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Quality of environmental information disclosure and enterprise characteristics

Based on heavily polluted industries of A-share in the Shanghai Stock Exchange

Jianshu Wang and Bo Zhang
Qingdao University, Qingdao, China

Abstract

Purpose – Based on several important environmental protection and information disclosure policies that have been issued in China, the purpose of this paper is to test the relationship between characteristics and the environmental information disclosure quality of sample companies.

Design/methodology/approach – The OLS regression analysis is selected for this research which takes China's heavy pollution companies listed on the Shanghai Stock Exchange from 2015 to 2016 as samples.

Findings – The quality of these environmental information disclosures needs to be strengthened, and while the quality of the disclosures among the companies examined improved significantly in 2016 compared with 2015, there are still high variations in quality from industry to industry. In addition, the scale of company is most closely correlated to the quality of environmental information disclosure and the economic situation of the enterprises is the next. Other factors affecting the disclosure quality include in order the degree of local economic development the scale of the state-owned shares and the independent directors. Listed years and equity restriction show a positive correlation but not significant in statistics.

Originality/value – The research will assist administrative organizations to allocate governance sources effectively, plan governance investment as a whole, and improve the overall level of the disclosure of environmental information while strengthening the governance efficiency and effectiveness, according to the correlation and degree between the company characteristics and environmental information disclosure quality.

Keywords Enterprise characteristics, Heavy pollution industry, Quality of environmental information disclosure

Paper type Research paper

1. Introduction

After more than 30 years of rapid economic growth stemming from reformation policies – including the "open door policy" – the standard of living in China has greatly improved. However, the extensive means of development in the long term has also made the deterioration of the quality of China's environment increasingly serious (Wang and Sun, 2018). Over the last few years, air pollution, revealed by frequent haze in most of central and eastern China, has caused widespread respiratory diseases (Cao and Wang, 2017).

On April 24, 2014, the President of the People's Republic of China, Xi Jinping, signed the 9th Presidential Decree and passed the emendatory "Environmental Protection Law of the People's Republic of China." The act notably calls for more transparency by these pollutant discharging units, exposing conditions of pollution control facilities to society, and thereby accepting social supervision that would ensure. Then, the Report of the 19th National Congress of the Communist Party introduced a developmental goal aiming "to accelerate the systematic reform of ecological civilization and build a beautiful China." In effect, this points out that China should focus on serious environmental issues by trying to build and perfect mandatory disclosure of information systems.

In fact, supervisory organizations in China had formulated and implemented some specific regulations in the field of environmental information disclosure long before the issue of the new Environmental Protection Act. For example, the State Department of

Environmental Conservation passed the "Opening of the Environmental Information Rules (on Trail)" on February 8, 2007, which has since regulated the opening of government environmental information and enterprise environmental information. In the majority of countries, companies listed on the stock market are supposed to be strictly regulated. The "Environmental Information Disclosure Guidelines for Listed Companies on Shanghai Stock Exchange" issued by the SSEC in 2008 and "Environmental Disclosure Guidelines for Listed Companies" (hereinafter referred to as Guidelines) issued by Ministry of Environment in 2010 are both regulations to lead listed companies to actively exhibit social responsibility insofar as environmental protection is concerned. They also point out listed companies in industries associated with heavy pollution should disclose environmental information at regular intervals, issue an annual environmental report and encourage listed companies in other fields to implement by reference to the results revealed. The complete and comprehensive disclosure of environmental information is at the crux of environmental protection, so the compiling and disclosure of environmental information in listed companies is vital to aid creditors, investors, the public and government administrations in learning about enterprise environment protection situations.

Though all industries causing heavy pollution are subject to the same regulations, different companies' performances can heavily impact the quality of environmental information disclosure. Only can high quality of environmental information disclosure work effectively in information transfer, thus becoming an important part of social and government supervision. The focus of this paper aims to find enterprise characteristics related to the quality of environmental information disclosures, as well as to assist the management department in formulating and implementing policies and procedures that will improve the quality of environmental information disclosures. According to enterprise characteristics and the quality of environmental information disclosures, to some extent we can plan the governance investment as a whole for any governance measures that need to take into account cost. Accordingly, these characteristics need to be prioritized and invested in, for grasping the main direction of governance is necessary. We should also realize that effectively allocating governance sources is vital to improving overall quality. Meanwhile, the governance department can choose different supervisory strategies or incentives to strengthen governance efficiency and effects targeting enterprises with different characteristics.

The main contributions of this paper include the following aspects: we design a new method to measure the quality of environmental information disclosure and we enlarge the research field of environmental information disclosure from annual reports to social responsibility reports and environmental reports, which overcomes the shortcomings of depending too much on financial reports in previous researches and fully reflects the environmental performance of enterprises.

This paper intends to achieve two aims. First, it focuses on the current situation and characteristic about environmental information disclosure of China's industrial companies causing heavy pollution listed on SSEC and attempt to reveal some main problems. Second, it offers proposals to improve the quality of environmental information disclosure and provide a direction for the future environmental governance.

Apart from Section 1, there are five parts in this paper. The second section is related to literature review, followed by research design and assumptions, samples and descriptive statistics, the empirical analysis results. The last section is the conclusion.

