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# Implementing Effect of Chinese Corporate Environmental Information Disclosure Policy: Empirical Data From A-Share Listed Companies in Heavy Pollution Industry

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## Abstract

Corporate environmental information disclosure policy (CEIDP) is a system tool for solving the asymmetry problem of corporate environmental information. Relevant literature suggests that there are obvious differences on implementing effect of CEIDP in different countries, regions, and industries. As far as implementing effect of CEIDP is concerned, the domestic researches have distinct opinions. Because of relating the single corporate environmental governance, environmental protection and environmental investment decision-making in microscopic scales and China's sustainable development strategy goals in macroscopic view, it is of theoretical value and practical significance to estimate implementing effect of CEIDP. Based on the mechanism of CEIDP, this article analyses comprehensively the relationship between corporate environmental disclosure and its system, builds a comprehensive index system by system function analysis, taking 2008-2010 A-share listed companies in heavy polluting industries for the study sample, and makes use of Wilcoxon rank sum test to appraise implementing effect and its lagged effects. The research results show that CEIDP is not only a statistically significant effect, but also has a lagged effect. This paper builds an operable and reflecting effect of CEIDP index system, and introduces non-parametric test method to the Evaluation of CEIDP, thus enriching the theory of CEIDP.

**Key words:** Corporate environmental information; Disclosure policy; Implementing effect; Non-parametric tests

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## INTRODUCTION

On May 1, 2008, China formally implemented the first laws and regulations related to the corporate environmental information disclosure: *Environmental Information Disclosure Method* (trial) issued by Environmental Protection Bureau. This policy regulates that : "Corporate shall disclose the corporate environmental information timely and accurately in accordance with the principles combining with the voluntary disclosure and mandatory disclosure", it is mandatory required for the serious pollution discharge corporate to disclose the environmental information such as names of the main pollutants, discharge modes, emission concentrations and total quantity, over weight amount, and construction and operation of the corporate environmental protection facilities, environmental pollution accident emergency plan, etc. At present, the system has been operating for more than four years. How did CEIDP be carried out in China? This issue is not only related to the decision-making with respect to the corporate environmental information supply and disclosure, environmental pollution and environmental

management, etc, also related to how the social public can fully understand the information conditions that the corporate performs the environmental responsibility, and finally related to the national economic and environmental sustainable development.

The study on the effect of corporate environmental information disclosure policy (CEIDP) can be divided into two kinds: one study thinks that the system effect is remarkable. Take Australia as an example, Frost (1997) found that the quantity and quality of the corporate disclosure environmental information were increased significantly after the environmental information mandatory disclosure guidance was implemented, indicating that the system had the action promoting the corporate environmental information disclosure. Eisner (2004) investigated the effects of the United States environmental management system and rule changes, and pointed out that the environmental management system enhanced the corporate environmental performance, and promoted the corporate to disclose more environmental information. 1987-2005 Some Norwegian companies were taken as example, revealed that the system had the important, immediate influence on the corporate environmental information disclosure (Fallan & Fallan, 2009, p.472). The studies also showed that the systems related to the environment had the substantial impact on the environment information disclosure (Barth, 1997, p.36; Hughes, Anderson, & Golden, 2001, p.217; Lyon & Maxwell, 2010, p.39). 2007-2008 Shanghai A-share listed companies in the manufacturing industries were taken as example, studied the effect of CEIDP in china. The results showed that the environmental information disclosure contents and disclosure strength of the listed company were obviously improved after the system was issued (Lu & Li, 2010, p.63)**;** the other study thinks that the system effect is not significant. Seven Asia Pacific countries (such as Australia, Singapore, etc) were taken as example, the study by S. Mitchell (1999) showed that the culture and domestic political factors had the decisive influence on the environmental information disclosure; on the contrary, the influence of the legal system and fair market on the corporate environmental information disclosure importance is not obvious. The study based on the environmental report of Australian company showed that many companies did not strictly abide by the mandatory disclosure system, the system effect is poor (Cowan & Gadenne, 2005, p.166). Compared with the environmental information disclosure practices of French and American companies, there were not the diversity about the corporate environmental information disclosure due to the mandatory disclosure system (Crawford & Williams, 2010, p.512). The study based on the environmental information data provided by China's 31 provinces and cities government showed that the short-term effect of CEIDP was not ideal (Zhang, Mol, He, & Lu, 2010, p.1649).

