastics, and ferrous metals Smelting, non-ferrous metal smelting, metal manufacturing, thermal power, 16 industries in total.

Compustat, I/B/E/S, Thomson, etc., which are widely used in China's relevant economic research fields. The raw data is processed as per the following rules: For sample companies, the following types of observations are excluded in this study: (1) we eliminated companies with missing data; (2) we eliminated companies with ST (special treatment); (3) the continuous variable are winsorized on the 1% and 99% quantile by year. As a result, our final sample comprised 632 companies with an unbalanced panel, for a total of 2050 observations.

3.2 Main Variables

(1) Environmental disclosure. The current mainstream method is to use content analysis to measure the quality of corporate environmental disclosure. We refer to the existing environmental disclosure scoring system for measurement (Clarkson, Li, Richardson, & Vasvari, 2008). This system is based on the Global Reporting Initiative (GRI) standards and widely used. It can reflect the environmental protection of the company from various aspects such as strategy, organization, culture, behavior, and performance. However, considering the timeliness and institution differences, we have adjusted the original scoring system in accordance with the update of the GRI (2014) proposal and the policy documents of the "Guidelines for Environmental disclosure of Listed Companies" issued by the Ministry of Environmental Protection in 2010. The environmental disclosure scoring system mainly includes seven parts, namely vision and strategy, governance structure and management system, credibility, environmental performance indicators, environmental expenditure, environmental profile, and specific environmental measures. There are 40 entries with a total of 100 points. The attached table at the end of the paper report it.

We extract content based on annual reports, social responsibility reports, environmental reports, and sustainable development reports of high-polluting listed companies, then perform item-by-item evaluations based on scoring indicators, and finally calculate the score of the quality of environmental disclosure. In the scoring process, in order to ensure the objectivity of the scoring, each sample was averaged by two people. Until the scoring consistency reaches 90%, the two assessors will not formally score.

(2) Cost of Equity Capital. Referring to the existing literature, we use the OJN model to calculate the cost of equity capital of corporate (Ohlson & Juettner-Nauroth, 2005). The OJN model has fewer restrictions and is easy to implement. The data required by the model is highly available and follows the principles of ex-ante risk management. Considering the robustness of the results, we also use the PEG model to recalculate the cost of equity capital and perform a robustness test (Easton, 2004). The formula for calculating the cost of equity capital based on the OJN model is as follows:

$$\mathrm{CEF} = \mathrm{A} + \sqrt{A^2 + \frac{eps_1}{P_0} \times \left(\frac{\Delta eps_2}{eps1} - (\gamma - 1)\right)} \quad (1)$$

$$\mathrm{A} \equiv \frac{1}{2}(\gamma - 1 + \frac{\delta \times eps_1}{P_0}) \quad (2)$$

Among them, CEF is the cost of equity capital;γ-1 represents the long-term earnings growth rate, we use the GDP growth rate;δ is the average dividend payment rate in the past two years; $P_0$ is the closing price of the stock at the end of the period t-1; $eps_1$ is the t + 1 predicted by the analyst 1 year earnings per share and $eps_2$ is the t + 2 years earnings per share predicted by the analyst.

3.3 Regression Model and Variable Definition

Based on the previous theoretical analysis, we build the model (3) to test the Hypothesis 1 proposed above, that is, by analyzing the impact of corporate environmental disclosure on the cost of equity capital, to examine the value relevance and potential economic consequences of corporate environmental disclosure. Then, after the basic regression results are verified, we use the Lerner Index to measure the corporate monopoly power (*Lerner*) and use model (4) to examine the impact of the monopoly power of the company on the relevance of environmental disclosure value to test Hypothesis 2. Finally, using the Herfindahl-Hirschman index (HHI) as a measure of the degree of industry competition (*Compete*), we use model (5) to examine the impact of industry competition on the relevance of corporate environmental disclosure values to verify Hypothesis 3. The models are as follows:

$$\mathrm{CEF}_{i,t} = \alpha_0 + \alpha_1 ED_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 ROA_{i,t} + \alpha_4 LEV_{i,t} + \alpha_5 Q_{i,t} + \alpha_6 INS_{i,t} + \alpha_7 MHR_{i,t} + \alpha_8 First_{i,t} + \alpha_9 State_{i,t} + \alpha_{10} Volatility_{i.t} + \alpha_{11} Turnover_{i.t} + \alpha_{12} Beta_{i,t} + \varepsilon_{i.t} \quad (3)$$