2. Literature review

2.1 Background
In March 1989, the issue of environmental information disclosure was first raised during the seventh meeting of the export working group on international conferences and reporting standards (Bi *et al*, 2012). Consequently, researchers from various countries started

conducting research. Now, the research method of environmental information disclosure can be divided into several classes: canonical analysis, case analysis, theoretical model, data analysis and empirical analysis. In empirical analysis, some researchers use environmental information disclosure as an explanatory variable, while others use the research itself as an explanatory variable. The approach for this paper reflects the latter. There are two ways to do the research when we take samples from listed companies in the capital market and use environmental information disclosure as an explanatory variable in research. One way only focuses on the effect on environmental information disclosure caused by specific factors, while another way does not set any limitations on explanatory variables. The content basically covers external factors such as system, culture, pressure, political connection and internal factors including enterprise business capacity, internal system and governance, environmental performance and investment in environmental protection. The research results are as follows.

Wang's (2008) research shows that the restraints of external supervision systems are significant to the improvement of environmental information transparency. Bi Qian *et al.* (2012) also proved that the issue and implementation of environmental information disclosure laws and regulations did improve the level of enterprise environmental information disclosure. The research (2015) after them once again proved that traditional culture and environmental systems are positively correlated to the level of environmental information disclosure; meanwhile, traditional culture and environmental systems are complementary. Zhang *et al.* (2016) believes government supervision pressure and market pressure can elevate the enterprise environmental information disclosure level, but pressures related to social opinion do not have a meaningful impact. Coerciveness, imitativeness isomorphic institutional pressure largely influences the probability and level of the environmental information disclosure in a positive way while standardization isomorphic institutional pressure affects the probability and level of the environmental information disclosure in a negative way (Xiao *et al.*, 2016). The higher the enterprise external governance is, the higher the quality of environmental information disclosure (Ye *et al.*, 2015). The negative relationship between political connection and environmental information disclosure was proved in the research done by Yao Sheng (2011), while Wu *et al.* (2015) formed an opposing conclusion.

Among enterprise internal factors, the scale of company, profitability and operation capacity are positively correlated to the environmental information disclosure level (Cheng *et al.*, 2011), but Zheng and Xiang (2013) does not support the conclusion that operation capacity significantly affects environmental information disclosure, representing the positive relationship between ownership structure of the degree of ownership concentration, ratio of outstanding shares and environmental information disclosure (Cheng *et al.*, 2011). Similarly, Huang Jun and Zhou (2012) proves that controlling shareholders, the degree of equity balance, a high shareholding ratio and ownership of property can effectively lead the management layer to actively disclose environmental information. Li and Feng (2015) shows that the environmental information disclosure level in listed companies in the manufacturing industry has risen steadily year after year, and internal controls working as institutional systems of the company have noticeable positive effects on environmental information disclosure levels. Hou and Sun (2017) support the above opinion and demonstrate institutional environment can adjust this influence relation. Meanwhile, the more enterprises invest in environmental protection, the more likely they can transmit high-quality environmental information (Li and Feng, 2015). In the research about the relationship between environmental performance (or social responsibility performance) and environmental information disclosure, it is agreed that environmental performance has a remarkably positive effect (Chen and Lindkvist, 2013; Wu *et al.*, 2015; Wang and Ni, 2016). However, the research results in Shen *et al.* (2014) demonstrate a U shaped relationship between enterprise environmental performance and environmental information disclosure, different from other research on linear relations.

2.2 Evaluations and comments

In these research findings taking Chinese listed companies as samples, the relationship between enterprise scale and environmental information disclosure reveals a high consistency of results based on the same variable (except Kong and Tang's, 2016 findings), while the performance on other variables is far less consistent. Different performances on these companies are related to the selected differences between samples (including selected industry differences and differences between the plates), the difference in annual selection and differences on variable specific assignment.

In the design and acquisition of environmental information disclosure, Wiseman (1982) used content analysis to obtain results through dividing the enterprise environmental information disclosure into indicator categories and detailing the indicators at a rather early time, and his method was subsequently referred to and imitated by scholars (Zhang *et al.*, 2016). The research has expanded from merely identifying directional indicators to accounting for directional indicators, and some research even considers the disclosure method. There are no official regulations on measuring environmental information disclosures. So researchers use a method of quantification by awarding points, but this design is not consistent across research in this field. This paper adapts research results presented by previous researchers who awarded points on the quality of environmental information disclosure, but it first considers the measure standards on the quality of information, then it considers factors of specific environmental information disclosure. Meanwhile, it should account for related laws and regulations when awarding a number. The details are as follows.