The above literatures indicate that there is still argument about if CEIDP has the significant effect. Generally speaking, the studies from the China and foreign countries more focus on the studies of the corporate environmental information disclosure or corporate environmental performance evaluation. There is the relatively scarce of the direct literatures about CEIDP and effect. The existing relevant literatures often choose the descriptive statistics of small samples to study the implementation effect of CEIDP. The disclosure rate is generally used to reflect the overall conditions of the disclosure system, or single environmental information disclosure situation index is used to measure the system effect, so as to neglect the comprehensive influence of CEIDP on the environmental information disclosures (such as corporate environment cost, environmental liabilities, environmental management, etc). The literatures are rare with respect to the systemic evaluation on the effect of CEIDP.

## 1. THEORETICAL ANALYSIS AND STUDY HYPOTHESIS

Corporate production and operation activities will produce the environmental impact, the corporate environmental impact is shown by the environmental information. The environmental information disclosure means that the environmental information is expressed in a certain form. The environmental information disclosure reflects the scope, quantity and level of the corporate environmental information disclosure. The corporate environmental information disclosure will provide the decision-making reference for the relevant stakeholders such as social public, etc. CEIDP requires that the corporate disclose environmental information, and has positive role in promoting the corporate environmental information disclosure. Consequently, the operation effect of CEIDP is embodied in the environmental information disclosure quality. In other words, if the quality of the corporate environmental information disclosure is higher, indicating that CEIDP is more strictly carried out. Conversely, if the quality of the corporate environmental information disclosure is poorer, indicating that more company didn't abided CEIDP. The action mechanism of CEIDP is shown in Figure 1. It can be seen that the environmental information disclosure status reflects the implementation effect of CEIDP, is the result of the role of the policy. Observation from time lagging of the policy role, the power of CEIDP in past year will affect the future decision-making of corporate about environmental information disclosure.

It should be pointed out that CEIDP is only one of the external factors for influencing the corporate environmental information disclosure, and also includes the other external factors, such as public environmental protection awareness, regional economic level and social supervision level, etc

(Zhang & Guan, 2009, p.103), also includes the internal factors such as corporate environmental performance, social responsibility consciousness of the disclosure subject, information supply cost, accounting personnel quality, operation cost of the environmental measuring equipment, company size, company profitability, etc. (Cheng & Li, 2011, p.83; Shen & Liu, 2010, p.76; Pahuja, 2009, p.227). We believe that the study period in the 2007-2010 is not long, in addition to CEIDP, the other main external factors and the main internal factors that influence the corporate environmental information disclosure can not be big changed in the short term, because the significant changes of the corporate external factors and internal factors will be usually a long accumulation process. From the point of view of the rational economic man, the scope and level of the corporate environmental information disclosure is determined based on the relationship between the information supply cost and price, and CEIDP is also the key factor for influencing the corporate decision-making (Yusoff, Lehman, & Nasir, 2006, p.123). Because the enterprise's environmental information supply needs artificial and equipment costs. The higher the environmental information disclosure quality, the larger the cost of the environmental information supply will be (Raiborn, Butler, & Massoud, 2011, p.428; Cho, Freedman, & Patten, 2012, p.486). If the operation effect of CEIDP is poor, the cost which the corporate does not supply the environmental information is small, the corporate can choose not to disclose or less disclose the environmental information; conversely, if CEIDP is implemented strictly, the illegal cost that do not supply or less supply the environmental information is very big, the corporate will disclose the environmental information as needed.