$$\mathrm{CEF}_{i,t} = \beta_0 + \beta_1 EDI_{i,t} + \beta_2 ED_{i.t} \times Lerner_{i.t} + \beta_3 Lerner_{i.t} + \beta_4 Size_{i,t} + \beta_5 ROA_{i,t} + \beta_6 LEV_{i,t} + \beta_7 Q_{i,t} + \beta_8 INS_{i,t} + \beta_9 MHR_{i,t} + \beta_{10} First_{i,t} + \beta_{11} State_{i,t} + \beta_{12} Volatility_{i.t} + \beta_{13} Turnover_{i.t} + \beta_{14} Beta_{i,t} + \varepsilon_{i.t} \quad (4)$$

$$\mathrm{CEF}_{i,t} = \gamma_0 + \gamma_1 EDI_{i,t} + \gamma_2 ED_{i.t} \times Compete_{i.t} + \gamma_3 Compete_{i.t} + \gamma_4 Size_{i,t} + \gamma_5 ROA_{i,t} + \gamma_6 LEV_{i,t} + \gamma_7 Q_{i,t} + \gamma_8 INS_{i,t} + \gamma_9 MHR_{i,t} + \gamma_{10} First_{i,t} + \gamma_{11} State_{i,t} + \gamma_{12} Volatility_{i.t} + \gamma_{13} Turnover_{i.t} + \gamma_{14} Beta_{i,t} + \varepsilon_{i.t} \quad (5)$$

In the model, i and t reflects the individual and the year, respectively, and $\varepsilon_{i.t}$ reflects the regression error term. Because the corporate environmental disclosure and the cost of equity capital are significantly affected by individual characteristics, we also tried to control the year and firm fixed effects during the regression process with standard error clustering at the firm level. *CEF* is the explanatory variable, the cost of corporate equity capital; *ED* is the explanatory variable, the quality of corporate environmental disclosure. According to the previous theoretical analysis and Hypothesis 1, we mainly observe the coefficient and significance of *ED* and expect that $\alpha_1$ will be significantly negative. According to the opposite Hypothesis 2a and 2b, the coefficient and significance of the crossover term may be significantly positive or negative. It is expected that $\beta_2$ maybe positive or negative to verify Hypothesis 2a and Hypothesis 2b; According to Hypothesis 3, $\gamma_2$ is expected to be negative significantly.

We follow prior related research by controlling a set of variables from the aspects of operating conditions, corporate governance and stock trading (Dhaliwal, Li, Tsang, & Yang, 2011; Plumlee, Brown, Hayes, & Marshall, 2015). Specifically, Includes the following variables: *Size* (the natural logarithm of total assets); *Lev* (the ratio of total liabilities to total assets); *ROA* (the ratio of return on total assets); *Q* (Tobin'Q, investment opportunities); *INS* (the percentage of shares held by the institutional investor), *Mhldn* (the percentage of shares held by management); *First* (the percentage of shares held by the largest shareholder); *State* (a dummy variable, 1 for firms whose controlling shareholder is the state and 0 otherwise); *Volatility* (the coefficient of variation of return in the last three years); *Turnover*(the ratio of trading amount to total issued shares); *BETA* (beta coefficient). Table 1 lists the symbols and definitions of all variables involved in the model.

**Table 1: Variable definitions**

| Variable Name | Symbol | Definition |
|---|---|---|
| **Dependent Variable** | | |
| The cost of equity capital | *CEF* | Financing cost, calculating with OJN model |
| **Independent Variables** | | |
| Environmental disclosure | *ED* | The quality of environmental disclosure of enterprises |
| Monopoly power | *Lerner* | Calculating with Lerner index |
| Industry competition | *Compete* | Calculating with Herfindahl-Hirschman index |
| **Control Variables** | | |
| Firm size | *Size* | The natural logarithm of the total assets |
| Firm profitability | *ROA* | The ratio of return on total assets |
| Firm Liabilities | *LEV* | The ratio of total liabilities to total assets |
| Investment opportunities | *Q* | Tobin's Q |
| Holdings of institutions | *INS* | Percentage of shares held by institutions |

| | | |
|---|---|---|
| Holdings of management | *MHR* | Percentage of shares held by management |
| Holdings of the largest shareholder | *First* | Percentage of shares held by the largest shareholder |
| Ownership | *State* | 1 if the company is state-owned, 0 otherwise |
| Earnings volatility | *Volatility* | The coefficient of variation of return in the last three years |
| Stock turnover | *Turnover* | The ratio of the trading amount to total issued shares |
| Stock risk | *Beta* | Beta coefficient |