3. Research design and hypothesis

3.1 Research design

The research describes the characteristics of the sample company in terms of its SIZE, ZONE, PUBLICYEAR, GOVERNANCE, OPERATING STATUS and INDUSTRY CATEGORY. We chose equity structure (including the state-owned system and equity balance system) and independent director scale to thoroughly expound company governance. A liner regression model was used in examining the relationship between the corporate environmental information disclosure quality and its characteristic (together, the sample year was under control). Concrete definition of variables and calculation are shown in Table I:

$$EIDQ = \beta_0 + \beta_1 SIZE + \beta_2 \sum ZONE + \beta_3 PUBLICYEAR + \beta_4 STATE$$

$$+ \beta_5 EB + \beta_6 IDS + \beta_7 NOCF + \beta_8 \sum INDUSTRY + \beta_9 YEAR + \varepsilon.$$

3.2 Variable being explained

In this paper, EIDQ is the explained variable. In our opinion, the measurements of the disclosure quality have similarities. On top of its comprehensiveness, the authenticity, timeliness, thoroughness and explicitness should also be considered when accounting for disclosure quality. In other words, a high-quality information disclosure must be authentic, integral, thorough, transparent and timely; environmental information disclosure is no exception.

It is a pity that we cannot ensure the authenticity in a satisfying way, because now China only has a few environmental information attestation activities. This problem holds back the quality of the assessment of environmental information quality, but it does not mean we can deny the value of other information's quality, because we cannot assume that all information is fake. Meanwhile, this problem exists not only in the environmental information sector, and

Variable	Definition
Variable being explained	
EIDQ	Environmental information disclosure quality comes from the evaluation for environmental information being disclosed
Test variable	
SIZE	Corporate size is the natural logarithm of closing assets
ZONE	The development status of regional economy. Set up two dumb variables with underdeveloped region as the control group. 1 represents ZONE1– the developed region, and ZONE2 the secondary developed region
PUBLICYEAR	The public year of the corporation
STATE	Make the state-owned holing 1, others 0
EB	Equity balance system is about the aggregate proportion of the second and the fifth share or the shareholding ration of the shareholders
IDS	Independent director scale indicates the number of the independent directors
NOCF	Net operating cash flow shows the amount of the net closing cash flow
INDUSTRY	Industry: taking the coal industry as the control group set up 14 dumb variables
Controlled variable	
YEAR	Sample year: 1 represents 2016, 0 represents 2015

Table I.
Definition of variable
and evaluation

it cannot be solved by only one researcher. We believe that it will be gradually improved, even fixed, as the environmental information attesting business expands.

All in all, this paper will assess the EIDQ from four dimensions – integrity, timeliness, thoroughness and explicitness, which represent the comprehensiveness, profundity and promptness of the environmental information disclosure. Among which, integrity and timeliness, by evaluating the analysis of existing official regulation (mainly the Guidance issued by the Environmental Department in 2010), seek to follow the past experience. At the same time, thoroughness and explicitness play a supplementary role. The detailed process is as follows.

In the dimension of integrity, 18 environmental information disclosure projects were set based mainly on the Guidance issued by the Environmental Department in 2010 and partly on the Guidance issued by the Shanghai government in 2008. There are 18 points in total with one point for each project. As for timeliness, we will first consider whether the reports conform to the criteria or not. The Guidance stresses that the listed corporation should announce its annual environmental report on its environmental protection department website and its corporate website at the same time. Annual environment report period, in principle, is an accountant year – from January 1 to December 31. The environmental information report can be disclosed together with the corporate annual report. That is to say, the Guidance requires that the disclosure of the environmental information should be made in the form of an independent report. As a result, our evaluation of timeliness is mainly based on the issuance independent environmental information report. Thus, we give two points, the minimum one, to those who disclosed environmental information without an independent environmental information report. At the same time, we take the deadline (April 30 of next year) as the passing mark for the evaluation of timeliness, which means, if the independent environmental information disclosure is finished before April 30, it can be given at least six points (ten is the full mark), or it can be given only four points. There are three levels above the passing points according to the publishing time. If the issuing time is before March 31, then it can be given ten points; if it is between April 1 and 20, six points; if it is at the end of the month (April 21 to 30), four points. It is hard to find a unified quantitative criterion to assess the thoroughness and explicitness; therefore, subjective judgment was the main method used to determine whether the environmental information has a high quality or not. Specifically, there

are three levels for thoroughness: incomplete (two points), relatively thorough (four points) and perfectly thorough (six points). The selection of the explicitness is mainly based on its comprehensibility. More specifically, two points to those corporations who only use words to disclose environmental information and do so in a vague way; four points to those who use quantitative and graphic methods and with clear expression; six points to those who express perfectly clear and use words, quantitative and graphic methods as well as examples; based on these three criterion, eight points (the maximum) to those who give a clear description of their cases making it easier for readers to understand.

The total points of the above dimensions are the original score of the EIDQ. On the basis of this score, the centesimal system was used in order to keep in line with thinking habit. To be clear, when evaluating relevance, which has attracted much public attention, we just evaluate the information disclosure related to environment. Therefore, it will not be mentioned in this evaluation system.

3.3 Explanatory variables and research hypothesis

Corporate size is a variable that was widely used in empirical study. Compared to small companies, the large ones have a stronger economic strength and are more professional in management. As a result, they are more capable of disclosing environmental information. At the same time, it is easier for them to receive attention from the public and press. That is the reason why they cared so much more about their reputation and social responsibility and are more willing to provide high-quality environmental information disclosure. Thus, our anticipations are as follows:

H1. The larger the corporation is, the higher quality of environmental information disclosure it might provide.