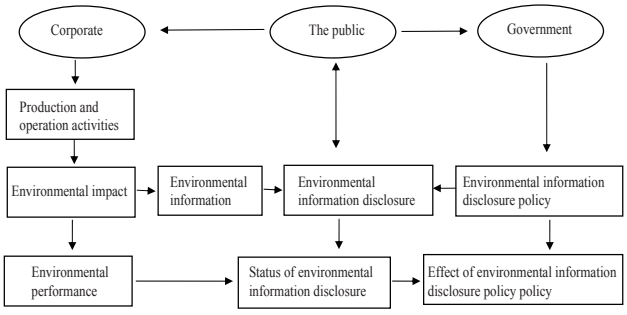


**Figure 1**
**Action Mechanism of CEIDP**

The above analysis shows that because the running effect of the disclosure system will reflect the corporate environmental information disclosure condition, if the environmental information disclosure quality of most of enterprises have been improved significantly comparing with it before the issuance of the system, indicating that the operation effect of CEIDP is good, on the contrary, the operation effect is poorer. Therefore, this paper proposes two null hypotheses:

Hypothesis 1 $H_0$: before and after the implementation of CEIDP, there is no the significant difference on the environmental information disclosure of listed company, namely, it is assumed that the system does not have the significant effect.

Hypothesis 2 $H_0$: during the follow-up years after the implementation of CEIDP, there is no significant difference on the environmental information disclosure of listed company in the short term, namely, it is assumed that the system does not have short-term hysteresis effect.

## 2. RESEARCH DESIGN

### 2.1 Sample Study and Data Sources

#### 2.1.1 The Time Definition

It can be seen from the evolution of CEIDP in china: the laws and regulations of the real CEIDP were not yet published before 2008. The formal laws and regulations were published in 2008 to encourage the corporates to voluntarily disclose. The mandatory disclosure is used for the special corporate. Therefore, this article will define 2007 as the previous year of the implementation of CEIDP, and define 2008, 2009 and 2010 as the first year, second year and third year of the implementation of CEIDP, respectively.

#### 2.1.2 The Sample Selection

The CEIDP come into being because of the problem of environmental pollution. It is pointed out in the "China Corporate Citizenship Report (2009)" Blue Book that the major source of environmental pollution in China is the industrial enterprises, accounting for about 70% of the proportion of the total pollution. Among them, the heavily polluting enterprises are also the main body of the main pollution emissions of the industrial enterprises. Therefore, the implementation objects of China's CEIDP focus on the heavy polluting enterprises, the heavy polluting listed companies are forced to carry out the environmental information external disclosure. To do this, the A-share listed companies in the heavily polluting industries are selected as the study sample. Study group will define 20 industries such as power, breweries, cement, photographic materials, chemical fiber, chemical, textile, glass, iron and steel, building materials, pesticides and fertilizers, bio-pharmaceuticals, petroleum, plastics manufacturing, clothing and footwear, water supply and gas supply, coal, printing and packaging, food, non-ferrous metals, etc as heavy polluting industries, covering all heavy polluting industries released by the Ministry of Environmental Protection in 2003 and 2008.

#### 2.1.3 Description of the Data Sources

Study group will use the official website of the Shanghai Stock Exchange, the official website of Shenzhen Stock Exchange, Phoenix Financial Network, CSMAR database and relevant public resources network as data sources, collect the types of data, including the annual reports, sustainable development reports, social responsibility

reports and day-to-day environmental information disclosure information of the A-share listed companies in the heavily polluting industries, to obtain the corporate environmental disclosure data of the A-share listed companies in the heavily polluting industries.

## 2.2 Function and Effect Evaluation Index System of CEIDP

### 2.2.1 CEIDP Functional Analysis

The first clause in the first chapter of "Environmental Information Disclosure Method (Trial)" stipulates: "In order to promote and standardize the administrative department in charge of environmental protection (hereinafter referred to as the environmental protection department) and the corporate to disclose the environment information, and maintain the interests of the citizens, legal persons and other organizations obtaining the environmental information, so as to promote public to participate in the environmental protection", therefore, the main functions of CEIDP are as follows:

#### 2.2.1.1 CEIDP Will Improve the Quality of the Corporate Environmental Disclosure

CEIDP stipulates the range, time and form, etc for the corporate environmental disclosure, standardizes the behavior of the corporate environmental information disclosure, it is the legal basis for the corporate environmental information disclosure. Therefore, CEIDP is helpful to improve the quality of environmental information disclosure.

