

# Empirical Research on Environmental Information Disclosure and Equity Capital Cost of Chinese Chemical Enterprises

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This paper takes Shandong's listed companies in the chemical industry in 2014-2017 as study case, empirically tests how the information disclosure about environmental concerns has an impact on the cost of business equity capital. The findings show that the improved quality of Environment Information Disclosure (EID) can significantly reduce the cost of equity capital of listed companies in the chemical industry; in relation to those non-state-run in chemical industry, there is a strongly negative correlation between the EID and the cost of equity capital in the state-owned companies. On this basis, it is suggested that the EID of listed companies in the chemical industry be improved.

## 1. Introduction

The chemical industry as a basic strength in China is closely bound with people's basic necessities of life. It occupies an important place in the national economy. However unfortunately, the chemical industry ranks as a major polluter since it emits diverse pollutants with high toxicity during production. In recent years, China has witnessed the dramatic development in economy, bringing with it inevitably surges in environmental accidents and ecological pollution events including some river basins, and a flood of haze, all of which seriously threaten people's lives. In this context, the chemical companies as a heavily polluting industry have aroused common concern of the masses and the environmental protection agencies. The listed companies in the chemical industry should publish their fulfilment of environmental responsibilities with an appropriate environment information disclosure system to the outside world. So well, whether the EID as a positive way to cope with environmental risks will reduce the cost of equity capital of chemical companies, thereby increasing the value of the company? Here comes a theoretical and empirical analysis of this issue.

## 2. Literature Review

Foreign studies on how the EID affects the cost of equity capital have yielded inconsistent conclusions. Clarkson et al. (2010) made a study on the most polluted industries in the United States (including chemical industry), but they found no significant correlation between the quality of EID and the cost of equity capital. Richardson and Welker (2001) focused on the Canada's listed companies and found that EID would add the burden to companies. There was a significantly positive correlation between the quality of EID and the cost of equity capital. Aerts et al. (2008) investigated listed companies from France, Germany, and the United States as samples and found that the better quality of EID helps analysts more accurately predict future benefits, thereby to reduce the cost of equity capital. Botosan and Plumlee (2002) found the law that the higher the quality of EID, the lower the cost of corporate equity capital. This law will be more evident in environmentally sensitive companies. Hassel et al. (2005), Dhaliwal (2011) and Latridis (2013) also bore out that the quality of EID has a significantly negative relation with the cost of equity capital.

Most of China's studies support negative correlation between the EID and the cost of equity capital. Wu Hongjun (2014) made a study on chemical companies sampled the listed in the chemical industry from 2006 to 2008. Study results revealed that the high level of EID would effectively reduce the cost of equity capital. The former also played a signal transmission effect. Shen Hongtao et al. (2010) sampled 2006-2009 listed companies in heavy polluting industries for study and also found the law stated above. Yuan Yang (2014) took the heavily polluting industries listed in 2008-2010 as samples to study and discovered there was a negative

correlation between financial environmental information disclosure and the cost of equity capital, while the non-financial environmental information disclosure has a little impact on the investment decisions. Similarly, Ye Chengang et al. (2015) sampled 2009-2013 listed companies in heavy polluting industries, and also bore out a consistent conclusion as above.

### 3. Theoretical Analysis and Hypothesis

Information asymmetry exists between businesses and investors, while the more information and the better quality the listed companies disclose, the lower the degree of this asymmetry. Under the signal transmission theory, rational investors make some investment decisions based on the information disclosed by the company. Favourable information can win investor's confidence in the company by signal transmission and lower the investor's risk expectations for the company, thus reducing the cost of equity capital. Verrecchia (2001) believed that EID would play a role similar to that financial information disclosure does, that is, information disclosure diminishes information asymmetry, thereby reducing transaction costs and estimation errors, as well as the cost of equity capital. As above, here puts forward the first hypothesis:

Hypothesis 1: The EID quality of chemical companies has a significantly negative correlation with the cost of equity capital.