ZONE is used to measure the developing degree of the region. The more prosperous the region is, the stronger sense of participation and democratic awareness its people and corporations will have. In contrast, people and corporations in underdeveloped regions pay much more attention to their own economic status, thus ignoring other aspects. This paper, for starters, collected the registration places of the sample companies. Then based on the ranking of provincial per capita GDP issued by the Statistics Bureau of China 2016, which was calculated on the basis of the GDP in 2016 and population data in 2015, we have divided them into three levels: prosperous region (the first place to the tenth); secondary developed region (the eleventh to the twentieth) and underdeveloped region (the twenty-first to the thirty-first):

H2. The more prosperous the region is, the higher quality of environmental information disclosure it might provide.

PUBLICYEAR means the duration of the sample company in the capital market, and the longer the duration is and the more familiar the company is with the capital institution environment, the stronger sense it will have to follow all regulations of the capital market. As a result, it will be more capable of providing high-quality information disclosure:

H3. The longer its public year, the higher quality of environmental information disclosure it might provide.

State-owned corporations have long been considered as the main bearer of social responsibility, and they need to perform various responsibilities before they deliver the economic one. This policy incentive allows state-owned corporations to provide a higher quality of environmental information disclosure:

H4. State-owned corporations can provide a higher quality of environmental information disclosure.

Equity balance is another measurement of holding-structure. Through an internal check system, no shareholders can solely control the decision outright. Therefore, the random behavior of the shareholders and the managements can be restricted so as to improve corporate governance. The research of Huang and Zhou (2012) shows that equity balance can make the management's practices go a long way toward long-term development and can improve their environmental information disclosure quality:

H5. The higher the equity balance degree it has, the higher quality of environmental information disclosure it might provide.

IDS represents the number of the independent directors of the sample company. Independent directors can, from the external perspective, provide decisions for internal governance independently:

H6. The more the independent directors it has, the higher quality of environmental information disclosure it might provide.

NOCF can tell the financial situation of the corporation. For corporations, economic interest comes first, and they are less likely to abandon this interest to achieve others. Thus, the financial situation determines how they pursue and achieve other goals. Corporations with a better financial situation are more likely to finish corporate environmental information disclosure. In most research, ROA and ROE were chosen to assess the financial situation. But we believe that the key is the transformation from corporate profitability to cash flow. Meanwhile, this net cash flow should come mainly from corporate operation income rather than investment and capital raising. Thus, this paper chooses net operating cash flow to measure the financial situation:

H7. The more net operating cash flow it has, the higher quality of environmental information disclosure it might provide.

INDUSTRY is used to examine the difference (most research only pointed out the control to the industries instead of the results) of the EIDQ between the sample companies in 15 industries. (The Guidance has defined 16 highly polluted industries. However, in the process of sample evaluation, we have not obtained an effective sample in the leather industry. Thus, 14 dumb variables were set up with the coal industry being the control group). Among all high-pollution industries, the quality of the disclosure is different. Therefore, the awareness of different EIDQ in different industries can lead to more targeted supervisory measures. We have not yet made detailed expectations because of the large amount of industries.

Besides, we will take sample year as the controlled variable to control the YEAR difference of the sample observation, because it does not belong to corporate characteristics.

4. Sample and statistical description
4.1 Sample selection and data sources
In the selection of samples, this paper considers that the values of explained variables are mainly based on guidelines (The disclosure of environmental information in heavy pollution industries is mandatory in the guidelines, and the selection of integrity projects also mainly comes from the guidelines). At the same time, we also referred to the guidelines of the SSEC (the Shenzhen Stock Exchange has not yet issued any relevant guidelines specifically for environmental information disclosure), so the sample was defined as A-heavy pollution industry of the SSEC. In the selection of the time of the sample, the new environmental protection law in 2014 was chiefly considered because it reflects China's unprecedented environmental protection efforts, and it is known as "the strictest one in history," particularly emphasizing the social disclosure of environmental information (The bill was implemented on January 1, 2015); thus, we selected the company at the year of 2015–2016 as a sample (the relevant information has not yet been fully reported in 2017).

In this paper, the A-share listed companies in the SSE of China from 2015 to 2016 were first matched with the industry classification of listed companies in Guotai'an CSMAR database through 16 heavy pollution industry directories (because the classification of heavy pollution industry is different from it in the Guotai'an database), and the heavy pollution industry was preliminarily identified. The specific match is shown in Table II.

On the basis of the above matches, we read the company reports one by one to identify whether the company belongs to the heavy pollution industry. Among them, no effective samples were found in the leather, paper and brewing industries in 2015. The total number of sample companies is 361 (159 in 2015, 202 in 2016), involving 15 heavily polluting industries, and there are 366 environmental information reports. The locations of environmental information are shown in Table III.

As mentioned above, the explained variable (quality of environmental information disclosure) of the sample company is manually obtained through reading the environmental information report and annual report of the company, and the report information is mainly obtained from the great tide network. The data of other variables mainly comes from the Guotai'an database or has been obtained through corresponding calculation and processing. The data of state-owned holding variables are from the wind database.