#### 2.2.1.2 CEIDP Will Promote the Corporate to Disclose the Negative Environmental Information

The important objective of CEIDP is aimed to solving the asymmetric problem of the environmental information, and providing decision making basis for the stakeholders. Environmental information is a public good, exclusive. The corporate do not want to take the initiative to disclose the negative environmental information. Therefore, the power of the corporate that voluntarily provides the negative environmental information is not enough. So, it is necessary for a system to force the corporate to disclose the negative environmental information, so as to correct the market's failures with respect to the transmission of environmental information, so that the asymmetric problem of the environmental information can be solved to a certain extent.

#### 2.2.1.3 CEIDP Will Help the Corporate to Improve the Environmental Performance

Under the conditions of market economy, the open corporate environmental information has an important influence on the corporate value, thereby forcing those troubled enterprises to improve their environmental performances. The important influence mainly contains: First, the environmental information affects the corporate image, the corporate image is an important aspect for establishing the modern corporate, can bring the economic value to the corporate; second, the corporate environmental information is an important reference for the decision-making of the relevant stakeholders. Enterprises' relevant stakeholders include the customers, suppliers, investors, banks, etc. The operating activities such as corporate procurement, sales, financing and investment, etc shall be closely related to them. If the corporate environmental performance is poor, the corporate may be administrative or legal punished, indicating that the corporate is an irresponsible corporate Thus, the relevant stakeholders may abandon the cooperation with the corporate, or increase the cooperation cost of the corporate.

#### 2.2.1.4 CEIDP Will Help Government Regulation and Public Supervision of the Corporate Environmental Behaviors

CEIDP will help the government and public to understand the corporate environmental information, determine the environmental regulatory important points, and compare the differences between the corporate actual implementation and environmental information disclosure, in order to determine the authenticity and integrity of the corporate environmental information disclosure, and reduce the administrative costs of the government environmental management. At the same time, CEIDP will provide the basic information for public evaluation of corporate environmental behaviors so that the public can participate in the environmental protection activities through the market. In a society with good environmental responsibility awareness, the social public can understand and judge the implementation of the corporate environmental responsibility to a certain extent, the social public is willing to consume the products of the enterprises with good environmental performances, but will not purchase or less purchase the products of the enterprises that do not fulfill the environmental responsibility.

### 2.2.2 Effect Evaluation Index System and Weighted Calculation of CEIDP

System implementation effect is substantially the system evaluation; it can be evaluated from the views of the efficiency or effectiveness. The DEA method is used for the evaluation of the efficiency view, the basic idea is to build and estimate the function relationship between the input and output, in order to determine the efficiency of the input and output. At present, the information of the inputs and outputs (such as labor, equipment and so on) of the corporate environment information are related to the corporate image, related to the corporate environmental costs and environmental liabilities, thus it is quite difficult for the field survey to obtain these data. Currently, there are no the direct data or indicators related to the operation effect of CEIDP. The use of the single index (such as disclosure rate) will reflect only the appearance of the implementation effect of the system, does not reflect the comprehensive situation of the environmental information

disclosure contents (such as range and quality, etc). Therefore, this paper will build the index system following the principles of the systematicness, importance and operability, combined with the objective situation of the environmental information disclosure of listed companies in China, and based on the main functions of CEIDP. The specific indexes and data processing are shown in Table 1.

It is generally acknowledged that the factors (such as the size of the sample size, and how much the information is known) should be considered when the empowerment method is selected. The study involves a number of samples, indexes, the interaction relationship between the indexes is not clear. Therefore, the objective weighting method should not be used which determines the weight by the difference. Due to the short implementation time of the Analytic Hierarchy Process (AHP), incompletion of corporate environmental disclosure as well as the wide range of corporate environmental information disclosure performance, which includes the effects on the corporate environmental management, environmental costs, environmental liabilities, environmental governance,. According to the principle of AHP method, the corresponding judgment matrix is constructed by seeking the opinions from the experts. The calculation results are performed the single sequencing consistency test and total sequencing test, the comprehensive weighting of various indexes are as shown in Table 1 below.