# 4. Empirical Results

In this section, we assess whether the evidence shows that the firms enjoy a lower cost of equity capital when it disclosure more comprehensive environmental information and this relationship is more pronounced for firms that have higher monopoly power and which in the industries where has fierce competition.

4.1 Descriptive Statistics of Variables

We describe the industry characteristics of corporate environmental disclosure based on "Guidelines for Industry Classification of Listed Companies" issued by the CSRC (China Securities Regulatory Commission), as shown in Table 2. It can be found that the quality of environmental disclosure of most of the high-polluting enterprises in China is currently low, especially in the leather, rubber plastic, metal manufacturing industries. The median of the environmental disclosure score is only about 3. The score in mining, petroleum, steel industries is relatively high, and the median is all over 10. On the one hand, these industries with a higher quality of environmental disclosure are on the upper and middle reaches and involve basic livelihood supplies, which receive more attention from the government and market. Based on strict external supervision and abundant resources, their information disclosure is often more standardized. On the other hand, there are obvious economies of scale effects and lower entry barriers in these industries. Under the background of the "supply-side structural reform" [2]and "green development"[3] in China, they are facing more competition pressure and will be more motivated to environmental disclosure information in order to gain more favor and support from governments and investors.

**Table 2: Description of statistics of industry characteristics of ED**

| Industry | N | Percent | Mean | Std. Dev. | P25 | Median | P75 |
|---|---|---|---|---|---|---|---|
| Mining | 165 | 8.05% | 13.64 | 10.02 | 5 | 11 | 23 |
| Brewing | 108 | 5.27% | 8.500 | 6.344 | 2 | 9 | 13 |
| Fermenting | 83 | 4.05% | 7.506 | 6.254 | 3 | 5 | 13 |
| Leather | 26 | 1.27% | 5 | 4.243 | 2 | 3.500 | 8 |
| Papermaking | 60 | 2.93% | 8.567 | 7.853 | 3 | 6 | 12.50 |
| Petroleum | 21 | 1.02% | 12.52 | 8.646 | 5 | 12 | 19 |
| Chemical raw materials | 380 | 18.54% | 8.937 | 6.648 | 3 | 7 | 14 |
| Pharmaceutical | 397 | 19.37% | 7.025 | 6.498 | 2 | 5 | 10 |
| Chemical fibers | 54 | 2.63% | 7.963 | 7.936 | 2 | 4 | 13 |
| Rubber and plastics | 111 | 5.41% | 3.775 | 2.853 | 2 | 3 | 5 |
| Non-metal products | 174 | 8.49% | 7.224 | 6.255 | 2 | 5.500 | 10 |
| Ferrous metals smelting | 64 | 3.12% | 15.30 | 8.697 | 8.500 | 13.50 | 22.50 |
| Non-ferrous metal smelting | 135 | 6.59% | 9.119 | 8.635 | 3 | 6 | 13 |
| Metal products | 136 | 6.63% | 4.338 | 4.798 | 1 | 2.500 | 6 |
| Thermal power | 136 | 6.63% | 8.816 | 6.789 | 3 | 8 | 13 |
| Total | 2032 | 100.00 | 8.287 | 7.400 | 3 | 6 | 12 |

[2] In 2015, in order to promote China 's economic growth, the Party Central Committee with Xi Jinping at the core proposed a "supply-side structural reform" strategic deployment. On the basis of the innovative development of Marxist political economy, it emphasized "three gossip, one drop and one supplement". In recent years, driven by the government, the effectiveness of capacity reduction and industrial restructuring of traditional industries such as steel and coal have received continuous attention from the government and many other aspects.