Name of heavy polluting industry	Guotai'an database industry classification		Name of heavy polluting industry	Guotai'an database industry classification	
	Code	Name		Code	Name
Thermal popup	D01	Production and supply industry of electricity, steam and hot water	Building materials	E01	Civil engineering construction industry
	D03	Gas production and supply industry		E05	Decoration industry
Steel	C65	Ferrous metal smelting and rolling processing industry	Papermaking	C31	Papermaking and paper products industry
	B05	Ferrous metal mining and selection industry	Brew	C05	Beverage manufacturing
Cement	C61	Non-metallic mineral products industry	Pharmacy	C81	Pharmaceutical manufacturing
Electrolytic aluminum	C67	Non-ferrous metal smelting and rolling processing industry		C85	Biological products industry
Coal	B01	Coal mining and selection industry	Fermentation	C01	Food processing industry
Metallurgy	C65	Ferrous metal smelting and rolling processing industry		C03	Food manufacturing
	C67	Non-ferrous metal smelting and rolling processing industry	Textile	C11	Textile industry
Chemical industry	C43	Chemical raw materials and chemical products manufacturing	Tanning	C14	Leather, fur, feather and products manufacturing industry
	C47	Chemical fiber manufacturing	Mining industry	B49	Other mining selection industry
	C48	Rubber manufacturing		B50	Mining service industry
	C49	Plastic manufacturing		B07	Non-ferrous metal mining and selection
Petrochemical	C41	Petroleum processing and coking industry		B09	Non-metallic mining and selection

Note: The code in the table is the company industry code in the Guotai'an database, which is different from the industry classification code of CSRC

Table II.
Preliminary matching of heavy polluting industry classification with it in Guotai'an database

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Name of heavy pollution industry (number of reports)	2015					2016				
	Environmental report	Social responsibility report	Sustainable development report	No independent report	Total	Environmental report	Social responsibility report	Sustainable development report	No independent report	Total
Thermal power (41)	0	12	0	8	20	1	13	2	5	21
Steel (36)	0	11	1	6	18	1	9	1	7	18
Cement (25)	0	3	0	8	11	0	7	0	7	14
Electrolytic aluminum (5)	0	1	0	1	2	1	1	0	1	3
Coal (25)	0	7	0	5	12	0	8	0	5	13
Metallurgy (25)	1	4	1	6	12	2	5	0	6	13
Chemical industry (63)	0	10	0	16	26	0	13	0	24	37
Petrochemical (3)	0	1	0	0	1	0	2	0	0	2
Building materials (6)	0	1	0	1	2	0	3	0	1	4
Papermaking (10)	0	0	0	0	0	1	5	0	4	10
Brewing (4)	0	0	0	0	0	0	2	0	2	4
Pharmaceutical (80)	0	16	0	26	42	0	13	0	25	38
Fermentation (15)	0	3	0	1	4	0	6	0	5	11
Textile (11)	0	1	0	2	3	0	3	0	5	8
Tanning (0)	0	0	0	0	0	0	0	0	0	0
Mining industry (17)	2	5	0	1	8	2	5	0	2	9
Total (366)	3	75	2	81	161	8	95	3	99	205

Notes: Tanning industry belongs to heavy pollution industry, but no one company is required to disclose the environmental information. Similarly, there are no valid samples in papermaking and brewing industry in 2015

Table III.
Disclosure of
environmental
information report of
sample companies

4.2 Description of environmental information disclosure quality of the sample company
It can be seen from Table IV that compared with 2015, the level of environmental information disclosure in almost every industry in 2016 showed a significant increase (except the fermentation industry). According to the four dimensions of environmental information disclosure quality, 2016 is better than 2015. Inter-industry comparison shows that the petrochemical industry has the highest level of environmental information disclosure, with a standardized score of 75 in 2016. However, the overall environmental information disclosure quality of heavily polluting industries has not yet reached a satisfactory level.

4.3 Descriptive statistics of variables
Table V shows the descriptive statistical results of sample variables in the regression model. The standardized average score of environmental information disclosure quality of all sample companies is 42.19 points. Although there was no official or accepted criterion to evaluate the results, the results were not optimistic according to conventional criteria. Companies in the upper quartile did not reach the generally accepted pass line (score 54.76). A total of 52 percent of these companies are in economically developed regions and 22 percent are in economically underdeveloped regions. The average listing period is nearly 13 years, the longest of which has been in the capital market for 24 years. In total, 59 percent of the companies are state-owned and there are seven independent directors at most, but some companies do not have independent directors.

4.4 Correlation test
Because of the different types of variables used in different correlation coefficient tests, Pearson correlation coefficients are used in fixed distance variable correlation tests provided in Table VI, and Spearman correlation coefficients are used in the other variables. While the sub-developed regions and equity balance degree have no significant relationship with the explained variables, in the test variables the correlation between other variables and the quality of environmental information disclosure is obvious, and the direction of the correlation is basically in line with expectations. However, the significance of age variable of listed companies is slightly weak, which is only significant at the significance level of 0.1. The correlation coefficient matrix can also be used to diagnose multicollinearity between independent variables. The maximum correlation coefficient between independent variables is 0.564 (it exists in regions divided according to the degree of economic development, and this correlation is unavoidable). The correlation coefficient of more than three quarters is below 0.2, which is not enough to affect the applicability of the test model.