**Table 1**
**Comprehensive Evaluation Index System of the Environment Information Disclosure Quality of the Listed Companies in the Heavy Polluting Industries**

| Objective layer | Element layer | Index layer (comprehensive weighting) | Meaning represented by the index and data processing instructions |
|---|---|---|---|
| Corporate environmental information disclosure quality $B_1$ | Environmental information quality characteristics $C_1$ | Disclosure mode $C_{11}$ 0.0247 | Characterizing the level of the environment information quality. Currency disclosure 2; data disclosure 1.5; textual description 1; undisclosed 0 |
| | | Disclosure carrier $C_{12}$ 0.0515 | Characterizing the external quality level of disclosure information. independent report; directors' report; Important note 1; report note; undisclosed 0 |
| | | Disclose detail level $C_{13}$ 0.1161 | Characterizing the intrinsic quality level of disclosure information. Detailed disclosure; brief disclosure 1; undisclosed 0 |
| | | Whether to perform the environmental audit $C_{14}$ 0.0176 | Characterizing the reliability of the disclosure information. Environmental audit; unused environmental audit 0 |
| Promoting the corporate to disclose the negative environmental information $B_2$ | Environmental cost information disclosure $C_2$ | Ten-thousand yuan GDP energy consumption $C_{21}$ 0.0553 | Characterization of the economic efficiency of energy consumption. Number disclosure, text disclosure1, undisclosed 0 |
| | | Total consumption water $C_{22}$ 0.0485 | Characterizing the water consumption. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Total standard coal quantity $C_{23}$ 0.0695 | Characterizing the overall energy consumption. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | Environmental liabilities information disclosure $C_3$ | Total wastewater discharge $C_{31}$ 0.0683 | Characterizing the overall wastewater emissions. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | SO2 emissions C32 0.0673 | Characterizing the SO2 emissions. Number disclosure 2, text disclosure, undisclosed 0 |
| | | CO2 emissions $C_{33}$ 0.0417 | Characterization of SO2 emissions. Number disclosure 2, text disclosure, undisclosed 0 |
| | | Smoke dust and dust emissions $C_{34}$ 0.0366 | Characterizing the SO2 smoke dust and dust emissions. Number disclosure 2, text disclosure, undisclosed 0 |
| | | Industrial solid waste generation amount $C_{35}$ 0.0288 | Characterizing the industrial solid waste generation situation, Number disclosure 2, text disclosure, undisclosed 0 |
| Promoting the corporate environmental performance improvement $B_3$ | Corporate environmental management $C_4$ | Environmental report release situation $C_{41}$ 0.0139 | Characterizing the corporate environmental reporting management system construction. Published 2; unpublished 0 |
| | | Major environmental issue occurrence situation $C_{42}$ 0.0063 | Characterizing the effects of corporate environmental management. No significant environmental event 2; significant environmental event 0 |
| | | Environmental Education and Training $C_{43}$ 0.0108 | Characterizing the environmental awareness of the employee trained by the corporate. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Corporate environmental management organization establishment and environmental objective $C_{44}$ 0.0094 | Characterizing the corporate environment organization and environmental protection objective construction. Clear disclosure, partial disclosure 1, undisclosed 0 |