As the material basis of China's socialist system, state-owned firms play an important role in the national economy and people's lives. They also act as the essential tools the government uses to intervene in the market economy and maintain social stability. In addition to the constraints of the norms issued by the national environment protection agencies and the stock exchange for the environmental information disclosure, they are also subjected to the supervision from the SASAC. In this sense, they remain under greater pressure from external masses, so that they are bound to regard the authenticity of environmental information disclosed. Accordingly, investors have a higher confidence in the environmental information disclosed by state-owned listed companies, which will require lower risk compensation and reduce the cost of equity capital. Given the above, here comes the second hypothesis:

Hypothesis 2: Compared with non-state-owned companies, the negative correlation between environmental information disclosure quality and the cost of equity capital in the state-owned companies is stronger.

### 4. Study Design

#### 4.1 Sample selection and data sources

The chemical industry defined herein falls into three major categories: petrochemical industry, basic chemicals, and chemical fibre, including chemical industry, oil refining, metallurgy, energy source, light industry, petrifaction, environmental, pharmaceutical, and other concrete industries. In Shandong, as a major province of China's economy and a production base for chemical industry, many companies with enormous strengths in the chemical industry have sprung up. Here we take the 2014-2017 A-share listed companies in the chemical industry of Shandong as a case, exclusive of those under special treatment in 2014-2017, with incomplete data, and listed after January 1, 2014. In the end, there are 140 samples for 35 companies listed in the chemical industry in four years. Environmental information data disclosed by the sample companies in their financial and social responsibility reports and annual report are manually available from the www.cninfo.com, and other finance data from the CMSAR and Sina Finance. Data treatment uses the Stata 15.0 statistical software.

#### 4.2 Variable Selection and Model Construction

##### 4.2.1 Dependent variable

The dependent variable of this paper is the cost of equity capital, which is calculated by the classical capital asset pricing model. The specific formula is as follows:

$$R_i = R_f + \beta_i(R_m - R_f) \quad (1)$$

Where, the risk-free rate of return,  $R_f$ , is the arithmetic average of China's one-year time deposit rate in 2014-2017. As the China's Shanghai and Shenzhen stock markets have a certain disparity, the market portfolio returns,  $R_m$ , of Shenzhen and Shanghai stocks are their respective overall yield rates. The coefficient  $\beta$  comes from market segment of the CMSAR Database.

##### 4.2.2 Independent variable

The quality of EID of sample companies are measured with the content analysis used by most scholars in the study on it and social responsibility (Clarkson et al., 2008; Iuga et al., 2015; Nicoletti et al., 2016). First, in accordance with the *Measures for the Environmental Information Disclosure Measures (Trial)* promulgated by the former State Environmental Protection Administration in 2007, the *Guidelines for Environmental*

*Information Disclosure of Listed Companies and the Guide to Environmental Information Disclosure of Listed Companies* promulgated by the Shanghai Stock Exchange in 2008, the environmental information disclosed by sample companies is classified into 6 parts, each of which is set with appropriate secondary indicators (as shown in Table 1). They are then given a rating in such a rule that those without descriptions in the annual and social responsibility reports are rated as zero, those with qualitative description are 1 point, and with both qualitative and quantitative descriptions is 2 point. Some projects can only be qualitatively described, so that their highest score is 1 point. Rating and summary for the six indicators can get the score of EID of individual samples. According to this rating method, the optimal information disclosure of Sample Company gets 34 points. The index of EID (EIDI) can be obtained by dividing the score made by each company in a year by the optimal information disclosure.

Table 1: EIDI of companies

Items	Level 2 indicator	Top score	Items	Level 2 indicator	Top score
Environment management	Major environmental issues	2	Environment inputs	Total investment in environmental	2
	Environmental education and training	2		R&D expenditure	2
	Energy dissipation per RMB 10,000 GDP	2		Sewage treatment	2
Environment cost	Total water and power consumption	2	Environmental performance and governance	Multipurpose utilization of industrial wastes	2
	Total standard coals	2		Reduction of total energy consumption (standard coal)	2
Environmental liabilities	Wastewater discharge	2		Emission reduction of SO <sub>2</sub> , CO, COD, soot, etc.	2
	SO <sub>2</sub> , CO <sub>2</sub> emissions	2		Environment certification	1
	Smoke and dust emissions	2	Government supervision and agency certification	2	
	Industrial solid waste yield	2	Execution of "three concurrencies" system	2	
			Is there an environment audit	1	

#### 4.2.3 Control variables

This paper selects asset size, capital structure, profitability, growth, and corporate governance at the company level as control variables, see Table 2 for the definitions and measurements of the above variables.