5. Empirical analysis results
5.1 Main inspection results
According to Table VII, a D-W value close to 2 (1.942) indicates that the perturbation term sequence has a small degree of auto-correlation. The regression normalized residual histogram (Figure 1) shows the standardized residual with a mean normalized residual value of −2.18E-15 (-2.18×10^{-15}), a standard deviation of 0.968, tending to standard normal distribution with a mean value of 0 and a standard deviation of 1. The standard P-P graph of regression normalized residuals (Figure 2) also intuitively reflects that the model normalized residuals basically conform to the normal distribution. These results indicate that the model satisfies the basic assumptions of multiple linear regression. The F-statistic for measuring the overall significance of the regression equation is 9.240, which is statistically significant, and the variable explanatory force Adj. R^2 reaches 0.345. The VIF results also show that the model does not have serious multicollinearity problems.

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Name of the industry	Average score of industry in 2015 (n = 159)						Average score of industry in 2016 (n = 202)					
	Integrity	Timeliness	Elaboration	Clarity	Total score	Sandardization	Integrity	Timeliness	Elaboration	Clarity	Score	Standardization
Thermal power	6.20	5.80	2.30	2.60	16.9	40.24	7.59	6.70	2.90	3.70	21.25	50.60
Steel	7.06	5.78	3.78	2.89	19.5	46.43	8.44	6.00	3.56	3.67	21.67	51.60
Cement	6.09	3.82	2.18	2.54	14.64	34.86	6.29	5.29	2.86	2.57	17.00	40.48
Electrolytic aluminum	4.00	6.00	3.00	3.00	16.00	38.10	6.00	7.33	3.33	4.00	20.67	49.21
Coal	6.33	5.33	3.33	3.50	18.50	44.05	7.77	5.69	3.38	3.85	20.69	49.26
Metallurgy	7.09	5.09	4.00	3.64	19.82	47.19	7.42	4.67	4.00	4.00	20.08	47.81
Chemical industry	5.58	4.23	3.00	2.69	15.5	36.90	5.95	4.22	3.08	3.68	16.92	40.29
Petro- chemical	9.00	6.00	4.00	4.00	23.00	54.76	13.50	8.00	5.00	5.00	31.50	75.00
Building materials	6.50	6.00	4.00	2.00	18.50	44.05	10.50	6.00	4.00	4.50	25.00	59.52
Papermaking					0		8.40	6.60	3.60	3.80	22.40	53.33
Brewing					0		4.00	5.00	2.50	3.00	14.50	34.52
Pharma- ceutical	4.90	3.86	2.83	2.93	14.48	34.48	4.32	4.37	3.00	3.42	15.11	35.98
Fermen- tation	3.25	7.00	2.00	2.00	14.25	33.93	4.00	5.45	2.00	2.00	13.45	32.02
Textile	2.67	4.67	2.00	2.67	12	28.57	7.00	4.50	3.25	3.00	17.75	42.26
Mining industry	6.71	7.71	3.71	4.28	22.43	53.40	8.00	8.00	4.00	4.75	24.75	58.93
Total	5.79	4.91	3.00	2.94	16.62	39.57	6.55	5.33	3.19	3.53	18.60	44.29

Table IV.
Average scores of
environmental
information disclosure
quality industries of
sample companies

Var.	n	Min.	Max.	Mean	Median	SD	Q1	Q3
EIDQ	361	16.67	100	42.19	38.10	19.18	26.19	54.76
SIZE	361	19.45	27.07	23.07	22.98	1.41	22.04	24.00
ZONE1	361	0	1	0.52	1	0.50	0	1
ZONE2	361	0	1	0.22	0	0.42	0	0
PUBLICYEAR	361	0	24	12.99	14	6.27	11	17
STATE	361	0	1	0.59	1	0.49	0	1
EB	361	0.01	3.25	0.59	0.40	0.56	0.16	0.85
IDS	361	0	7	3.20	3	1.10	3	4
NOCF	361	−9,300	81,900	2,070	489	6,700	94.2	1,650
INDUSTRY	361	0	1	–	–	–	–	–
YEAR	361	0	1	0.56	1	0.50	0	1

Notes: Q1 is the lower quartile and Q3 is the upper quartile. The measuring unit of NOCF is one million RMB

Table V.
Descriptive statistics
of sample variables

The regression results show that the quality of environmental information disclosure is significantly related to the company scale, regional economic development, corporate governance and business conditions. Specifically, the larger the company, the higher the quality of corporate environmental information disclosure. This is also the most consistent variable in the current relevant research (some studies have not supported this conclusion. For example, Kong Huige and Tang's (2016) study found that the size of the enterprise was negatively correlated with environmental information disclosure, but it was not statistically significant). When there is a big difference in the degree of economic development in the region where the company is located, the quality of environmental information disclosure also shows significant differences. If there is little difference in the degree of economic development, there is no significant difference in the quality of disclosure (the performance is statistically insignificant in sub-developed regions). In the corporate governance equity structure, the performance of state-owned shares was significant, and there was no significant relationship between the balance of equity and the level of environmental information disclosure. However, companies with a large number of independent directors have a high quality of environmental information disclosure. The relationship between operating net cash flow and the quality of environmental information disclosure is also very obvious, indicating that for profit-oriented enterprises, a good financial situation is a basis for high-quality environmental information reporting.