Continued

| Objective layer | Element layer | Index layer (comprehensive weighting) | Meaning represented by the index and data processing instructions |
|---|---|---|---|
| Promoting the corporate environmental performance improvement $B_3$ | Corporate environment investment $C_5$ | Total environmental protection investment amount $C_{51}$ 0.0669 | Characterizing the overall situation of the corporate environmental protection investment. Currency disclosure 2, text disclosure 1, undisclosed 0 |
| | | R & D expenses $C_{52}$ 0.0358 | Characterizing the corporate environmental protection scientific research investment. Currency disclosure 2, text disclosure 1, undisclosed 0 |
| | Corporate energy saving and emission reduction $C_6$ | Cleaner production implementation $C_{61}$ 0.0334 | Characterizing the effect of clean production. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Wastewater discharge compliance rate $C_{62}$ 0.0369 | Characterizing the wastewater treatment efficiency. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Industrial solid waste comprehensive utilization $C_{63}$ 0.0251 | Characterizing the industrial solid waste utilization efficiency. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Comprehensive energy consumption decrease (standard coal) $C_{64}$0.0206 | Characterizing the corporate energy consumption control effect. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | $SO_2$, CO, COD, smoke dust emissions $C_{65}$0.0275 | Characterizing the corporate emission governance effect. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Wastewater emission reduction $C_{66}$ 0.0294 | Characterizing the wastewater treatment effect. Number disclosure 2, text disclosure 1, undisclosed 0 |
| | | Water saving $C_{67}$ 0.0131 | Characterizing the corporate water conservation. Number disclosure 2, text disclosure 1, undisclosed 0 |
| Third-party evaluation $B_4$ | Social evaluation $C_7$ | D environmental certification and awards 0.0244 | Characterizing the social recognition on the corporate environmental protection and control. ISO14000 or environmental protection award 2, undisclosed 0 |
| | Government regulation $C_8$ | Implementation of the "three simultaneous" system 0.0197 | Characterizing the recognition of the government on the corporate construction project environmental protection. Good implementation 2, generally 1, not implemented 0 |

### 2.2.3 The Test Model

According to the information of annual report of the A-share listed companies in the heavily polluting industries and some other relevant information, we have collected the environmental information disclosure data of these companies in 2007-2010, and calculated the overall state of the corresponding company environmental information disclosure. Upon examination, it is found that the annual data reflecting the effect of CEIDP does not meet the common statistical distribution (such as normal distribution, uniform distribution, exponential distribution and Poisson distribution). Therefore, the annual data is the overall distribution unknown circumstance. Under the unknown circumstances of the overall distribution, the parametric test method should not be used; the non-parametric test method should be used. In the project, for the same listed company, its environmental information disclosure has the relevance before and after the implementation of the system. Therefore, the independent sample nonparametric test should not be used, but the non-parametric test method of two paired samples should be used. Compared with it before the implementation of the system, in addition to CEIDP, the main internal characteristic factors and external factors affecting the same listed company environmental information disclosure are little changed in the short term. In case the environmental information disclosure quality is improved significantly after the system is implemented, it indicates that the effect of the implementation of the system in the company is obvious. On the contrary, in case the environmental information disclosure quality is little changed or declined, it indicates that the effect of the implementation of the system in the company is poor. The non-parametric test methods of two paired samples include the McNemar test, sign test, Wilcoxon rank sum test. McNemar test is only suitable for the binomial analysis test. The system effect evaluation value is not binomial value, thus McNemar test can not be used. The nature of the changes in the overall data is only considered in the sign test, ignoring the extent of the changes of two groups of samples, but two factors are considered in the Wilcoxon rank sum test. This article will select the Wilcoxon rank sum test to determine whether there is the significant difference between the sample performances before and after the implementation of CEIDP. Basic principles: First, the observed values of the second group of samples minus the corresponding observed values of the first group of samples in accordance with the method of the sign test. If the obtained difference value is a positive number, a positive sign will be marked; if the difference value is a negative number, negative sign will be marked. The absolute value data of the difference value is maintained at the same time. The absolute value data is sorted in the ascending order to calculate the corresponding rank. The positive sign rank sum $W^+$, negative sign rank sum $W^-$, positive sign average rank and negative sign mean rank are finally calculated respectively. If the positive sign average rank is roughly equal to the positive sign average rank, the negative and negative change extent of two paired sample data are roughly equal, the distribution

difference is smaller. Conversely, there is the significant difference between two paired sample data. On this basis, Z statistical magnitude is constructed:

$$Z = \frac{W - n(n+1)/4}{\sqrt{n(n+1)(2n+1)/24}}$$

Where: n is the number of observed values; W = min ($W^+$, $W^-$)

If the accompanied probability of Z statistical magnitude is less than or equal to the set significance level α, the null hypothesis $H^0$ should be rejected, indicating that there is the significant difference about the overall distribution from two paired samples; if the probability value is more than the significance level, the null hypothesis can not be rejected, indicating that there is no the significant difference about the overall analysis from two paired samples.