Table 2: Description for variables

Variables	Variable name	Variable symbol	Variable definitions
Dependent variable	Cost of equity capital	R <sub>e</sub>	Cost of equity capital calculated using formula (1)
Independent variable	EID quality	EIDI	Standardized EID
Control variable	Company scale	SIZE	Natural logarithm of the total period-end assets of the listed company
	Financial Leverage	LEV	Total liabilities / assets
	Growth	BM	Shareholders' equity / company's market value
	Profitability	ROA	Return on total asset
	Business risk	TAT	Total asset turnover
	Ratio of independent directors	DP	Number of Independent Directors / Number of Board Members
	Equity concentration	TOP	Shareholding ratio of the largest shareholder
Proportion of circulated shares	CSP	Ratio of total circulation market to the total market value	

## 5. Model construction

In order to test how the environmental information disclosure quality has an impact on the cost of equity capital, a model (1) is built herein to perform multilevel linear regression analysis.

$$R_e = \beta_0 + \beta_1 \text{EIDI} + \beta_2 \text{SIZE} + \beta_3 \text{LEV} + \beta_4 \text{BM} + \beta_5 \text{ROA} + \beta_6 \text{TAT} + \beta_7 \text{DP} + \beta_8 \text{TOP} + \beta_9 \text{CSP} + \varepsilon \quad (2)$$

## 6. Empirical test

### 6.1 Descriptive analysis

The descriptive statistics for each major variable is listed in Table 2. The average value of EIDI of listed companies is 0.133, with a median of 0.093, far below the pass line of 0.6, which suggests that the environmental information disclosure quality of listed companies is still at a low level, and the maximum is 0.605, the minimum is 0, and the standard deviation approaches to the average value. It is suggested that environmental information disclosure varies greatly among a variety of list companies. In addition, there are significant differences in the cost of equity capital between listed companies.

Table 3: Descriptive statistics for samples

Variable symbol	Max	Min	Mean value	Median	Standard deviation
$R_e$	0.822	-0.195	0.183	0.100	0.264
EIDI	0.605	0	0.133	0.093	0.136
SIZE	11.34	8.209	9.916	9.902	0.639
LEV	0.846	0.103	0.451	0.439	0.194
BM	1.131	0.035	0.608	0.589	0.272
ROA	0.228	-0.077	0.050	0.038	0.051
TAT	2.443	0.066	0.726	0.662	0.380
DP	0.600	0.286	0.379	0.364	0.063
TOP	0.637	0.093	0.304	0.302	0.122
CSP	1	0.611	0.932	0.995	0.094

The annual changes in the level of EID in 2014-2017 are shown in Table 4. On the average, the EIDI of sample company increases year by year, from the original 0.0831 to 0.1787, by 53.5%. The optimal quality of EID also goes up from 0.3953 to 0.6046, which suggests that over time, the quality of EID of listed companies continues to increase.

Table 4: Annual changes of EIDI level in 2014-2017

YY	Max	Min	Mean value	Median	Standard deviation
2014	0.3953	0	0.0831	0.0233	0.1140
2015	0.5116	0	0.1050	0.0698	0.1178
2016	0.6047	0	0.1668	0.1395	0.1380
2017	0.6046	0	0.1787	0.1395	0.1552

### 6.2 Correlation analysis

Table 5: Variable correlation coefficients

	$R_e$	EIDI	SIZE	LEV	BM	ROA	TAT	DP	TOP	CSP
$R_e$	1									
EIDI	-0.2125	1								
SIZE	0.0067	0.5368	1							
LEV	0.0914	0.2025	0.4040	1						
BM	-0.0355	-0.0837	-0.0940	-0.117	1					
ROA	-0.0582	0.0553	-0.132	-0.5448	0.0974	1				
TAT	-0.0078	0.2483	0.0595	-0.132	-0.0282	0.159	1			
DP	-0.0719	-0.0771	-0.0779	0.115	0.0841	-0.134	-0.143	1		
TOP	0.114	0.2547	0.3244	0.2135	0.0042	-0.0327	0.3500	-0.100	1	
CSP	0.0451	-0.0160	-0.0283	0.138	0.0156	0.1969	-0.0717	-0.1290	0.117	1