From the above correlation degree, the company's scale is the most relevant, followed by the company's net cash flow, then the degree of economic development, state-owned shares and independent directors' scale. There is a positive correlation between the listed years and the quality of environmental information disclosure, but it is not statistically significant.

In the verification of industry differences, we take the coal industry as a reference group and conclude that the quality of environmental information disclosure in the metallurgy, mining, chemical engineering, papermaking, steel and petrochemical industries (sorted by the differences) is significantly higher than that of the coal industry. And under the premise of a significance level of 0.1, the textile industry is slightly higher than the coal industry ($p = 0.096$). The coefficient of the variables of the pharmacy, building materials, electrolytic aluminum, cement, brewing and thermal power industries is positive, and the coefficient of the fermentation industry variable is negative, but not statistically. That means there is no substantial difference in the quality of environmental information disclosure between these industries and the coal industry.

In summary, *H1*, *H2*, *H4*, *H6* and *H7* are supported (but the difference in environmental information disclosure quality in *H2* which is between secondary developed economic

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Var.	EIDQ	SIZE	ZONE1	ZONE2	PUBLICYEAR	STATE	EB	IDS	NOCF	YEAR
EIDQ	1									
SIZE	0.492 (0.000)	1								
ZONE1	0.148 (0.005)	0.025 (0.639)	1							
ZONE2	−0.050 (0.348)	0.023 (0.664)	−0.564 (0.000)	1						
PUBLICYEAR	0.093 (0.077)	0.099 (0.060)	−0.045 (0.390)	0.081 (0.124)	1					
STATE	0.307 (0.000)	0.320 (0.000)	−0.057 (0.281)	0.013 (0.801)	0.269 (0.000)	1				
EB	−0.064 (0.223)	−0.119 (0.024)	0.119 (0.023)	0.031 (0.563)	−0.119 (0.024)	−0.342 (0.000)	1			
IDS	0.256 (0.000)	0.348 (0.000)	0.025 (0.633)	−0.051 (0.336)	0.369 (0.000)	0.346 (0.000)	−0.051 (0.336)	1		
NOCF	0.346 (0.000)	0.512 (0.000)	0.168 (0.001)	−0.012 (0.827)	−0.040 (0.453)	0.157 (0.003)	−0.012 (0.827)	0.100 (0.058)	1	
YEAR	0.132 (0.012)	0.040 (0.454)	0.047 (0.369)	0.065 (0.221)	0.040 (0.446)	−0.043 (0.420)	0.065 (0.221)	−0.091 (0.084)	0.135 (0.010)	1

Notes: The probability is shown in brackets, and Pearson and Spearman correlation coefficient is used, respectively, to test different types of variables

Table VI.
Correlation test of
variables

Var.	Exp. sign	Coef.	t	Sig.	VIF
C			−4.510	0.000	
SIZE	+	0.357	5.528	0.000	2.290
ZONE1	+	0.132	2.358	0.019	1.781
ZONE2	+	−0.007	−0.124	0.901	1.560
PUBLICYEAR	+	0.020	0.398	0.691	1.427
STATE	+	0.124	2.199	0.029	1.749
EB	+	−0.020	−0.411	0.681	1.243
IDS	+	0.117	2.259	0.025	1.485
NOCF	+	0.151	2.914	0.004	1.470
YEAR	+	0.101	2.233	0.026	1.117
Industry					
Steel	/	0.149	2.283	0.023	2.328
Mining	/	0.177	3.265	0.001	1.609
Fermentation	/	−0.006	−0.103	0.918	1.730
Textile	/	0.096	1.670	0.096	1.818
Petrochemical	/	0.133	2.931	0.004	1.136
Chemical	/	0.174	2.082	0.038	3.854
Cement	/	0.033	0.523	0.601	2.144
Electrolytic aluminum	/	0.037	0.787	0.432	1.242
Metallurgy	/	0.199	3.268	0.001	2.037
Pharmacy	/	0.114	1.248	0.213	4.550
Thermal power	/	0.013	0.190	0.849	2.249
Building material	/	0.046	0.980	0.328	1.231
Brewing	/	0.021	0.445	0.657	1.236
Papermaking	/	0.171	3.234	0.001	1.543
n	361				
F	9.240				
Sig.	0.000				
R^2	*0.387*				
Adj. R^2	*0.345*				
D−W	1.942				