## 3. RESULTS

### 3.1 Descriptive Statistical Results

According to the comprehensive weighting coefficients in Table 1, combined with the annual raw data, the comprehensive status of the environmental information disclosure quality of 2007-2010 A-share listed companies in the heavily polluting industries can be calculated; the specific descriptive statistical indexes are shown in Table 2. It can be seen from the table, during 2007-2010, the integrated mean values of the corporate environmental information disclosure quality of A-share listed companies in the heavily polluting industries are significantly increased, and the disclosure rates are also increased, preliminarily indicating that the environment of CEIDP promotes the environmental information disclosure of the listed companies in the heavily polluting industries.

**Table 2**
**Descriptive Statistical Indexes of the Corporate Environmental Information Disclosure Integrated Status in 2007-2010**

| Year | The total sample | Minimum | Maximum | Mean value | Median | Standard deviation | Disclosure rate |
|---|---|---|---|---|---|---|---|
| 2007 | 618 | 0.00 | 1.0075 | 0.1902 | 0.2016 | 0.2076 | 47.90% |
| 2008 | 651 | 0.00 | 1.1454 | 0.2740 | 0.2838 | 0.2583 | 51.77% |
| 2009 | 695 | 0.00 | 1.3912 | 0.3243 | 0.3353 | 0.2685 | 60.14% |
| 2010 | 847 | 0.00 | 1.4320 | 0.3392 | 0.3432 | 0.3126 | 67.06% |

### 3.2 Wilcoxon Rank Sum Test and Analysis

This article has designed three groups of two paired samples, including: the first group of paired samples mean one year (2007) prior to the implementation of the system, and the first year (2008) when the system is implemented, and it is used to test if there is the significant change about the corporate environmental information disclosure before and after the implementation of the system; second group of paired samples and third group of paired samples mean the first year (2008) when the system is implemented and the second year (2009) when the system is implemented as well as first year (2008) when the system is implemented and third year (2010) when the system is implemented, and they are used to test the short-term time lagged effect of the system. It should be noted that due to different total sample number each year, the number of three groups of two paired samples is less than the number of samples of corresponding comparative year: because some corporates withdraw from the market or are new listed. It can be seen from Table 3, the total number of three groups of paired samples (2007-2008, 2008-2009, 2008-2010) are 611,637 and 639, respectively, accounting for the proportion of the total sample of the corresponding year of more than 75%, indicating that the number of paired samples can reflect the overall difference of the combination listed company environmental information disclosure in the corresponding years.

**Table 3**
**System Effect and Lagged Effect Pairing and Testing Situation**

| 2007-2008 | | | 2008-2009 | | | 2008-2010 | | |
|---|---|---|---|---|---|---|---|---|
| Paired samples | Proportion accounting for the total samples of 2007 | Proportion accounting for the total samples of 2008 | Paired samples | Proportion accounting for the total samples of 2008 | Proportion accounting for the total samples of 2009 | Paired samples | Proportion accounting for the total samples of 2008 | Proportion accounting for the total samples of 2010 |
| 611 | 98.86% | 93.85% | 637 | 97.84% | 91.65% | 639 | 98.16% | 75.44% |

Corresponding year data are respectively input in the SPSS statistical software, the test results of each paired samples can be calculated by 2 related samples function in Nonparametric Test. The specific results are summarized in Table 4. It can be seen from Table 4 that the accompanied probability of Z statistical magnitude of each item in the first group test is less than 5%; the corresponding null hypothesis 1 $H_0$ is rejected, indicating that there is the significant difference about the overall distribution from two paired samples.