[3] In 2015, at the Fifth PLernerry Session of the 18th Central Committee of the Communist Party of China, Chairman Xi Jinping proposed five development concepts of innovation, coordination, greenness, openness and sharing, and began to promote green development to the height of the national development strategy. Civilization. In recent years, the Chinese government has been committed to deepening and implementing the concept of green development and developing a green economy.

Table 3 reports the descriptive statistical results of the main variables involved in our research. We can see, the average score of environmental disclosure of the sample companies is 8.287, and the median is 6. From the standard deviation, there are obvious differences between the samples. The average cost of equity capital of the sample company is 0.154, which is roughly similar to the existing literature data. The data and processing of this paper are more objective and reliable because the distribution characteristics of each other variable are also close to the existing literature based on Chinese sample data. In addition, due to the missing value, there are only 2039 samples about the corporate monopoly power (*Lerner*).

**Table 3: Descriptive statistics of variables in the model**

| Variables | N | Mean | Std. Dev. | P25 | Median | P75 |
|---|---|---|---|---|---|---|
| *CEF* | 2050 | 0.154 | 0.0467 | 0.122 | 0.147 | 0.177 |
| *ED* | 2050 | 8.287 | 7.400 | 3 | 6 | 12 |
| *Lerner* | 2039 | 0.0774 | 0.0758 | 0.0208 | 0.0638 | 0.106 |
| *Compete* | 2050 | 0.142 | 0.113 | 0.0659 | 0.116 | 0.186 |
| *Size* | 2050 | 22.61 | 1.232 | 21.72 | 22.36 | 23.34 |
| *ROA* | 2050 | 0.0558 | 0.0462 | 0.0216 | 0.0445 | 0.0774 |
| *LEV* | 2050 | 0.412 | 0.188 | 0.257 | 0.405 | 0.564 |
| *Q* | 2050 | 2.301 | 1.423 | 1.361 | 1.874 | 2.728 |
| *INS* | 2050 | 0.0518 | 0.0462 | 0.0158 | 0.0401 | 0.0739 |
| *MHR* | 2050 | 0.0989 | 0.175 | 2.38e-06 | 0.000816 | 0.126 |
| *First* | 2050 | 36.76 | 15.06 | 25.67 | 34.88 | 46.23 |
| *State* | 2050 | 0.429 | 0.495 | 0 | 0 | 1 |
| *Volatility* | 2050 | 0.319 | 0.644 | 0.147 | 0.256 | 0.479 |
| *Turnover* | 2050 | 67.93 | 75.91 | 22.72 | 45.43 | 85.66 |
| *Beta* | 2050 | 1.157 | 0.320 | 0.951 | 1.150 | 1.329 |

We also test the pairwise Spearman rank-order correlations and see that there is a negative correlation between the cost of corporate equity capital (*CEF*) and its environmental disclosure level (*ED*), but it is not significant (the correlation coefficient is -0.035), and further regression analysis is needed. From the correlation coefficient and significance of other variables, the cost of equity capital is significantly positively related to *Size*, *LEV*, *Volatility*, and significantly negatively related to *ROA*, *Q* and *Turnover*. From the perspective of risk-reward and stock trading, it is very in line with theoretical expectations and also reflects the validity of the data and model. Through the collinearity test, the mean value of the variance inflation factor (*VIF*) is 1.51, indicating that there is no serious collinearity problem between the variables.

4.2 Benchmark Regression Analysis

Table 4 reports the regression analysis of the impact of corporate environmental disclosure on the cost of equity capital, including regression with industry and year fixed-effect and regression with the firm and year fixed-effect based on model (3), respectively. There are the regression results without control variables in Columns (1) and (3), and the regression results with controlling the influence of other potential factors in Columns (2) and (4). It can be seen that the coefficients of *ED* in each column are significantly negative at the 5% or 1% level, indicating that the disclosure of higher-quality environmental information by companies helps reduce the cost of equity capital, the Hypothesis 1 is verified. That is, corporate environmental disclosure can play a certain information increment effect in the emerging market, alleviate information asymmetry, and help companies gain more investor recognition and support. In addition, it can be found that whether the regression with firm and year fixed-effects or not, the coefficients of *ROA* and *Beta* are negative significantly at least at the 5% level, while the coefficients of *LEV* and *Volatility* are positive significantly at least at the 10% level, roughly in line with expected results.