As shown in Table 5, the correlation coefficient between  $R_e$  and EIDI is -0.2125, that is, the cost of equity capital is negatively correlated to the quality of EID, the Hypothesis 1 is true initially. The cost of equity capital is positively correlated to company scale, financial leverage, equity concentration, and proportion of tradable shares, and negatively to growth, profitability, business risk, and the proportion of independent directors. In Table 5, it is found that the correlation coefficient between the variables is basically lower than 0.5, so that the model does not have serious multicollinearity.

### 6.3 Multiple regression results

The multiple regression results in model (1) are shown in Table 6. The first column in Table 6 gives the regression results of the full samples for the cost of equity capital and EIDI. The coefficient of the EIDI is -0.691, a significantly negative at the level of 1%, which shows that after controlling the company's characteristics, corporate governance and other factors, the cost of equity capital drops 0.691 units every time the EIDI goes up 1 unit, so that hypothesis 1 is true. In the sample of state-owned listed companies, the EIDI coefficient is -0.741, significant at the level of 1%. In the sample of non-state listed companies, the EIDI coefficient is -0.640, significant at the level of 5%, which suggests that the quality of EIDI is more negatively correlated with the cost of equity capital. Hypothesis 2 is true.

Table 6: Multilevel linear regression results

Variables	Full sample regression	Grouping regression	
		State-owned companies	Non-state-owned companies
Constant item	-0.0469 (-0.08)	-0.0893 (-0.11)	-0.621 (-0.50)
EIDI	-0.691*** (-4.47)	-0.741*** (-3.05)	-0.640** (-2.23)
ASSET	0.0453 (0.95)	0.0408 (0.43)	0.0960 (1.74) *
LEV	0.129 (1.79) *	0.0718 (1.22)	0.225 (1.77) *
BM	-0.0479 (-0.55)	0.0480 (0.33)	-0.112 (-1.94) *
ROA	0.248 (0.38)	0.383 (0.45)	0.516 (0.34)
TAT	-0.0119 (-0.19)	0.0304 (0.30)	-0.0539 (-0.53)
DP	-0.485 (-1.04)	-0.783 (-1.95) *	-0.325 (-0.42)
TOP	0.370 (1.75) *	0.624 (1.84) *	0.350 (1.26)
CSP	-0.0759 (-0.26)	-0.0314 (-0.07)	-0.0148 (-0.03)
adjR <sup>2</sup>	0.048	0.028	0.043
N	140	84	56

Note: \*\*\*, \*\*, and \* are significant at the 1%, 5%, and 10% levels, respectively, and t is the value in parentheses.

## 7. Conclusion and comments

This survey traces data from Shandong's listed companies in the chemical industry in 2014-2017 to empirically test how the EID has an impact on the cost of equity capital. A few of conclusions are drawn herein: (1) the EID and the cost of equity capital of listed companies in the chemical industry have a significantly negative correlation. Improved quality of EID can reduce the cost of corporate equity capital, which suggests that Chinese stock investors have taken the EID level on board when assessing risk and developing strategies. (2) as compared to non-state-run companies listed in chemical industry, state-owned companies have been subjected to more environmental supervision, and the EID has reduced the cost of equity capital more significantly.

The chemical companies in China must follow the road of sustainable development. They should give consideration to their own development and environmental protection. In doing so, they have to fully disclose the company's environmental behaviours, thus creating a good external development environment. The government and the stock market should further devote greater effort to supervise these through compulsory

measures, establish a sound system for EID, and standardize corporate behaviours in this regard. Chemical companies should continuously intensify the environmental protection management, improve the EID quality, make their signal transmission function in this area to reach their full potential, and maximize the corporate value.

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