The test results show that there are the significant differences with respect to the information disclosure quality, negative information disclosure, environmental performance improvement, government regulation and social evaluation of the listed companies in the heavy polluting industries after the implementation of the system. Because the individual effects are greater than the effects before the implementation of the system, therefore, China's CEIDP has played an important role in improving the environmental information quality of the listed companies in the heavy pollution industries and promoting the negative environmental information disclosure, improving the environmental performance, and contributing to the non-corporate parties (government and society) regulatory. In the 611 total pair samples, 2008 comprehensive performance value is more than or equal to that in 2007, there are 533 paired samples, accounting for 87.23 percent of the total paired samples, indicating that 2008 environmental information disclosure level of the listed companies in the heavy polluting industries is significant more than that in 2007 before the implementation of the system. Therefore, CEIDP has the significant positive impact on the environmental information disclosure of the listed companies. The test results of the second and third groups show that the other items are below the 5% level except the accompanied probability of the Z statistical magnitude of the negative information disclosure effect is less than the 10% level, indicating that the corresponding null hypothesis 2 $H_0$ is rejected, to define that there is the significant difference between the overall distribution of various items of the first year when the implementation of the system and overall distribution of various items of the second year and third year when the implementation of the system, indicating that CEIDP has the significantly lagged effects.

**Table 4**
**Difference Significant Test for Single Effect and Combined Effect**

| **Year** (pairing number) **Z value** / **Comparison item** | **2007-2008** (611) **Wilcoxon test Z value** | **2008-2009** (600) **Wilcoxon test Z value** | **2008-2010** (617) **Wilcoxon test Z value** |
|---|---|---|---|
| Information quality level | -8.729** | -6.036*** | -6.905** |
| Negative information disclosure | -4.452** | -1.803* | -1.603* |
| Environmental performance improvement | -7.662*** | -7.760*** | -11.743*** |
| Government regulation and social evaluation | -3.734** | -2.289** | -2.774** |
| Comprehensive Performance | -10.644*** | -7.694*** | -7.973*** |

Note: "*" indicates that it is less than 10% level (two-tailed); "**" indicates that it is less than the 5% level (two-tailed); "***" indicates that it is less than 1% level (two-tailed)

## CONCLUSIONS

In case our country's corporate social responsibility awareness is not high and the stakeholder power is not strong enough, CEIDP is the irreplaceable means to promote the corporate environmental disclosure. It has a crucial impact on the corporate environmental disclosure decision-making. The examination of the operating conditions of CEIDP will be not only conducive to master the information disclosure status of corporate environmental costs, environmental pollution, etc, but also conducive to strengthen the penalties of the enterprises that do not fulfill or less perform the corporate environmental disclosure responsibility, to promote the establishment of a fair corporate environmental disclosure environment, and truly reflect the binding effect of the system, so as to promote the enterprises to improve the quality of environmental information disclosure, and ease the contradiction between supply and demand of corporate environmental information, thus laying a solid foundation for the achievement of China's sustainable development strategy. This article will take 2008-2010 A-share listed companies in heavy polluting industries as the study sample, use the comprehensive evaluation method to measure the corporate environmental information disclosure status, and the Wilcoxon sign rank test method to compare the difference between the corporate environmental information disclosure comprehensive status before and after the implementation of the system. The study results show that the environmental information disclosure status of the A-share listed companies in the heavily polluting industries are improved significantly after the implementation of the China CEIDP, and the lagged effect of the system is also very clear. In the second and third years when the system is implemented, the environmental information disclosure comprehensive quality of the listed companies in the heavy polluting industries are improved. However, we found that the overall comprehensive status of the environmental information disclosure of the A-share listed companies in the heavily polluting industries remained at the low level, in particular to the serious shortage of negative environmental information disclosure, far from the system objectives and requirements after the implementation of the system. The main contribution of this paper is aimed to useful exploration of the quantitative measurement of the combined effect of

CEIDP. The effect of CEIDP evaluated by choosing two paired non-parametric methods is significantly better than that evaluated by choosing the descriptive statistical method used in the existing literatures.

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