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| ED | -0.065*** | -0.054*** | -0.057** | -0.060** |
| | (-4.63) | (-3.43) | (-2.21) | (-2.36) |
| *Size* | | 0.002* | | -0.008** |
| | | (1.66) | | (-2.06) |
| *ROA* | | -0.113*** | | -0.171*** |
| | | (-4.07) | | (-4.33) |

| | | | | |
|---|---|---|---|---|
| *LEV* | | 0.022*** | | 0.023* |
| | | (3.21) | | (1.75) |
| *Q* | | 0.000 | | 0.003** |
| | | (0.47) | | (2.06) |
| *INS* | | 0.041** | | -0.005 |
| | | (1.96) | | (-0.19) |
| *MHR* | | 0.000 | | -0.031* |
| | | (0.05) | | (-1.79) |
| *First* | | -0.000*** | | 0.000 |
| | | (-2.73) | | (0.98) |
| *State* | | -0.010*** | | -0.011 |
| | | (-4.28) | | (-0.71) |
| *Volatility* | | 0.004*** | | 0.003* |
| | | (2.83) | | (1.93) |
| *Turnover* | | -0.000 | | 0.000 |
| | | (-0.56) | | (1.53) |
| *Beta* | | -0.009** | | -0.010** |
| | | (-2.35) | | (-2.21) |
| *_cons* | 0.147*** | 0.120*** | 0.167*** | 0.360*** |
| | (35.23) | (4.15) | (63.15) | (3.96) |
| *Industry* | Yes | Yes | | |
| *Year* | Yes | Yes | Yes | Yes |
| *Firm* | | | Yes | Yes |
| *N* | 2050 | 2050 | 2050 | 2050 |
| *F* | 25.518 | 20.777 | 53.019 | 21.899 |
| $R^2$ | 0.201 | 0.242 | 0.184 | 0.210 |

In order to alleviate the problem of measurement bias that may exist in the empirical analysis, we re-analyzes the regression by changing the specific parameters and models for calculating the cost of equity capital. Considering the firm and year fixed effect regression model is more rigorous in the firm research field, that is mainly reported later, as shown in Table 5. At first, we recalculated the indicator of the cost of corporate equity capital by replacing the long-term earnings growth rate in the previous model (1) with China's GDP growth rate in the past 20 years. We call this indicator *CEF_c1*. Then we take it to regress and report results in Columns (1) and Columns (2). In addition, referring to the existing studies, we reestimate our baseline model by using *CEF_c2* which is another indicator to calculate the cost of equity capital by PEG models, regression results as shown in Columns (3) and Columns (4). Consistent with the previous tables, Columns (1) and (3) are the basic regression, and the remaining two Columns are the results of regression with control variables added. It can be seen that the *ED* coefficients are still significantly negative, at least at the 10% level, which is consistent with the previous conclusion and the results are robust.

| **Variables** | *CEF_c1* | | *CEF_c2* | |
|---|---|---|---|---|
| | （1） | （2） | （3） | （4） |
| ED | -0.054* | -0.048 | -0.044** | -0.041* |
| | (-1.81) | (-1.61) | (-2.03) | (-1.93) |
| *Size* | | -0.007 | | 0.001 |
| | | (-1.36) | | (0.31) |
| *ROA* | | -0.141*** | | 0.086*** |
| | | (-3.08) | | (2.63) |
| *LEV* | | 0.038** | | 0.034*** |
| | | (2.40) | | (3.08) |
| *Q* | | 0.003* | | 0.002 |
| | | (1.75) | | (1.45) |
| *INS* | | 0.003 | | 0.045* |
| | | (0.10) | | (1.96) |
| *MHR* | | -0.048** | | -0.024* |

| | | | | |
|---|---|---|---|---|
| | | (-2.37) | | (-1.66) |
| *First* | | -0.000 | | 0.000 |
| | | (-1.16) | | (1.55) |
| *State* | | -0.015 | | -0.004 |
| | | (-0.78) | | (-0.28) |
| *Volatility* | | 0.027*** | | 0.000 |
| | | (4.48) | | (0.33) |
| *Turnover* | | 0.000 | | 0.000*** |
| | | (1.42) | | (3.55) |
| *Beta* | | -0.015*** | | -0.001 |
| | | (-2.95) | | (-0.32) |
| *_cons* | 0.175*** | 0.352*** | 0.115*** | 0.058 |
| | (58.02) | (3.12) | (52.30) | (0.77) |
| *Year* | Yes | Yes | Yes | Yes |
| *Firm* | Yes | Yes | Yes | Yes |
| *N* | 1956 | 1956 | 2046 | 2046 |
| *F* | 48.961 | 21.294 | 52.531 | 22.146 |
| $R^2$ | 0.179 | 0.214 | 0.183 | 0.212 |