Table VII.
Regression analysis results of environmental information disclosure quality and enterprise characteristics
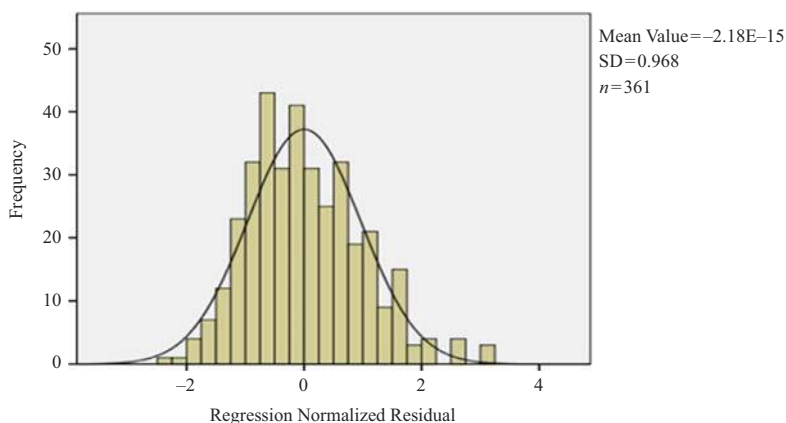
Figure 1.
Regression normalized residual histogram

regions and underdeveloped economic regions is not significant), while *H3* and *H5* have not been verified. At the same time, the annual variable shows that the quality of environmental information disclosure in the heavily polluting industry in 2016 was significantly better than in 2015.
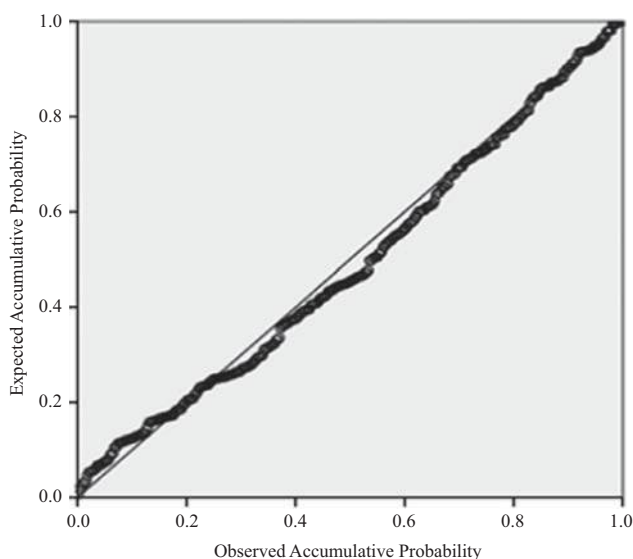
Figure 2.
Standard P–P
diagram of regression
standardized residual

5.2 Sensitivity analysis

In order to test the robustness of the results, we performed the following sensitivity analysis: first, the data for the two years were tested separately. Second, the test variables were replaced as follows: make the company's operation revenue (taking natural logarithm) measure the company's size; make the share proportion of the largest shareholder replace the equity balance; the size of the board of directors replaced the size of the independent director. Third, in order to prevent the influence of outliers on the results (whether the significance of the variables of state-owned shares decreases), the outliers were eliminated by triple standard deviations.

After the two years of data were tested separately, the Adj. R^2 decreased in 2015 and increased in 2016, but the overall model for the two years remained significant (Sig. = 0.000). The significance of the size of independent directors decreased in 2016, and the performance of other test variables did not have any material impact. After replacing the variables, the model Adj. R^2 slightly decreased (0.340), but the model was still significant (F-value 9.076, Sig. = 0.000). The specific coefficient values and p-values of the variables changed, but there was no substantial difference in significance. After the outlier is removed, the result is the same as the main test, indicating that the main test data do not have an outlier of over triple standard deviation.

6. Conclusion

The research examines the relationship between environmental information disclosure quality and company characteristics by taking samples of listed companies in China's Shanghai A-share heavy polluting industry from 2015 to 2016. Through the statistical analysis of the sample observations, it is found that the quality of environmental information disclosure of the A-share heavily polluting industry in Shanghai has to be improved as a whole, but there has been significant improvement in comparing 2016 with 2015. The size of the company is the most relevant company characteristic with the quality of environmental information disclosure, and it manifests that enterprises with high quality of environmental information disclosure usually have a large size. There may be multiple driving factors behind this

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correlation, such as the ability of large companies to have better environmental disclosure capabilities, the subjective efforts to maintain a reputation for the company, or being more subject to the relevant systems. The financial situation of the enterprise itself (this paper uses the net operation cash flow to measure) and the degree of economic development in the region are also significantly related to the quality of environmental information disclosure. It means that the economic environment and economic conditions are important factors in whether companies can report environmental information with high quality. The relationship between corporate governance and environmental information disclosure quality is slightly weaker than the first three. Specifically, the state-owned shares of the shareholding structure have a significant role, but there is no significant correlation between equity checks and balances. However, the quality of corporate environmental information disclosure of large independent directors is better. The difference in the life of the sample company in the capital market is not significantly related to the quality of environmental information disclosure. At the same time, although they are both heavily polluting industries, there is a certain degree of difference in the quality of environmental information disclosure. Taking the coal industry as a reference, the environmental information disclosure quality of the six industries including metallurgy is significantly better than that of the coal industry, while the difference between other industries is not statistically significant. Sensitivity analysis supports the results of the main test.

This research extends the existing literature of environmental information disclosure on database, index design and policy suggestions. Of course this paper also has certain limitations. It only studies the disclosure situation of the companies listed on the SSE without taking into account the overall performance of all listed companies causing heavy pollution. In addition, the index design and evaluation method possess a certain degree of subjectivity, which needs a further test and improvement.

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Further reading

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Corresponding author
Bo Zhang can be contacted at: z-b514@163.com