4.3 Regression Results of Moderating Effect

In order to test whether the relationship between corporate environmental disclosure and the cost of equity capital is influenced by firm characteristics and industry competition, we include the crossover term on the basis of model (3) to test the moderating effect. Table 6 reports the regression results. We can see that the coefficients of the crossover term (*ED* × *Lerner*) in Columns (1) and Columns (2) are significantly negative, that is, the impact of corporate environmental disclosure on the cost of capital will be more significant when firms have a strong monopoly power, Hypothesis 2a is verified and Hypothesis 2b is not true. This means that the firm characteristics will affect the recognition and exposure of its environmental disclosure in the capital market to a certain extent, and thus affect investor decision. On the whole, external investors and other market participants are more sensitive to the information disclosure of leading companies, resulting in the more obvious economic value of their environmental disclosure. Then, the coefficients of crossover term (*ED* × *Compete*) in Columns (3) and Columns (4) are significantly negative, that is, the higher the degree of industry competition, the stronger the negative impact of corporate environmental disclosure on the cost of equity capital, Hypothesis 3 is verified. This shows that investors are more sensitive to the information disclosure of listed companies in fiercely competitive industries, which leads to higher-value relevance of corporate environmental disclosure.

| **Variables** | （1） | （2） | （3） | （4） |
|---|---|---|---|---|
| ED | -0.060** | -0.058** | -0.058** | -0.061** |
| | (-2.34) | (-2.26) | (-2.26) | (-2.38) |
| ED×Lerner | -0.444*** | -0.431** | | |
| | (-2.61) | (-2.54) | | |
| Lerner | -0.084*** | -0.028 | | |
| | (-4.20) | (-1.04) | | |
| ED×Compete | | | -0.685** | -0.561* |
| | | | (-2.25) | (-1.85) |
| Compete | | | -0.082 | -0.073 |
| | | | (-1.32) | (-1.17) |
| *Size* | | -0.008* | | -0.007* |
| | | (-1.82) | | (-1.79) |
| *ROA* | | -0.139*** | | -0.167*** |
| | | (-2.77) | | (-4.23) |
| *LEV* | | 0.024* | | 0.023* |
| | | (1.78) | | (1.72) |
| *Q* | | 0.003* | | 0.003** |

| | | | | |
|---|---|---|---|---|
| | | (1.83) | | (2.01) |
| *INS* | | -0.002 | | -0.011 |
| | | (-0.06) | | (-0.42) |
| *MHR* | | -0.031* | | -0.030* |
| | | (-1.79) | | (-1.77) |
| *First* | | 0.000 | | 0.000 |
| | | (0.87) | | (0.94) |
| *State* | | -0.011 | | -0.013 |
| | | (-0.67) | | (-0.80) |
| *Volatility* | | 0.003* | | 0.003* |
| | | (1.80) | | (1.82) |
| *Turnover* | | 0.000 | | 0.000 |
| | | (1.64) | | (1.51) |
| *Beta* | | -0.009** | | -0.010** |
| | | (-2.13) | | (-2.21) |
| *_cons* | 0.178*** | 0.348*** | 0.173*** | 0.343*** |
| | (47.95) | (3.68) | (30.95) | (3.76) |
| *Year* | Yes | Yes | Yes | Yes |
| *Firm* | Yes | Yes | Yes | Yes |
| *N* | 2039 | 2039 | 2050 | 2050 |
| *F* | 42.717 | 19.792 | 40.969 | 19.951 |
| $R^2$ | 0.196 | 0.213 | 0.189 | 0.213 |

## 5. Conclusions and Implications

This study focuses on the value relevance of corporate non-financial information disclosure and examines the incremental effects and economic consequences of corporate environmental disclosure in emerging capital markets. We find that in emerging capital markets with incomplete institutions and low effectiveness, the disclosure of higher quality environmental information by companies will help alleviate information asymmetries and increase recognition and favor of investors and other participants in the capital market for firm performance. So that firms can obtain more support or lower risk-reward requirements for firms, and ultimately reduce their cost of equity capital. From the perspective of information, identify and exposure, the role of environmental disclosure of enterprises with high market monopoly position is stronger in reducing corporate financing cost; from the perspective of information demand, when the competition of industry in which the company operates is intense, the role of environmental disclosure is stronger in reducing corporate financing cost.

Therefore, from the conclusion of the research in this paper, calling on listed companies in heavily polluting industries in emerging capital markets to strengthen environmental management of their production and operations, and to proactively and normatively disclose high-quality environmental information, which will help obtain more Much cheaper and preferential treatment. Especially for companies with high systemic risk factors and fierce competition in the industry, this will be a more favorable choice. For the head companies with high market share, as the focus of much attention, they should also set an example and strengthen environmental disclosure.

In the current situation where Chinese enterprises are still weak in fulfilling environmental responsibilities, the research conclusions of this study help manager to understand the capital market feedback mechanism of environmental disclosure and help to improve the quality of environmental disclosure by enterprises. In the future, except for the perspective of this study, we can also research the value relevance and economic consequence of environmental disclosure from other perspectives such as institutional investor interest and analyst forecasts. Therefore, we hope that more scholars will conduct related research in the future in order to deepen our knowledge and understanding of this field continuously.

## References:


i. *Aerts, W., Cormier, D., & Magnan, M. (2008). Corporate environmental disclosure, financial markets and the media: An international perspective. Ecological economics, 64(3), 643-659.*

ii. *Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.*

iii. *Cho, C. H., & Patten, D. M. (2007). The role of environmental disclosures as tools of legitimacy: A research note. Accounting, Organizations and Society, 32(7-8), 639-647.*

iv. *Clarkson, P. M., Fang, X., Li, Y., & Richardson, G. (2013). The relevance of environmental disclosures: Are such disclosures incrementally informative? Journal of Accounting and Public Policy, 32(5), 410-431.*

v. *Clarkson, P. M., Li, Y., Richardson, G. D., & Vasvari, F. P. (2008). Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. Accounting, Organizations and Society, 33(4-5), 303-327.*

vi. *Cormier, D., & Magnan, M. (2015). The Economic Relevance of Environmental Disclosure and its Impact on Corporate Legitimacy: An Empirical Investigation. Business Strategy and the Environment, 24(6), 431-450.*

vii. *Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary Nonfinancial Disclosure and the Cost of Equity Capital: The Initiation of Corporate Social Responsibility Reporting. The Accounting Review, 86(1), 59-100.*

viii. *Easton, P. D. (2004). PE ratios, PEG ratios, and estimating the implied expected rate of return on equity capital. The accounting review, 79(1), 73-95.*

ix. *Hea, Y., Tangb, Q., & Wanga, K. (2013). Carbon disclosure, carbon performance, and cost of capital. China Journal of Accounting Studies, 1, 190-220.*

x. *Irvine, P. J., & Pontiff, J. (2009). Idiosyncratic return volatility, cash flows, and product market competition. The Review of Financial Studies, 22(3), 1149-1177.*

xi. *Lorraine, N. H. J., Collison, D. J., & Power, D. M. (2004). An analysis of the stock market impact of environmental performance information. Accounting Forum, 28(1), 7-26.*

xii. *Merton, R. C. (1987). A simple model of capital market equilibrium with incomplete information. The journal of finance, 42(3), 483-510.*

xiii. *Ohlson, J. A., & Juettner-Nauroth, B. E. (2005). Expected EPS and EPS growth as determinants of value. Review of accounting studies, 10(2-3), 349-365.*

xiv. *Pigou, A. (2017). The economics of welfare: Routledge.*

xv. *Plumlee, M., Brown, D., Hayes, R. M., & Marshall, R. S. (2015). Voluntary environmental disclosure quality and firm value: Further evidence. Journal of accounting and public policy, 34(4), 336-361.*

xvi. *Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. The British Accounting Review, 48(1), 102-116.*